Intergovernmental Grants and Local Government Learning

Lyndal Keeton
Institutions and Political Economy Group (IPEG)
School of Economic and Business Sciences
University of the Witwatersrand
Private Bag X3, WITS 2050
Johannesburg, Republic of South Africa
+27.11.717.8065 (Tel.)
+27.11.717.8081 (Fax)
Lyndal.Keeton-Stolk@Wits.ac.za

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1. Introduction

The Public Economics literature on intergovernmental grants is extensive (e.g., Musgrave 1959; Bradford 1965; Bradford and Oates 1971; Oates 1972, 1999; Courant et al 1979; King 1984; Carlson 1995; Oulasvirta 1997; Mieszkowski and Musgrave 1999; Volden 2007). In this extensive literature, grants are usually analysed according to consumer behaviour theory. Under these analyses, the income and substitution effects determine community spending (and ultimately community welfare). However, these effects shed little light on how local governments can use grants to experiment with policy.

Casual empiricism shows that local governments routinely experiment with policy and achieve varying degrees of success. One example is Mayor Bloomberg's range of anti-poverty experiments in New York City (Bosman 2009). Another example is that of Mayor Mockus of Bogotá who introduced many innovative policy experiments. In one experiment, Mayor Mockus employed mimes to direct traffic and, thereby, alleviate traffic congestion (Caballero 2004). However, very little theory has been produced that ties the policy experimentation issue with the role of intergovernmental grants. Hence, it seems appropriate to start to develop models to understand how intergovernmental grants can help local governments to perform policy experiments and learn.

This paper considers the role of different intergovernmental grants (e.g., a matching grant versus a lump-sum grant) in local government policy experimentation. By taking a different view of grants – namely, as incomplete contracts (Brennan and Pincus 1990, Garzarelli 2006) – this paper suggests how certain grants can be instruments for the creation and discovery of new knowledge (Garzarelli 2006). More precisely, this paper

intends to develop a model that tries to capture the learning effects that different types of grants can engender.

2. Background

2.1 Laboratory Federalism

The theory of laboratory federalism suggests that such local government "laboratories" are useful units in which to experiment. The reason for this is that local experiments that prove unsuccessful will have a low cost to the federation as a whole, as the experiments are only performed on a local level. Local experiments that prove successful will have a high return as they can be applied by other local governments in the federation (Oates 1999: 1132). Furthermore, different experiments to solve the same problem can be run simultaneously by different local governments to find the best policy solutions more quickly than if experiments are tested in succession (Kollman, Miller and Page 2000: 102).

Put differently, a federation composed of local government "laboratories" is able to solve problems by creating search networks. A local government with a particular problem can find other local governments who can provide them with solutions because the other local governments have already dealt with that particular problem. The advantage of solving problems this way is that a federation is able to adapt to new problems faster than a centralized government (Sabel 2004:12).

2.2 Grants as Incomplete Contracts

Garzarelli (2006: 249) suggests that intergovernmental grants can be used as a tool by a central government to induce a local government to experiment with policy. In submitting grants as a fiscal federalism counterpart to incomplete contracts[1], Garzarelli indicates that the type of grant communicates the donor's preferred spending behaviour to the recipient. Hence, a grant is an instrument of exchange between the donor and the recipient.

However, there is no free lunch: with any type of grant comes the implication that future grants will be related to how efficiently the current grant is used (Brennan and Pincus 1990: 129; Garzarelli 2006: 248). Since the contract is incomplete, one or more of the contracting parties may not be able to observe all information pertinent to the contract. The rational grant recipient, therefore, has an incentive to use the funds efficiently (or, at least, to the donor's satisfaction) or else run the risk of not receiving additional grants in the future.

Hence, an incomplete contract may only specify some conditions explicitly leaving the remaining contract conditions implicit (See also, e.g., Seabright 1996). For this reason, the grant can be viewed as a quid pro quo incomplete contract between the donor (the central government) and the recipient (the local government) (Brennan and Pincus 1990; Garzarelli 2006). This view of grants provides an institutional approach to grants that is useful to understanding the role that grants can play in promoting experimentation and learning in a federation.

[1] An incomplete contract (also referred to as a relational contract) is a contract between two or more parties that contains gaps or missing stipulations (Hart 1988:123). See, also, Baker, Gibbons and Murphy (2002) and Levin (2003).

2.3 Grant Conditionality: Implicit and Explicit Conditions

Traditionally, there are two main classes of intergovernmental grants, namely conditional and unconditional (see, e.g., King 1984). By viewing an intergovernmental grant as an incomplete contract, a grant has conditions attached regardless of whether it is classed as a conditional grant or not. Thus, we can distinguish between explicit grant conditions (which give the grant its classification as a conditional grant) and implicit grant conditions (Brennan and Pincus 1990).

An explicit grant condition is a formal stipulation made by the donor as to how the grant should be spent (Brennan and Pincus 1990). It may specify which public good the grant funds should be spent on, in the case of a conditional lump-sum grant, or the matching ratio that the donor is committed to, in the case of a matching grant. Other conditions may well be attached to the grant, though not explicitly stately, and thus are implicit conditions of the grant. Hence, a grant donor can direct the spending of a grant by using both the explicit conditions attached to the grant as well as the implicit conditions attached to the grant.

Consequently, while an unconditional grant, e.g., an unconditional lump-sum grant, does not have explicit conditions imposed, it may well have implicit conditions attached. A conditional grant, e.g., a matching grant, is likely to have both the explicit conditions imposed as well as additional implicit conditions attached. Thus, all grants, whether explicitly conditional or not, are, in fact, conditional.

With different types of intergovernmental grants having different degree of conditionality, it also means that different types of grants have different degrees of

leeway for a rational grant recipient to take advantage of (Garzarelli 2006: 249). Thus, to reiterate, an unconditional lump-sum grant is likely to have relatively fewer conditions attached as compared to a conditional matching grant, and vice versa. Thus, an unconditional lump-sum grant has relatively more leeway as compared to a conditional matching grant, and vice versa.

At this point we should note that the donor and the recipient have different interests as regards how to spend grant funds. The donor or central government prefers to promote those policies which it views as important, e.g., positive externalities and merit goods. Thus, a donor will prefer a grant with explicit conditions attached, e.g., a matching grant. The recipient or local government prefers to have leeway to spend the funds according to local preferences. Thus, a recipient will prefer a grant with as few explicit conditions as possible, e.g., an unconditional lump-sum grant (Oulasvirta 1997: 401).

2.4 Grant Conditionality: An example

An example of how local governments exploit the relative conditionality of grant can be seen in the Canada Assistance Plan (CAP) grant scheme. This scheme offered federal government assistance to welfare programmes administered at the provincial level. Initially, the federal government contributed 50% of the costs of the welfare programmes on an open-ended basis. In 1990 the scheme changed from a matching grant to a closed matching grant for three of the ten Canadian provinces. This meant that federal shares to welfare programmes in these three provinces could not grow by more than 5% per annum from 1990 to 1994, relative to the 1989 welfare spending. If the provinces spend more than 5%, they would not receive matching funds.

In studying the results of this change, (Baker, Payne and Smart 1999), find that overall there was a decline in the growth of welfare expenditure in the three provinces. For the most part, though, the provinces affected by the ceiling did not reduce the growth rates of welfare benefits to correspond to the ceiling of the matching, as might be expected. Instead the provinces rather concentrated on indirect methods to reduce spending. For example, the three provinces implemented programmes to detect fraud, they reclassified some welfare recipients as employable where previously they had been classified as unemployable, and they changed incentives for beneficiaries to seek employment.

The responses of the three provinces were by no means identical, though. In attempts to detect fraud, one province employed more fraud investigators while another started a "snitch line." One province reclassified single parents as employable when their youngest child turned 12 years old. Some provinces reduced additional benefits, for example, dental care and optometry, while some provinces changed the benefits allocated to employed beneficiaries of the scheme. This is an example of a conditional matching grant becoming more conditional when it's changed to a conditional closed matching grant. However, despite the increased conditionality, each of the three beneficiaries responded differently, each exploiting the leeway within the grant to best satisfy local preferences.

3. Intergovernmental Grants and Policy Experimentation

Similarly, intergovernmental grant can be a policy tool to provide the incentives for local governments to experiment with policy. In this case, a policy is a single action taken by the local government to resolve an issue of local public concern. To promote policy

experimentation at the level of local government, Strumpf (1998: 229) recommends that fewer conditions be attached to an intergovernmental grant, it encourages greater experimentation. This is taken one step further by Garzarelli (2006) who suggests the rational grant recipient can take advantage of the leeway offered by an incomplete grant contract by undertaking experiments, while keeping to any explicit conditions attached to the intergovernmental grant. Hence, a grant that is less complete (e.g., an unconditional lump-sum grant) has greater leeway for the recipient to engage in policy experimentation than a grant that has relatively more complete (e.g., a matching grant). Thus, it is the leeway attached to a grant that induces experimentation.

Furthermore, if it is the wish of the donor, e.g., the central government, to encourage experimentation, it can reward a grant recipient, e.g., a local government, who engages in experimentation with future grants.[2] As mentioned, an intergovernmental grant is a means of exchange. In this case, the donor's future grants are rewarded by the donor in exchange for experimentation with the current grant. Hence, intergovernmental grants effectively 'soften' the budget constraint by providing a positive incentive for local governments to use the grant effectively. In this case, the central government will use intergovernmental grants to both encourage and reward experimentation.[3]

Since experimentation implies uncertainty for the local government in that it requires the local government to implement policy choices which may or may not work. Strumpf (2002) suggests that one reason for a local government not to engage in experimentation is risk aversion. However, in addition to rewarding successful experiments,

[2] Rewarding with future grants is not unlike the suggestion by Rose-Ackerman (1980) to offer prizes as a reward for officials who experiment with policy.

[3] The positive incentives created by soft budget constraints have not been examined in the literature. Typically, a soft budget constraint is considered harmful to a federation as it creates perverse incentives for local governments to overspend (e.g., Kornai 1986; Oates 2005; Vigneault 2007; Weingast 2009).

intergovernmental grants can be used to cushion unsuccessful experimentation.[4] As Kornai (1986:27) indicates, “a soft budget constraint has mercy on the loser," or, in this case, mercy on the grant recipient whose experiment is unsuccessful. By rewarding the action of experimentation, regardless of outcome, this can be achieved.

However, with any type of contract and not least of all with intergovernmental grants comes the issue of "what can reasonably supposed to be observed and enforced" (Besley and Persson 2011: 24). In this case, should the grant recipient choose not to engage in experimentation, she will be held accountable by *both* the donor and her constituents.[5]

The donor can punish the grant recipient by increasing grants to other local governments. The constituents of the local region will recognize that a portion of their taxes is going to fund other regions and will hold the local government official responsible (Goodspeed 2002: 418-419).[6] Indeed, a case study of Norway's grant reforms to replace conditional grants with unconditional lump-sum grants found that local government officials had an incentive to "use spending decisions as strategic instruments to achieve additional grants" because the public believed that the behaviour of the officials could be the reason for cutbacks i.e. if cutbacks happened, the public would hold the official responsible (Carlson 1995:56).

The objective of experimentation is to learn. And, thanks to policy experimentation, learning – the absorption and generation of new knowledge (e.g., Arrow 1962) – can take place at the local government level (Garzarelli 2006). A representative agent, such as a local government representative, is attempting to find the best policy solution by

[4] For local governments who abuse this soft budget constraint, it is possible for the central government levy a punishment by increasing grants to other local governments. The constituents of the local government abusing the soft budget constraint will recognize that a portion of their taxes is going to fund other regions (Goodspeed 2002: 418-419).
[5] Such accountability will avoid problems of transfer dependence (Rodden 2003; Oates 2008).
[6] Volden (1993: 73) finds that grant recipients do respond to the incentives created by intergovernmental grants but the nature of response depends on institutions of recipient government.

undertaking the activity of experimenting with different policy choices. Since learning occurs from both successful and unsuccessful experiments, it makes sense to reward all experimentation rather than only successful experimentation. For the central government it is less important whether the policy experiment is successful or not, what matters is the overall growth of knowledge in a federation that is derived from multiple simultaneous experiments.[7]

We have established that intergovernmental grants are incomplete contracts between the donor and the recipient. We have also established that there is a role for intergovernmental grants in laboratory federalism, namely in terms of providing the incentives for local governments to engage in policy experiments. Because there are many types of intergovernmental grants, particular types of grants are likely to have a predisposition for recipient learning (Garzarelli 2006: 249). Now, if we consider how intergovernmental grants can induce local government, it is possible to analyze how different types of grants (e.g. a matching grant compared to a lump-sum grant) engender different learning functions.

4. The Process of Learning

4.1 Mistake-ridden Learning

> *Learning may occur in all circumstances when agents have an imperfect understanding of the world in which they operate - either due to lack of information about it, or, more fundamentally, because of an imprecise knowledge of its structure; or when they master only a limited repertoire of actions in order to cope with whatever problem they face - as compared to the set of actions that an omniscient observer would be able to conceive*

[7] For a parallel analysis in open-source software development see Garzarelli and Fontanella (2010).

> *of; or, finally, when they have only a blurred and changing understanding of what their goals and preferences are.*
>
> Dosi, Marengo and Fagiolo (2005:255)

Until now, we have considered the role that intergovernmental grants can play in providing the incentives for grant recipients (in this instance, local governments) to experiment and to learn. We now consider the process of experimentation that leads to learning. As Arrow (1962:155) indicates, "learning can only take place through the attempt to solve a problem and therefore only takes place during activity."

Learning is not a perfect process. Because experimentation and innovation involve a degree of uncertainty, it is difficult to choose the correct policy straight away. Hence, learning from experimentation implies some degree of mistakes (Nelson and Winter 1977:51). Hence, from now on we refer to the learning at the local government level as mistake-ridden learning.

Dosi and Nelson (1994) suggest that learning is a process which is dynamic, i.e., it occurs over time, and that it requires a selection mechanism. Selection is a "mechanism providing differential rewards and penalties" (Dosi, Marengo and Fagiolo 2005: 318). In the context of learning at the local government level, selection is the act of choosing the most appropriate policy from the available policy options (Forte 1982: 234).

Each policy option under consideration for experimentation should have an associated value or reward function attached to it that provides a guide to selecting the most appropriate policy (Dosi and Nelson 1994: 154).[8] Thus, the policy options are competing with each other, and each policy option will be considered in terms of its value relative to the values of the other policies.

[8] This is similar to Lancaster's (1966a) notion of a characteristic vector that determines the consumption of a particular good.

In the case of local government learning, the local government official selects which policy to apply by choosing that policy with the highest value, relative to the mean value of all the available policy options, and switches between the policies depending on the relative values for each policy (Dosi, Marengo and Fagiolo 2005). The act of switching between the policy options is known as variation. Thus, learning at the local government level takes place by the combination of selection and variation among the various policy options.[9]

The selection of a policy requires feedback so that a local government official can switch away from that policy if it proves unsuccessful, and, instead, experiment with another policy. In this instance, the changes in the relative values of the different policies provide this feedback. The speed of this feedback is important. Should the feedback prove to be too slow, it can slow down learning. Similarly, if the feedback occurs too quickly, it does not allow for experimentation and innovation, and can crowd out learning (Dosi, Marengo and Fagiolo 2005: 319).

Notably the process of learning through selection and variation allows for multiple equilibria. Hence, there can be multiple stable policy choices (Dosi and Nelson 1994: 154; Dosi, Marengo and Fagiolo 2005: 294). Thus, different local governments may find different policy solutions for the same problem.

[9] Note that pure selection implies no learning as it relies solely on random switching behaviour. Instead of considering the value of each policy option, pure selection means that local government official will pick a policy arbitrarily without taking into account past experience or whether the policy will be successful (Dosi, Marengo and Fagiolo 2005: 318). Furthermore, there is a trade-off between selection and learning. Weak selection will allow slack behaviour to persist. Instead, strong selection will hinder learning by crowding out the trial-and-error process necessary for learning (Dosi, Marengo and Fagiolo 2005: 318-319).

4.2 Local Government Learning as a Process of Melioration

To understand how the grant recipient learns by experimenting with grant funding, we consider the recipient's behaviour upon receiving a grant. As Brennan and Pincus (1990: 136) note, "If the grant is in any way contingent on the recipient's behavior (either the making of the grant at all or its size), then the grant tends to induce behavioral responses in (potential) recipients." On receipt of a grant, using time and funds, the rational behaviour of the local government representative is to take policy actions tied to the grant, e.g., constructing a new road or reviving a local park. If the policy proves successful, the recipient will continue with it. If this policy does not prove successful, the recipient will switch to different policy.

One way to consider the process of experimentation and learning at the local government level as if it is a process of melioration (see, e.g, Herrnstein and Prelec 1991; Herrnstein et al. 1993; Metcalfe 2001).[10] Melioration is the "the process of choosing that alternative among the set of alternatives which currently has the higher yield in (value)" (Herrnstein et al 1993: 150). Within the melioration process, at the local government level, alternative policies are in competition with each other vying for the local government representative's time and funds.

It's important to note that in the framework of melioration, it is the response or action taken by the local government official that is the entity that we are interested in rather than an individual (Herrnstein et al 1993: 177-180).

[10] When analysing individual behaviour, whether maximization or, as in this case, melioration, we consider the decision process to have taken place as though the individual has acted purposefully following this behaviour. As (Buchanan 1982[1991]: 245) indicates:

> *Individuals do not act so as to maximise utilities described in independently-existing functions. They confront genuine choices and the sequence of decisions taken may be conceptualized, ex post (after the choices), in terms of "as if" functions that are maximized. But these "as if" functions are, themselves, generated in the choosing process, not separately from the process.* (Buchanan 1982[1991]: 245).

Furthermore melioration is an alternative to the traditional utility maximization framework. In a maximization framework, alternative policies are articulated together so that they lose their individuality, i.e., only the utility attached to whole choice bundle matters. Instead, melioration requires that the utility be unbundled and attached to each individual policy so that each policy can be considered separately. This unbundled utility is referred to as the value of the policy (Herrnstein and Pralec 1991: 154-155).

Melioration is appropriate to model experimentation and learning at the local government level because it encompasses both the selection of a policy based on the value attached to that policy and a process of switching to better policy choices.

Under the process of melioration, when a policy experiment is unsuccessful, the value of the policy will decline relative to the values of other possible policies. When the value of the policy is lower than that of an alternative policy, the local government representative can switch to the policy which has the greater value. Alternatively, though, if a policy is successful, the value of the policy will increase relative to the values of other possible policies. Provided the value of the policy remains higher than the values of alternative policies, the local government representative will have no incentive to switch to a different policy. Thus, implementing a chosen policy can have positive or negative effects on the relative value of the available policy options, i.e. the values associated with the policy options change endogenously during melioration. The process of melioration can continue up to the point where time and funds are used up. Furthermore, the process will tend to or reach a meliorator's equilibrium, which is where the average value of the alternative policies is equal (Herrnstein and Pralec 1991).

To illustrate the process of melioration, consider how a local government representative switches between two policies, x_1 and x_2. For example, suppose the local government needs to solve the problem of potholes on local roads. In this example, x_1 may involve simply fixing each pothole individually, while x_2 may involve re-tarring the roads where there are potholes. Each policy, x_i, has a corresponding value function $v_i(x_i)$ which is the amount or the value of satisfaction perceived to be obtained from x_i. $v_1(x_1)$ is the value of x_1 which is a faster solution with little inconvenience to drivers on the road while $v_2(x_2)$ is the value of x_2 that it is a long term solution because the potholes will not reappear. The weighted mean of the values is $\bar{v}(x) = \sum x_i v_i(x_i)$. The value function indicates relative preferences for different policies, so, for example, $v_1(x_1) > v_2(x_2) \Leftrightarrow x_1 \succ x_2$, and, similarly, $v_1(x_1) < v_2(x_2) \Leftrightarrow x_1 \prec x_2$. As mentioned, the value function provides feedback to the local government representative as to the relative success or failure of the policy chosen. Thus, the local government representative is aware of both value functions and their mean. Accordingly, the local representative is able to compare the two policies based on their relative values.

As previously indicated, selecting from the alternative policies can have positive or negative effects on relative value of the policy. If the relative value of that activity starts to decline, and falls below the relative value of another policy, the recipient will switch to the policy with a higher value. Let the derivative of the value function $\frac{\partial v_i}{\partial x_i} = v_i'$ for ease of notation. The sign of v_i' indicates the whether the policy continues to hold value, whether its value is appreciating or whether its value is diminishing, i.e.,

$v_i' < 0$ when the activity generates negative feedback (i.e. is an unsuccessful policy experiment) and $v_i' > 0$ when the activity x_i generates positive feedback (i.e. is a successful policy experiment).

Similarly, let $\frac{\partial^2 v_i}{\partial x_i^2} = v_i''$ which is the rate at which the value of the policy increases or decreases. In this instance of melioration, the changes in the relative values of the different policies provide the feedback.

Thus, to sum up, local government learning can take place as a process of melioration in which the local government representative selects a policy to implement by choosing that policy with the highest value (relative to the mean value of all the available policy options) and switches between the policies depending on the relative values for each policy.[11] Based on this process of selection (selecting a policy as an experiment) and variation (switching between policies) learning by experimentation can take place.

5. Intergovernmental Grants: Leeway to Experiment

5.1 The Local Community Budget Constraint

Assume there are two levels of government: the higher-level, central government and the lower-level, local government: the central government is the intergovernmental grant donor and the local government is the intergovernmental grant recipient. More specifically, within the local government, there is a local government representative who

[11] Note that pure selection implies no learning as it relies solely on random switching behaviour. Instead of considering the value of each policy option, pure selection means that local government official will pick a policy arbitrarily without taking into account past experience or whether the policy will be successful (Dosi, Marengo and Fagiolo 2005: 318).

is a representative agent of the local community acting according to the preferences of the median voter.[12] It is this local representative who determines how the grant will be spent.

The local government representative is aware of the local community's budget constraint which provides the limit or bound on local public spending. The budget constraint incorporates both a monetary component and a time component. The monetary component, initially, are local public funds which depend only on taxes raised from the local community. We assume there is no local government borrowing. There is a time component because, in this model, we are considering local government spending on experimental policies. It takes time for the local government representative to implement a policy experiment and to evaluate the experiment's success or failure.

Assume that the local representative has a period of time or a budget term, T, in which to spend local public funds, B. The assumption of both a monetary component and a time component is in line with many public budgets allocated for a period of time. This time period may be one year or, alternatively, over a longer period, such as three years. This may be country dependent. Typically budgets are spent over one year but countries such as Great Britain and South Africa have implemented medium-term budgets, e.g., a term of three years, for public spending (Ajam and Aron 2007). Later we will also see that learning at the local government level is a dynamic process i.e. learning has a time component. Suppose, also, that the local representative can choose to spend the local budget on two policies, x_1 and x_2. Thus the budget constraint becomes:

$$c_1(p_1,t_1)x_1 + c_2(p_2,t_2)x_2 = Y(B,T), \qquad \mathbf{1}$$

[12] For selection of representatives see Besley and Coate (2003).

where c_i is the cost of policy x_i, c_i consists of both a time component t_i and the price of the policy p_i where $i = 1, 2$. The total local community budget is Y which determined by both local public funds, once again, B; as well as the budget term, T, where, generally, $\sum t_i = T$ or, specifically in this case, $t_1 + t_2 = T$.

We can rearrange the budget constraint equation 1 to provide the share of the budget that is assigned to each policy, as follows:[13]

$$\frac{c_1(p_1,t_1)}{Y(B,T)}x_1 + \frac{c_2(p_2,t_2)}{Y(B,T)}x_2 = 1. \quad \textbf{2}$$

Let

$$z_1 = \frac{c_1(p_1,t_1)}{Y(B,T)}, \text{ and} \quad \textbf{3}$$

$$z_2 = \frac{c_2(p_2,t_2)}{Y(B,T)}, \quad \textbf{4}$$

such that z_i is the share of income (expressed in terms of both time and funds) devoted to policy x_i. Thus, the local budget constraint can be expressed as

$$z_1 x_1 + z_2 x_2 = 1. \quad \textbf{5}$$

5.1 Melioration and Local Policy Choices

Suppose the local government receives a grant with which to experiment. The melioration process is illustrated in Figure 1. Acting as meliorator, the local government representative will always choose that policy which has the highest value of the two policy choices, namely policy A and policy B. The values of the two policies, $v(x_A)$ and

[13] See Metcalfe (2001).

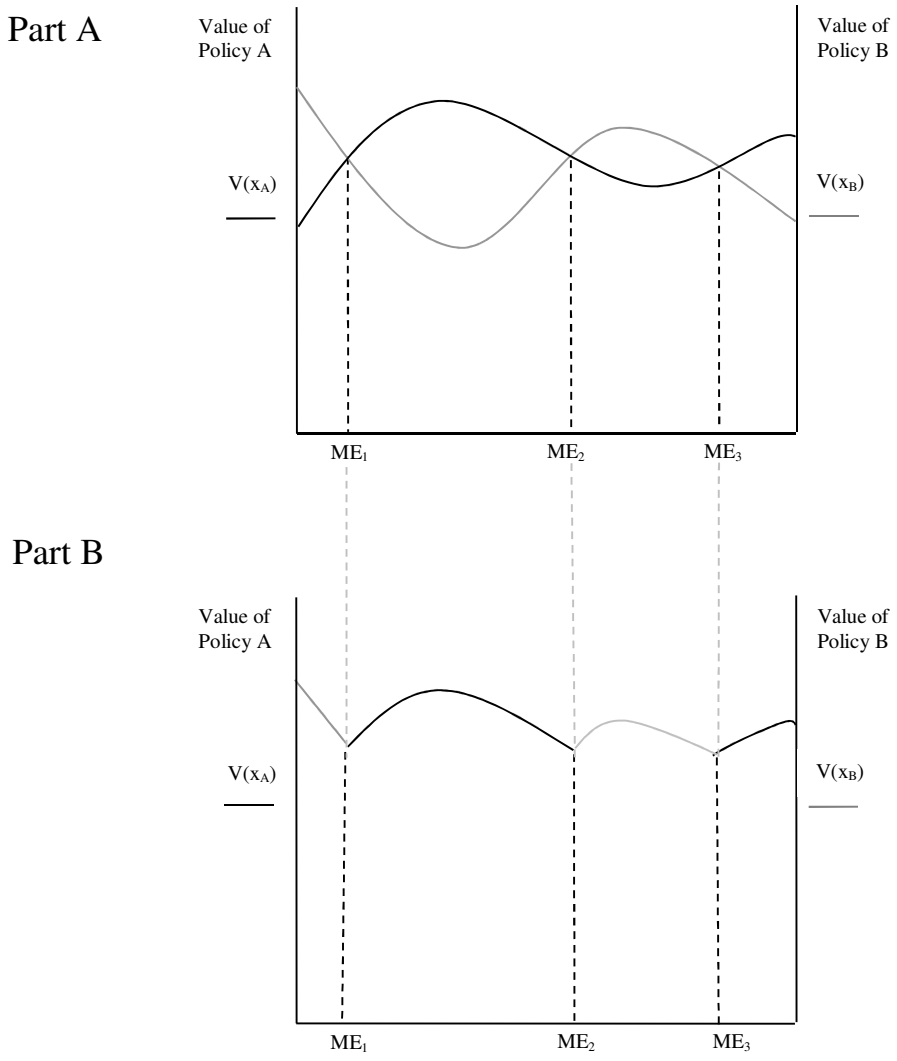
$v(x_B)$ respectively, change endogenously as more of the policy is tried out. Figure 1, thus, shows the how the value functions change relative to each other.

Consider Figure 1 Part A. Initially, Policy B has a higher value than Policy A. However, the value of Policy B is declining and the value of Policy A is increasing, so at ME_1, the values of Policy A and Policy B are equal. Thus, at ME_1, the local government representative switches to Policy A. The value of Policy A continues to increase, but at a decreasing rate, then falls while the value of Policy B begins to rise again. At ME_2, the values of both policies are equal, once again. Thus, ME_2 is another switching point, and the local government representative switches back to policy B, which has the higher value beyond ME_2.

This melioration process continues as long as there both time and funds are available, i.e, until the grant funding runs out or until a time limit on spending the grant funds is reached. The number of times the local government representative switches between the available policies is an indication of the number of experiments undertaken, and therefore, the extent of the learning that has taken place.

Figure 1 Part B shows a "learning path" along which policies will be implemented based on the value functions. Throughout the melioration process, the better or more successful policy (as determined by the value function) will be implemented.

Figure 1: Melioration between Two Policy Choices, A and B



The process of melioration reduces the choice set available to the policy representative to only those policy choices where the relative value is higher than the mean of the relative values. Thus, it is possible to remove some of the possible policy choice mistakes, though not all.

Successful experiments, in effect, destabilize the system by innovating and providing new policy solutions. These new policy solutions may even cause the budget constraint to shift outwards. Unsuccessful policy experiments, in turn, provide stability to the meliorating system by halting the progress of the unsuccessful experiments (Witt 1997: 490). The interaction between successful policy experiments and unsuccessful policy experiments provides learning at the local government level.

5.2 Melioration and Local Government Experimentation as a Replicator

The process of melioration can also be described by a simple dynamic replicator equation (Loewenstein, 2010)**:**[14]

$$\dot{z}_i = \gamma z_i \left(v_i \left(x_i \right) - \overline{v} \left(x \right) \right), \qquad \textbf{6}$$

which shows that the change in the share of income direct to a policy x_i over time, $\dot{z}_i$. $z_i \geq 0$ is the share of income (once again, incorporating both time and local public funds) directed to the policy x_i, where $i = 1,2$. γ is the rate of switching between policies. The process of melioration will take place provided $\gamma > 0$. Thus, γ determines the extent of learning. $\left(v_i \left(x_i \right) - \overline{v} \left(x \right) \right)$ is the difference between the value of the policy chosen $v_i \left(x_i \right)$ and the mean of the policy values $\overline{v} \left(x \right)$. Thus, the share of income directed to policy x_i over time will increase provided $\gamma > 0$, $z_i > 0$ and $v_i \left(x_i \right) - \overline{v} \left(x \right) > 0$ or $v_i \left(x_i \right) > \overline{v} \left(x \right)$.

[14] The dynamic replicator equation (1), which has been used in a variety of contexts, such as population genetics and animal behaviour (REFS?).

Hence, the replicator equation (Equation 6) shows the following three equilibria (at which melioration stops):

1. The rate of switching is zero, i.e., $\gamma = 0$,
2. The share of income devoted to a particular good is zero i.e. $z_i = 0$.
3. The value of current activity equals the average value of all activities i.e. $v_i(x_i) = \overline{v}(x_i)$ (which is the meliorator's equilibrium).

The local government official will experiment by process of melioration as long at there are both time and public funds available conduct policy experiments with (where $z_i = 0 \forall i$). Up to the point that the time and funds run out, the equilibrium that the official's meliorating behaviour will tend towards is the meliorator's equilibrium, where $v_i(x_i) = \overline{v}(x_i)$, i.e., all available policy choices have an equal value.

An optimal equilibrium point would be the case where equilibria (2) and (3) are reached simultaneously for both policies, x_1 and x_2. Consequently, this equilibrium requires both that the share of the budget devoted to each policy is spent, i.e., $z_i = 0$ and that the values of all policies tried out are equal and these values are equal also to the mean value of all activities, i.e., $v_i(x_i) = \overline{v}(x_i) \forall i$.

If the share of the budget devoted to each policy is exhausted, the local representative has used all available time and public funds to maximise the learning potential from the grants given (by performing as many policy experiments as possible). If the values of all policies tried out are equal, the local representative has reached the meliorator's equilibrium and both policies are valued equally.

Note that the process of learning by melioration allows for multiple equilibria. Hence, there can be multiple stable policy choices (Dosi and Nelson 1994: 154; Dosi,

Marengo and Fagiolo 2005: 294). Here the objective is not to reach the highest point on the budget constraint so that the local community consumes the most, but instead to learn the most from the grant funds given. Unsuccessful policies can provide as much learning as successful policy choices.

6. Types of Intergovernmental Grants and Learning

We can think of the local community budget constraint as a boundary of spending by the local community determined by local public fund-raising efforts (local government borrowing, local taxes etc). Similarly, we can consider the budget line that incorporates an intergovernmental grant as another boundary, the shape of the boundary is dictated by the type of grant. These two boundary lines delineate a corridor of potential local government spending as a result of receiving the grant. Thus, we can think of the two boundaries providing a corridor that can represent the propensity for the local government to learn from policy experimentation that is funded by the grant. Hence, an intergovernmental grant can open a learning corridor for policy experimentation.[15]

Here we consider the different learning functions attached to two commonly used grants, namely a conditional matching grant and an unconditional lump-sum grant. The reason for using these two types of grants is because one is explicitly conditional while the other had no explicit conditions attached. A matching grant is considered conditional under the traditional theory of intergovernmental grants. As discussed, it may have further conditions attached (in the form of implicit conditions) rendering it even more conditional than would seem on first glance. A lump-sum grant is considered

[15] For more on corridor phenomena see Leijonhufvud (1973, 2009), Witt (1997), and Brenner (2002).

unconditional, however, as discussed, all grants have conditions attached and these conditions can be implicit.[16] Thus, the matching grant has greater conditionality than the lump-sum grant. We assume that the grant donor encourages experimentation, and will reward the activity of policy experimentation with future grants.

Consider the budget constraint (Equation 2), now with intergovernmental grants. Suppose an unconditional lump-sum grant, G, is allocated to the local government. Thus, the local budget constraint (and upper bound of the learning corridor) for the local community with an unconditional lump-sum grant becomes:

$$\frac{c_1(p_1,t_1)}{Y(B+G,T)}x_1+\frac{c_2(p_2,t_2)}{Y(B+G,T)}x_2=1. \qquad \textbf{7}$$

Therefore, in the case of an unconditional lump-sum grant, the income to both goods increases. In comparison, if a conditional matching grant is allocated to the local government at matching rate m, where $0<m<1$. The grant is conditional on local spending on x_1 only. Thus, the budget constraint (and upper bound of the learning corridor) for the local community with conditional matching grant becomes:

$$\frac{(1-m)c_1(p_1,t_1)}{Y(B,T)}x_1+\frac{c_2(p_2,t_2)}{Y(B,T)}x_2=1. \qquad \textbf{8}$$

Note that $0<(1-m)<1$. Therefore, in the case of a conditional matching grant income to only the grant-aided good (once again, in this case, x_1) increases.

[16] As Breton ([1985] 1987: 315) indicates, "Unconditionality, in turn, is the product of a reliance on a theory of intergovernmental grants in which the decision makers are neither real governments, nor competitive."

6.1 Mathematical Representation

6.1.1 Lump-Sum Grant

Suppose that the central government provides the local government representative with a lump-sum grant, G. Once again, the budget constraint becomes:

$$(p_1 + bt_1)x_1 + (p_2 + bt_2)x_2 = bT + G \quad \textbf{9}$$

Or

$$\frac{(p_1 + bt_1)}{(bT + G)}x_1 + \frac{(p_2 + bt_2)}{(bT + G)}x_2 = 1 \quad \textbf{10}$$

Where $\alpha_i = \frac{(p_i + bt_i)}{(bT + G)}$ **11**

Suppose that the central government provides the local government representative with a lump-sum grant (G) with no explicit conditions attached. Thus G increases.

$$\frac{d\alpha_1}{dG} = -\frac{p_1 + bt_1}{(bT + G)^2} < 0 \quad \textbf{12}$$

$$\frac{d\alpha_2}{dG} = -\frac{p_2 + bt_2}{(bT + G)^2} < 0 \quad \textbf{13}$$

Once again, proceeding along the lines of Metcalfe (2001), the melioration equilibrium can be specified with matching conditions, which for the matching grant are:

$$v_1(x_1) = v_2(x_2) \quad \textbf{14}$$

$$\alpha_1 x_1 + \alpha_2 x_2 = 1 \quad \textbf{15}$$

Thus using equations (12) and (13) the total derivative of equation (10)

$$\alpha_1 dx_1 + \alpha_2 dx_2 = -x_1 d\alpha_1 - x_2 d\alpha_2 \quad \textbf{16}$$

becomes

$$\alpha_1 dx_1 + \alpha_2 dx_2 = \frac{(p_1 + bt_1)x_1 + (p_2 + bt_2)x_2}{(bT + G)^2} dG$$

Substituting equation (9)

$$\alpha_1 dx_1 + \alpha_2 dx_2 = \frac{1}{bT+G} dG$$

The system of adjustments that result from the lump-sum grant can be represented as follows:

$$\begin{bmatrix} v_1' & -v_2' \\ \alpha_1 & \alpha_2 \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} 0 \\ \frac{1}{bT+G} dG \end{bmatrix}$$

Solving yields:

$$\Delta = \alpha_2 v_1' + \alpha_1 v_2' > 0 \qquad \textbf{17}$$

$$\frac{dx_1}{dG} = \frac{v_2'}{\Delta(bT+G)} > 0 \qquad \textbf{18}$$

$$\frac{dx_2}{dG} = \frac{v_1'}{\Delta(bT+G)} > 0 \qquad \textbf{19}$$

Hence, an increase in G from a lump-sum grant results in an increase in policy experimentation on both goods and, consequently, learning takes place. The relative values of the goods remain as per the median voter's preferences. Note that decision to choose between policy 1, x_1, or policy 2, x_2, depends on the change in the relative values of the two policies, v_1 and v_2.

Now $z_i = \alpha_i x_i$,

$$\frac{dz_1}{dG} = \alpha_1 \alpha_2 \left(\frac{v_2' x_2 - v_1' x_1}{\Delta(bT+G)} \right) \qquad \textbf{20}$$

$$\frac{dz_2}{dG} = \alpha_1 \alpha_2 \left(\frac{v_1' x_1 - v_2' x_2}{\Delta(bT+G)} \right) = -\frac{dz_1}{dG} \qquad \textbf{21}$$

With a lump sum grant there is an increase in the funds to both policy experiments and the share of funds allocated to each is determined by the relative value of the policy experiment v_i and the amount of each experiment undertaken x_i.

6.1.2 Matching Grant

Suppose that the central government provides the local government representative with a matching grant with the explicit condition that it be spent on x_1, i.e. the matching grant increases the spending on x_1 by making it relatively cheaper.[17] Let the matching grant rate be m where $0 \le m < 1$, so, for example, if the central government decides to give 50% of what the local government has spent on the public good to them as a grant then $m = 0.5$. Thus the budget constraint becomes:

$$(1-m)(p_1 + bt_1)x_1 + (p_2 + bt_2)x_2 = bT \quad \textbf{22}$$

Or

$$\frac{(1-m)(p_1 + bt_1)}{(bT)}x_1 + \frac{(p_2 + bt_2)}{(bT)}x_2 = 1 \quad \textbf{23}$$

Where $\alpha_1 = \frac{(1-m)(p_1 + bt_1)}{(bT)}$ **24**

And $\alpha_2 = \frac{(p_2 + bt_2)}{(bT)}$ **25**

Thus:

$$\frac{d\alpha_1}{dm} = -\frac{p_1 + bt_1}{bT} < 0 \quad \textbf{26}$$

$$\frac{d\alpha_2}{dm} = 0 \quad \textbf{27}$$

[17] Thus the matching grant changes the relative prices, making the public or grant-aided good relatively cheaper.

The matching grant will change α_1 only. Proceeding along the lines of Metcalfe (2001), the melioration equilibrium can be specified with matching conditions, which for the matching grant are:

$$v_1(x_1) = v_2(x_2) \quad \textbf{28}$$

$$\alpha_1 x_1 + \alpha_2 x_2 = 1 \quad \textbf{29}$$

Then the system of adjustments that result from a matching grant can be represented as follows:

$$\begin{bmatrix} v_1' & -v_2' \\ \alpha_1 & \alpha_2 \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} 0 \\ -x_1 d\alpha_1 \end{bmatrix}$$

Solving yields:

$$\Delta = \alpha_2 v_1' + \alpha_1 v_2' > 0 \quad \textbf{30}$$

$$\frac{dx_1}{d\alpha_1} = -\frac{v_2' x_1}{\Delta} < 0 \quad \textbf{31}$$

$$\frac{dx_2}{d\alpha_1} = -\frac{v_1' x_1}{\Delta} < 0 \quad \textbf{32}$$

Now $z_i = \alpha_i x_i$,

$$\frac{dz_1}{d\alpha_1} = x_1 + \alpha_1 \left(\frac{dx_1}{d\alpha_1} \right) = \frac{\alpha_1 v_2' x_1}{\Delta} > 0 \quad \textbf{33}$$

$$\frac{dz_2}{d\alpha_1} = \alpha_2 \left(\frac{dx_2}{d\alpha_1} \right) = -\frac{\alpha_2 v_1' x_1}{\Delta} < 0 \quad \textbf{34}$$

A matching grant in favour of x_1 over x_2 increases the experimentation on x_1 at the expense of x_2.

Thus using equations (31) and (32) the total derivative of the budget constraint (equation 21)

$$\alpha_1 dx_1 + \alpha_2 dx_2 = -x_1 d\alpha_1 - x_2 d\alpha_2 \quad \textbf{35}$$

becomes

$$\alpha_1 dx_1 + \alpha_2 dx_2 = x_1 \frac{(p_1 + bt_1)}{bT} dm = \alpha_1 x_1 dm \quad \textbf{36}$$

Then the system of adjustments that result from the matching grant can be represented as follows:

$$\begin{bmatrix} v_1' & v_2' \\ \alpha_1 & \alpha_2 \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \end{bmatrix} = \begin{bmatrix} 0 \\ \alpha_1 x_1 dm \end{bmatrix}$$

Solving yields:

$$\Delta = \alpha_2 v_1' + \alpha_1 v_2' > 0 \quad \textbf{37}$$

$$\frac{dx_1}{dm} = \frac{\alpha_1 x_1 v_2'}{\Delta} > 0 \quad \textbf{38}$$

$$\frac{dx_2}{dm} = \frac{\alpha_1 x_1 v_1'}{\Delta} > 0 \quad \textbf{39}$$

Equations (36) and (37) are both positive. This means that a matching grant to one good can increase experimentation on both policies in absolute terms. However, the change in expenditure on both policies is dependent on the grant-aided good, x_1. This means that although experimentation overall increases, the experimentation is constrained by the commitment of the grant-recipient to honour the explicit matching condition of this grant. By comparing equations (36) and (37) with the parallel equations for a lump-sum grant, equations (16) and (17), the system of adjustments shows that under a lump-sum grant, the grant recipient does not face the same constraint. Hence, a lump-sum grant provides the grant recipient with greater leeway to experiment than the matching grant.

Now $z_i = \alpha_i x_i$,

$$\frac{dz_1}{dm} = \frac{dz_1}{d\alpha_1} \frac{\partial \alpha_1}{\partial m} = -\left(\frac{\alpha_2 v_1' x_1 (p_1 + bt_1)}{\Delta bT} \right) < 0 \quad \textbf{40}$$

$$\frac{dz_2}{dm} = \frac{dz_2}{d\alpha_1}\frac{\partial \alpha_1}{\partial m} = \frac{\alpha_2 v_1^{'} x_1(p_1 + bt_1)}{\Delta bT} > 0 \qquad \textbf{41}$$

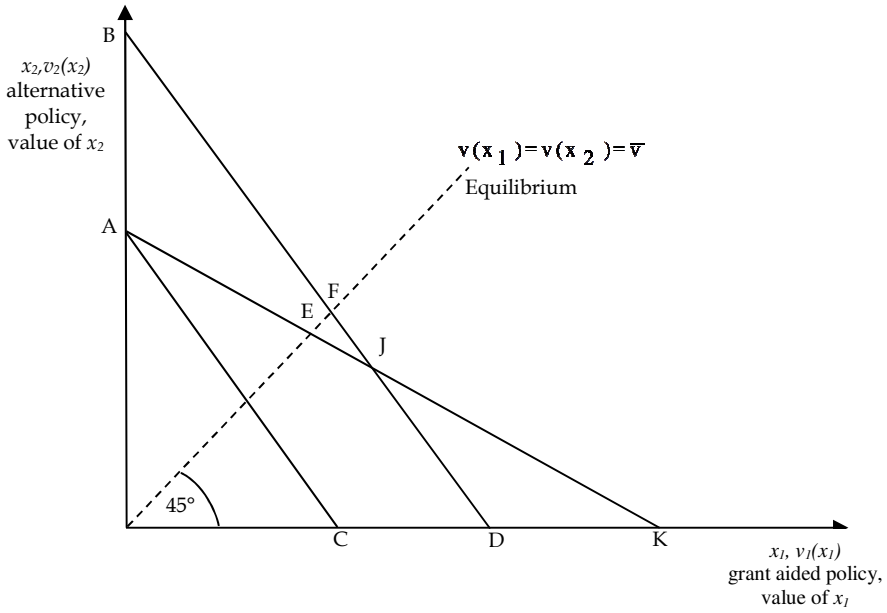
Note that in equations (38 and 39), the change in z_i is dependent only on the value of x_1. Thus, the matching grant is yields a different outcome to the lump-sum grant. As mentioned, the lump-sum grant increases funds to both policies depending on the relative values of the experiments. With a matching grant, however, the funds spent on each policy are, once again, constrained by the expenditure on the grant-aided good x_1.

6.2 Graphical Representation

The process of learning by melioration can be represented graphically in Figure 3,[18] although the graph is not a strict representation thereof. Assume, for illustrative purposes, that time is constant.

Figure 2: Graphical Representation: Learning under Lump-sum Grant compared to Matching Grant

[18] From Herrnstein's (1974) 'matching law,' since x_i represent responses and if we consider that the value functions $v(x_i)$ act as reinforcements, then $\frac{x_1}{x_1+x_2}=\frac{v(x_1)}{v(x_1)+v(x_2)}$, and, hence, $\frac{x_1}{x_2}=\frac{v(x_1)}{v(x_2)}$.



In Figure 3, the matching grant-aided policy, x_1, is on the horizontal axis and an alternative policy, x_2, on the vertical axis, along with their relative values. The budget constraint in the absence of intergovernmental grants (Equation 2) is represented by AC. BD represents the shift in the budget constraint due to the lump-sum grant (Equation 7). AK represents the shift in the budget constraint due to the matching grant which specifies that funds spent on the grant-aided policy, x_1 (Equation 8). The meliorator's equilibrium, as discussed previously, occurs when the value functions for both policies are equal, $v_1(x_1) = \overline{v}(x_i) = v_2(x_2)$. In Figure 3, the meliorator's equilibrium is represented by a 45°degree line from the origin. To the left of the 45° line, the alternative policy, x_2, has a greater value than the grant-aided policy, x_2. Thus, to the left of the 45° line, $v_2(x_2) > v_1(x_1)$ and, hence, $x_2 \succ x_1$. Similarly, to the right of the 45° line, the alternative

policy, x_2, has a lower value than the grant-aided policy, x_2. Thus, to the left of the 45° line, $v_2(x_2) < v_1(x_1)$ and, hence, $x_2 \prec x_1$.

First, consider Figure 3 for the unconditional lump-sum grant (once again, BD). The local representative receives this unconditional lump-sum grant from the central government donor. Then, behaving as a meliorator, the local government representative uses the time and funds from the grant to experiment the two different policies available, namely x_1 and x_2. As shown in Figure 3, the local representative will start with the policy with the higher value, and continue to implement it until the value of the policy declines and the other policy has a higher value.[19] At this point, the representative will switch to the other policy. This process will continue until the representative reaches the upper bound or the budget constraint BD. The potential for switching between policies is represented by the area of the corridor, ABCD.

Secondly, in parallel, consider Figure 3 for the conditional matching grant (once again, BD). The local representative receives this conditional matching grant from the central government donor. Then, behaving as a meliorator, the local government representative uses the time and funds from the grant to experiment the two different policies available, namely x_1 and x_2. As shown in Figure 3, the local representative will start with the policy with the higher value, and continue to implement it until the value of the policy declines and the other policy has a higher value. At this point, the representative will switch to the other policy. This process will continue until the representative reaches the upper bound or the budget constraint AK. The potential for switching between policies is represented by the area of the corridor, ACDJ.

[19] As Breton ([1985] 1987: 315) indicates, "unconditional money…will tend towards areas where competition is greater."

The optimal point under an unconditional lump-sum grant will be F where the values of the two activities are equal and the public budget exhausted, i.e. the recipient has made the most of the funds available. However, as the graph is shown in Figure 3, point F is unattainable under a conditional matching grant of the same size as the unconditional lump-sum grant. Thus, the optimal point under the conditional matching grant will be E, which is inferior to F, the optimal point under the unconditional lump-sum grant. Note that it is possible for another matching grant to make point F attainable (see Appendix 1).

However, the point of this type of policy experimentation is learning. As mentioned, the potential for switching between policies is represented by the area of the corridor created by the intergovernmental grant. Recall from equation 6, that the capacity for learning from melioration is γ. Thus, the capacity for learning attached to an intergovernmental grant, γ, is proportional to the area of the learning corridor bounded by the local community budget constraint prior to grants and the local community budget constraint after the grant is awarded. The learning corridor attached to the unconditional lump-sum grant is area ABCD. In comparison, the learning corridor attached to the conditional matching grant is area ACDJ. Thus, the potential learning from experimentation attached to the unconditional lump-sum grant (γ_G) is proportional to area ABCD, i.e., $\gamma_G \propto ABCD$. In comparison, the potential learning from experimentation attached to the conditional matching grant (γ_m) is proportional to area ACDJ, i.e., $\gamma_m \propto ACDJ$. The difference in areas is area ABJ which indicates that a grant recipient may learn less from a conditional matching grant than an unconditional lump-sum grant, i.e., $\gamma_m < \gamma_G$.

Finally, area ABJ represents the potential for learning that is crowded out by the conditions imposed by the conditional matching grant. Thus, difference between the learning capacity of an unconditional lump-sum grant and the learning capacity of a conditional matching grant is proportional to ABJ, i.e., $\gamma_G - \gamma_m \propto ABJ$. Thus, this shows that a local government can learn more from an unconditional lump-sum grant than a conditional grant.

7. Conclusion and Policy Implications

This paper considers a model of learning by a process of melioration that can illustrate how different types of intergovernmental grants can induce different degrees of learning at the local government level.

This paper additionally provides a positive role for a soft budget constraint at the local government level. Provided the local governments are accountable to both the central government donor and their local constituents, a soft budget constraint can stimulate experimentation and learning.

The flypaper effect is the phenomenon in which an intergovernmental grant leads to greater public spending than an equivalent increase in community income, e.g. a national tax cut (Bailey and Connolly 1998: 335).[20] It's dubbed the flypaper effect because *money sticks where it hits*.[21]

[20] The flypaper effect contradicts "veil hypothesis" which suggests that an unconditional lump-sum grant will have the same effect as a decrease in taxes of the same amount: the unconditional grant is a veil for a federal tax cut (Oates 1999).

[21] The term "flypaper effect" was coined by Arthur Okun (Inman 2008:1).

The flypaper effect can be broken down into *macro* effects and *micro* effects (Brennan and Pincus 1990). The *macro* effect is the effect of a grant on local government expenditure. This is the conventional form of the flypaper effect, as described. Here there is a choice between whether the grant will be spent on private consumption or on public consumption. When a lump-sum grant is given, the spending is skewed towards public goods. The *micro* effect is less conventional and relates to the different effects that different grants have on local government spending. One example of this is that a conditional lump-sum grant is typically more stimulating for that public good for which it is intended than a conditional matching grant or an unconditional grant (Brennan and Pincus 1990: 134-136).

While previously, and indeed in the first generation theory of fiscal federalism, the flypaper effect was viewed as an anomaly (Oates 2008: 324-325), much of the literature (e.g., Courant, Gramlich and Rubinfeld 1979; Brennan and Pincus 1990; Aronson and Munley 1996; Volden 1999; Knight 2002; Volden 2007; Oulasvirta 1997; Inman 2008) is in agreement that the flypaper effect is an inevitable outcome of intergovernmental relations.[22] As Inman (2008: 9-10) notes, "once viewed as an anomaly, the flypaper effect should now be seen as a reality of fiscal politics, and its study as an opportunity to fashion central government transfer policies and intergovernmental fiscal institutions that better reflect citizen preferences for public goods."

This paper shows that money will stick where it hits, when the policy experiment is successful. When the policy experiment is unsuccessful, though, the funds will shift towards experiments that appear to have greater potential for success.

[22] For a review of the alternative explanations for the flypaper effect given in the literature see Bailey and Connelly (2008).

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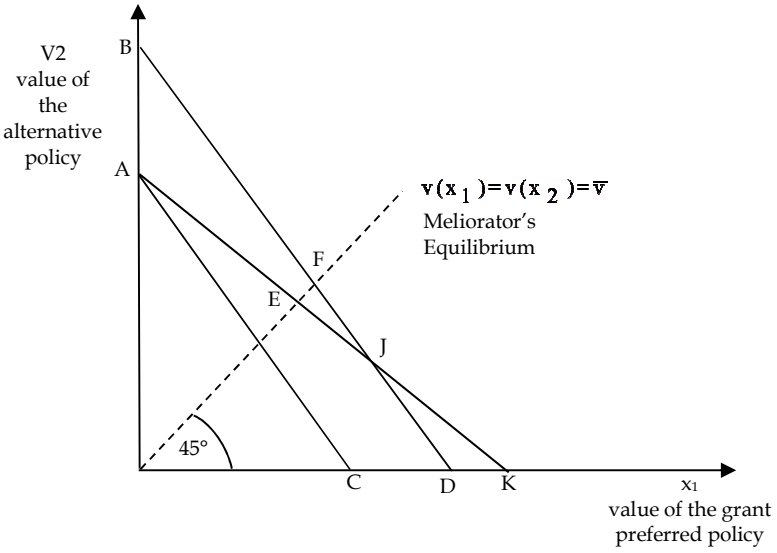
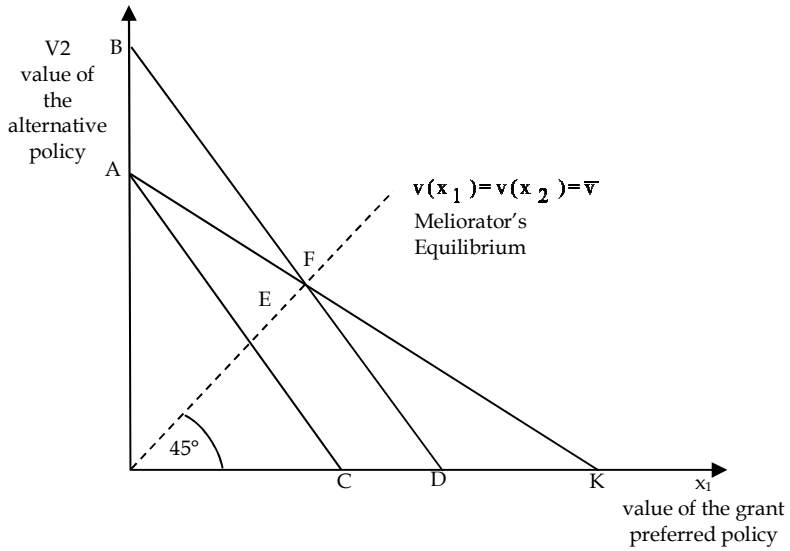
Appendix 1

Matching Grant 1



Matching Grant 2



Matching Grant 3