Expenditure Or Revenue? Spillover, Political Economy and Subnational Government Choice

Bodhisattva Sengupta*

This version: August 8, 2019. Preliminary version, do not quote without permission.

Abstract

Do subnational governments in a federal economy commit to expenditure or to taxes? In this study, we explore the tax-expenditure choice of sub national governments in an economy with interregional grants. Here, local public goods are produced through federally funds and (costly) local revenues. The marginal responsiveness of federal funds to local taxation is influenced by the nature of inter-jurisdiction spillover of such public goods. This, in turn, affects the choice of tax or expenditure by altering the tax price of public good at the provincial level. Second, we show how political economy considerations (for example, re-election probability at the local level elections) interact with provincial spillovers and correlate to a set of possible actions (commitment to revenue or expenditure). Our study complements previous literature (e.g. Koethenbuerger, 2011, JPubEcon) by predicting a richer set of responses at the local level.

*Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, Assam, India 781039. E-Mail: bsengupta@iitg.ac.in. I am indebted to Amarjyoti Mahanta for helpful comments and criticisms.
1 Introduction

In this paper, we attempt the following set of questions. In order to maximize its benefits, does a subnational government choose expenditure or tax? How this choice of policy (expenditure \textit{vis-a-vis} tax) gets affected by central grant allocation? How does politics affect grant allocation and hence the policy choice at the subnational level?

Researches on provincial policies have shown existence of a dichotomy between tax and expenditure policies. In the context of capital tax competition, the pioneering study of Wildasin (1988), for example, has shown that two policies lead to different values of local public good provision even if tax and expenditure are linked through a single budget constraint. He concludes that expenditure competition leads to more competitive tax setting. Bayindir-Upman (1998) extends Wildasin's model by incorporating industrial public good, and his conclusion is opposite. Hindriks (1999) highlights the difference between tax-transfer choices with imperfect labour mobility.\textsuperscript{1} These classes of models have two shortcomings. One, the policy is not endogenised. Moreover, the critical role of the central government in a federal structure is not recognized.

The effect of politics in federal grant dispensation is well documented. A few studies (see, for example, Porto and Sanguinetti 2001; Khemani 2003; Sollé-Ollé and Sorribas-Navaro 2006) find the evidence of partisan transfers (such that jurisdictions/provinces that share the same political identity with the upper level governments receive more transfers). On the other hand, Arulampalam \textit{et.al.} (2009) or Johansson (2003) found the evidence that central transfer are distributed to maximize re-election probability, not necessarily to reward loyal provinces. A different strand is Milligan and Smart (2005), who found evidence for both strategic and partisan allocation of grants across the provinces in Canada. However, the strand of literature

\textsuperscript{1}A related strand is concerned about the \textit{existence} of Nash equilibrium, see, for example Rothstein(2007). We abstract from these issues.
does not speak much about the effect of politics on subnational government choice of instrument.

The literature on political budget cycle (for a good survey, see Persson and Tabellini, 2000) offers another insight for endogeneity of policy variables. Incumbent governments (that are unsure to win any election) may indulge in spending just before the election. This may serve two purposes. One, such spending may lure some non-committed voters to its fold. Here, spending serves as a signal of good governance to potential voters. Second, the government may want to spend a lot in order to leave the next government (ruled by, presumably, another party) in trouble. Governments are fiscally prudent if they are firmly ensconced. But these studies fail to explain what happen in off election years.

In this connection, Koethenbuerger (2011) makes two important contributions to the literature. He endogenizes the choice of instruments and brings the central tax transfer scheme in forefront. The key variable in his study is the marginal responsiveness of central transfer to local taxation (that is, $\frac{\partial (\text{central transfer})}{\partial (\text{local taxation})}$). The marginal responsiveness determines the tax price (that is, $\frac{\partial (\text{local tax})}{\partial (\text{public good})}$) of public good provision. But the tax price itself depends on the neighboring region’s policy. One of the key results is, as long as central government rewards local taxation (the sign of first derivative is positive), then local governments choose to optimize over expenditure(taxes). If provinces are symmetric, then we should observe either tax optimization or expenditure optimization.

Empirically, however, such uniform behavior is not observed. A typical study is Payne (1998). Using a panel data analysis, he finds that, in US, the tax-to-spend (expenditure follows tax) hypothesis is supported by the budgetary decision of 24 states; the spend-to-tax hypothesis (tax follows expenditure) is valid for 8 states while the fiscal synchronization (both are determined simultaneously) pattern is observed for 11 states. Thus it seems that choices are rather disparate and should depend on initial con-
siderations. More recently Chowdhury (2011) showed that 40 percent of US states did not exhibit any pattern, while 18 percent of states supported the tax-to-spend hypothesis, 16 percent favor spend-to-tax hypothesis, and 26 percent exhibited fiscal synchronization. As Saunaris (2015, whose own paper largely supports the tax-to-spend hypothesis) points out, such differences may be attributed to "... differences in methodology, level of aggregation, and period." (ibid, pp 112).

The contribution of the present paper is twofold. First, we complement Koethenbuerger (ibid) by noting that the marginal responsiveness is endogenous in nature. In our formulation, we have shown that if the local public goods have inter-judiciary spillover effects, then the sign (and value) of the marginal central transfers do depend on the nature and strength of the spillover. Therefore, it is the nature of public good and provincial welfare that jointly determine the choice between expenditure policy and tax policy. Second, we introduce a very simple political framework (in which benefit of one province gets higher weight in central grant dispensation calculus). Then we attempt to show how political considerations and nature of spillover jointly condition the tax-expenditure decision by the provincial authorities. Third, the paper also contributes to the debate regarding subnational governments’ autonomy in a federal system. For example, the recent GST reform in India has virtually taken the power off the states to raise revenue through imposing taxes. Such policies allows force sub national governments to choose expenditure. We show that such behavior is not in the states’ best interest.

The paper is organized as follows. Section 2 presents the basic model. The choice of policy variable under apolitical and political settings is discussed in sections 3 to 5. Section 6 concludes the paper.
2 The Model

There exist two provinces, denoted by 1 and 2 (i = 1, 2). A representative consumer in either province derives utility from the public good \( P_i \) and private consumption \( c_i \). The utility function in province \( i \) is \( u^i(p_i; p_j; c_i) \) with standard properties. The benefit from public good consumed in province \( i \) includes ‘own’ production \( p_i \) and spillover from the neighboring province \( p_j \). To begin with, we assume that spillover is symmetric.

Transfer has two parts, and probably decided by two different authorities using different criteria. One part of transfer is committed (and mandated by a constitutional authority) such that \( T_{i \text{ com}} = m_i \theta_i \) (although it is likely to be the case that \( m_i = m \forall i \)). Thus the first part is a committed matching grant such that \( \left( \frac{\partial T_i}{\partial \theta_i} \right)_{\text{committed}} = m_i > 0 \). The value of \( m_i \) could be potentially small due to federal budget constraint. This may reflect the growing trend in the world where central governments try to encourage provinces to reduce their fiscal deficit. The second, uncommitted part of marginal grant is disbursed by a discretionary authority, which neglects the effect from the constitutional authority. This grant, as discussed below, is more sophisticated in the sense that it is formed by the interaction between inter jurisdictional spillover of provincial public good and federal objective of equalization, and can be negative. In sum, the marginal responsiveness can be written as

\[ \left( \frac{\partial T_i}{\partial \theta_i} \right) = \left( \frac{\partial T_i}{\partial \theta_i} \right)_{\text{committed}} + \left( \frac{\partial T_i}{\partial \theta_i} \right)_{\text{uncommitted}} \]

A public good produced within the province is financed by locally procured taxes/or local revenues \( \theta_i \) and transfer from the federal government:

\[ p_i = B_i + \theta_i + T_i \]

\( B_i > 0 \) is the status quo public good produced in province \( i \) independent of the tax/transfer scheme and \( T_i \) is the federal transfer.\(^2\) We assume that \( B_i \) is large enough such that the stock of public good does not fall below (or to) zero. Consumption is consumer income \( y_i \) less taxes. We assume that income is given. So we have \( c_i = y_i - \theta_i \).

The discretionary division of the federal government is constrained by

\(^2\)In what follows, we have assumed \( B_i = 0 \). This does not alter any result.
a fixed budget due to intergovernmental transfer. In other words, federal government embarks upon a equalization scheme. The net transfer to a province can be negative or positive, and the budget must balance. Therefore, we can write, \((T_1 + T_2)_{\text{uncommitted}} = S\). Here, once the committed part has been disbursed, the discretionary division of federal government treats \(S = M - m(\theta_1 + \theta_2)\) is a constant.

More specifically, the sequence of moves is as follows.

- Provincial governments set a policy: optimize through either \(\theta_i\) or \(p_i\).
- They choose either \(\theta_i\) or \(p_i\).
- Looking at \(\theta_i\), federal government disburses committed part of grant, that is \(m\theta_i\) and hands over the rest of budget to the discretionary authority.
- Given the fixed budget, the discretionary authority fixes the transfer rule to dispense uncommitted part of \(T_i\), conditional on provincial \(\theta_i\), neglecting the effect of constitutional grant. Thus the total budget of the department is \((T_1 + T_2)_{\text{uncommitted}} = S\), say, where it treats \(S\) as fixed.
- Public good is provided and consumed.

### 3 Federal Action: Uncommitted Transfer

We assume that given that federal government has already committed to one part of transfer, when it settles for uncommitted transfer, it ignores the effect of \(m_i\) on public good\(^4\). In the third stage of the game, given \(i\), the

\[A \text{ more realistic budget constraint is } \tau_1 + \tau_2 = T_1 + T_2 + C, \text{ where } \tau_i \text{ is taxes collected from state } i \text{ and } C \text{ is central expenditure. In order to focus on transfer, all variables except } T_i \text{ are assumed to be constant. The results will not change.}

\[^4\text{More realistically, it may perceive the "committed" part to be } \xi_i \theta_i, \text{ where } \xi_i \in [0, m_i]. \text{ } \xi_i = 0 \text{ is the case when there is complete disassociation between the two departments,} \]
federal government maximizes federal welfare through uncommitted part of transfers\textsuperscript{5}

\[ u^1(p_1, p_2, c_1) + u^2(p_1, p_2, c_2) = u^1(\theta_1 + T_1, \theta_2 + S - T_1, y_1 - \theta_1) + u^2(\theta_1 + T_1, \theta_2 + S - T_1, y_2 - \theta_2) \]

with respect to the transfers. The F.O.C. yields

\[ u_1^1 - u_2^1 = u_2^2 - u_1^2 \quad (1) \]

Here, the subscript refers to marginal utility. That is, \( u^j_i = \frac{\partial u^j_i}{\partial p^j_i} \) and so on. Thus the marginal costs and benefits of the public goods across the federation are equalized. We assume that \( u^j_i > 0 \), i.e. spillover are always beneficial

Note that equation 1 can also be written as

\[ u_1^1 + u_2^1 = u_2^1 + u_2^2 \quad (2) \]

That is, the marginal benefit from public goods is equalized across provinces.

Solving the first order conditions gives \( T_i = T_i(\theta_1, \theta_2) \). From the F.O.C.s, we have:

\[ \left( \frac{\partial T_i}{\partial \theta_i} \right)_{\text{uncommitted}} = -\frac{(u_{ii}^i + u_{ji}^j) - (u_{ji}^i + u_{ji}^j)}{[u_{11}^1 + u_{22}^2 + u_{11}^2] + u_{22}^2] - 2(u_{21}^1 + u_{21}^2)} \]

So that the net marginal incentive for local revenue is given by

\[ \frac{\partial T_i}{\partial \theta_i} = m_i - \frac{(u_{ii}^i + u_{ji}^j) - (u_{ji}^i + u_{ji}^j)}{[u_{11}^1 + u_{22}^2 + u_{11}^2] + u_{22}^2] - 2(u_{21}^1 + u_{21}^2)} \]

and \( \xi_i = m_i \) is the case when two departments work in tandem. Any intermediate value reflects partial cooperation between these two departments.

\textsuperscript{5}In what follows, we have omitted the subscript "uncommitted" because of notational clarity.
This is the marginal incentive for local revenue. Let us discuss that uncommitted part in detail. The terms in the denominator is the SOC, and we assume the SOC is fulfilled. The first term in the numerator is \((u_{ii}^i + u_{ij}^j)\), which we assume to be negative. The second term, that is \(u_{ij}^i + u_{ij}^j > 0\) if the public goods produced in each region are complementary to each other \((u_{ij} > 0)\).\(^6\) In that case, \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}}\) is unambiguously negative. On the other hand, if public goods are substitute to each other \((u_{ij} < 0)\), it may happen that the numerator is negative.\(^7\) \(A\ priori\), we cannot say anything on the sign of the term.

An upshot of this is \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}}\) can be positive or negative, taking both the committed and uncommitted part together. The following cases may arise.

(a) Suppose \(u_{ji}^i > 0\). Then \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}}\) is negative. Depending on the strength of \(m_i\) and \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}}\), \(\frac{\partial T}{\partial q_i}\) can be positive or negative. If the spillover effects are strong, \(\frac{\partial T}{\partial q_i} < 0\). Thus, strong complimentary spillover make \(\frac{\partial T}{\partial q_i} < 0\), whereas weak complementary spillover imply \(\frac{\partial T}{\partial q_i} > 0\).

(b) Suppose \(u_{ji}^i < 0\). Then also, if the strength of spillover is not strong enough, it might be the case that \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}} < 0\). Thus, weak substitute spillover make \(\frac{\partial T}{\partial q_i} < 0\).

c) On the other hand, if \(u_{ji}^i < 0\) and the value is high, then \((\frac{\partial T}{\partial q_i})_{\text{uncommitted}} > 0\) and \(\frac{\partial T}{\partial q_i} > 0\). Thus strong substitute spillover imply \(\frac{\partial T}{\partial q_i} > 0\).

The result can be summarized in the following lemma:

**Lemma 3.1** If marginal incentive is positive, then this implies presence of strong substitution and weak complementarity. On the other hand, weak substitution and strong complementarity is implied by negative marginal incentive.

\(^6\)Note that the effect of \(p_j\) on \(u^i\) is captured in two terms: \(u_{ij}^i\) and \(u_{ij}^j\). We assume that \(u_{ij}^j > 0\), so that we are not dealing with detrimental externalities like environmental pollution.

\(^7\)Kemph and Rota-Graziosi (2010) provided a nice taxonomy of public goods with spillovers. For example, better law and order situation is an example of complementary public good. Pollution abatement is an example of substitutes.
We make the following assumption

**Assumption 1:** The value of marginal incentive, $|\frac{\partial T_i}{\partial \theta_i}| < 1$. Thus, no province is ‘punished’ or rewarded disproportionately.

An upshot of the assumption is, marginal effect of local taxation on local public good, $\left(\frac{\partial p_i}{\partial T_i}\right)$ is always positive.

## 4 Regional Choice of Tax Expenditure Policy

Now we turn to stage 2 of the game, and analyze the implications of regional policy. We show that, given the transfer rule, the policy choice of the neighboring has some bearing on the tax price of public good of the states. There could be four possible policy choices: {tax, tax}, {tax, expenditure}, {expenditure, tax} and {expenditure, expenditure}. We term them $(\theta_1, \theta_2)$, $(\theta_1, p_2)$, $(p_1, \theta_2)$ and $(p_1, p_2)$, respectively.

### 4.1 $(\theta_1, \theta_2)$ and $(p_1, \theta_2)$ Outcomes

First, we take the case where the region 2 maximize through $\theta_2$ and see how the equilibrium values of tax and expenditure change if province 1 alters the policy. Let both regions choose local revenue ($\theta_1$ and $\theta_2$) as optimizing variable. Then, region 1’s problem is, given $\theta_2$\footnote{Here, each province perceives $T_i$ as sum of committed and uncommitted part, and recognizes the overall budget constraint of the Government, that is

$$\sum T_{i|\text{committed}} + \sum T_{i|\text{uncommitted}} = M$$

$$T_1 + T_2 = M$$}:

$$\max_{\theta_1} u^1(\theta_1 + T_1, \theta_2 + M - T_1, y_1 - \theta_1)$$

The first order condition is

$$\frac{\partial u^1}{\partial \theta_1} = 0$$
A similar exercise with region 2 defines two reaction functions \( \theta_i = R_i(\theta_j) \). Optimal taxes are \( (\theta_1^N, \theta_2^N) \), transfers are \( T_i(\theta_1^N, \theta_2^N) \) and public good in each province \( p_i = B_i + \theta_i^N + T_i(\theta_1^N, \theta_2^N) \).

Now assume that the region 1 maximizes its utility through public good expenditure, given that the other region chooses \( \theta_2 \). In other words, it maximizes its own welfare with respect to \( p_1 \) and \( \theta_1 \) is adjusted accordingly. Thus, it perceives the transfer rule to be implicitly defined by \( T_1 = T_1(p_1 - \bar{T}_1; \theta_2) \), given any level of \( \theta_2 \). By differentiating, we get

\[
\frac{\partial T_1}{\partial p_1} = \frac{\frac{\partial T_1}{\partial \theta_1}}{1 + \frac{\partial T_1}{\partial \theta_1}}
\]

(4)

Notice that the maximand for region 1 now is

\[
u_1 \left(p_1, \theta_2 - \bar{T}_1, y_1 - p_1 + \bar{T}_1\right)
\]

Maximizing with respect to \( p_1 \),

\[
u_1 - u_2^1 \frac{\partial T_1}{\partial p_1} = u_1^1 \left(1 - \frac{\partial T_1}{\partial p_1}\right)
\]

Using (4), this reduces to

\[
u_1^1 \left(1 + \frac{\partial T_1}{\partial \theta_1}\right) - u_2^1 \frac{\partial T_1}{\partial \theta_1} = u_1^1
\]

(5)

which is the same expression as (3). At the end, if region \( j \) \((1 = 2)\) maximizes its utility by adopting a tax policy, region \( i \) \((i \neq j)\) can choose either policy. Both of these will lead to same \((\theta_i, p_i, T_i, c_i)\). Thus, region \( i \) is indifferent between choosing either tax or expenditure as the optimizing variable.
4.2 \((\theta_1, p_2)\) and \((p_1, p_2)\) Equilibrium

Now assume that the province 2 chooses \(p_2\). If province 1 adopts tax policy, then it perceives the transfer formula to be implicitly defined by \(\hat{T}_1 = T_1(\theta_1; p_2 - \hat{T}_2)\). Note that \(\frac{\partial \hat{T}_1}{\partial \theta_1} = \frac{\partial T_1}{\partial \theta_1} \frac{\partial \hat{T}_2}{\partial \theta_2}\). The denominator is positive but less than 1 if \(\frac{\partial T_2}{\partial \theta_2} < 0\), and more than 1 if \(\frac{\partial T_2}{\partial \theta_2} > 0\).

The maximand for region 1 is \(u^1(\theta_1 + \hat{T}_1, p_2, y_1 - \theta_1)\) and the FOC is

\[
\begin{align*}
  u_1^1 \left(1 + \frac{\partial \hat{T}_1}{\partial \theta_1}\right) &= u_c^1 \quad (6) \\
  u_1^1 \left(1 + \frac{\partial T_2}{\partial \theta_2} + \frac{\partial T_1}{\partial \theta_1}\right) &= u_c^1 \left(1 + \frac{\partial T_2}{\partial \theta_2}\right) \quad (7)
\end{align*}
\]

Now assume region 1 maximizes through \(p_1\). Then it perceives the transfer formula to be implicitly defined as \(\hat{T}_1 = T_1(p_1 - \hat{T}_1; p_2 - \hat{T}_2)\). Note that \(\frac{\partial \hat{T}_1}{\partial p_1} = \frac{\partial T_1}{\partial p_1} \left(1 - \frac{\partial \hat{T}_1}{\partial p_1}\right) + \frac{\partial T_1}{\partial p_2} \left(- \frac{\partial \hat{T}_2}{\partial p_2}\right)\). Using \(T_1 = -T_2\) or \(\hat{T}_1 = -\hat{T}_2\), we can write

\[
\frac{\partial \hat{T}_1}{\partial p_1} = \frac{\partial T_1}{\partial p_1} \frac{\partial \hat{T}_2}{\partial \theta_2}.
\]

The maximand for region 1 is \(u^1(p_1, p_2, y_1 - p_1 + \hat{T}_1)\). The FOC is

\[
\begin{align*}
  u_1^1 &= u_c^1 \left(1 - \frac{\partial \hat{T}_1}{\partial p_1}\right) \\
  &= u_c^1 \left(1 - \frac{\partial T_1}{\partial p_1} \frac{\partial \hat{T}_2}{\partial \theta_2} \frac{\partial \hat{T}_1}{\partial \theta_1} \right) \\
  &\rightarrow u_1^1 \left(1 + \frac{\partial T_2}{\partial \theta_2} + \frac{\partial T_1}{\partial \theta_1}\right) = u_c^1 \left(1 + \frac{\partial T_2}{\partial \theta_2}\right) \quad (8)
\end{align*}
\]

This is same as (7). Hence, as long as the other province (province \(j\)) sticks to expenditure policy, province \(i\) (\(\neq j\)) can choose either tax or expenditure policy. Both policies lead to the same Nash outcome.

The discussion can be summarized in the following lemma, which is similar to Koethenbuerger (2011), albeit in a slightly different context.
Lemma 4.1 In a two province case, as long as province $i$ ($i = 1, 2$) sticks to expenditure/tax policy, province $j$’s ($j = 1, 2, j \neq i$) policy choice gives rise to identical equilibrium outcome for province $j$.

4.3 Tax price of Public Good and Neighbor’s Policy

Note that, public good production in any province is $p_i = B_i + \theta_i + T_i$. Thus reveals the tax price of public good in any province, i.e., to increase public good production by 1 unit, by how much should we increase the local taxes. A higher tax price increases the cost at the margin and provides lower incentive to levy taxes. Irrespective of sign of $\frac{\partial T_i}{\partial \theta_i}$ and $\frac{\partial T_i}{\partial \theta_j}$, we always have $\frac{\partial T_i}{\partial \theta_i} < \frac{\partial T_i}{\partial \theta_j}$ (both are negative numbers here). In other words, reduction (increase) in transfer is higher (lower) if the other province chooses to optimize through expenditure rather than tax. Note that, the tax price of public good is $\frac{\partial \theta_i}{\partial p_i} = \left( \frac{1}{1 + \frac{\partial T_i}{\partial \theta_i}} \right)$. Thus if the neighboring region (say region $j$) maximizes $u^j$ through $p_j$ than through $\theta_j$, tax price of public good in region $i$ will be higher and the incentive to tax and provide public good will be lower. As a result, region $i$ has lower incentive to tax (taxation becomes more costly) to generate public good vis-à-vis the case when region $j$ optimizes over tax. The reason is the following. Suppose that both regions are maximizing through taxes and the marginal incentive is negative. Then, if region $i$ want to raise revenues, it will receive less transfer. To balance the budget, region $j$ will receive more transfer. If region $j$ is maximizing through taxes, then this extra revenue increase public good provision, leaving the taxes unaltered. On the other hand, if region 2 maximizes through expenditure, then the extra amount will reduce tax in region $j$, generating a second round increase (decrease) of transfer to region $j$ (for region $j$).

Now let us compare the two equilibria. First, let both regions choose local taxes as the optimizing variable. We call this $(\theta_i, \theta_j)$ equilibrium. Now consider the $(\theta_i, p_j)$ equilibrium. We know that, as long as region 1 chooses
(θ₁), the level of p₂ and hence θ₂ is constant. But we have just seen that θ₁ falls across the two equilibrium.

4.4 Choice of Optimizing Variables

In the first stage of the game, provinces choose either θᵢ or pᵢ. Assume that both provinces initially maximize through taxes (θ₁, θ₂ equilibrium). But now region 1 shifts to expenditure optimization (p₁, θ₂ equilibrium). This will not alter public good provision or consumption in region 1 provided region 2 does not change level of its optimizing variable. But the tax price of public good rises for region 2 and, as a result, it reduces its tax. This should have an effect on the welfare of region 1. If welfare falls, then there is no incentive for region 1 to switch over to expenditure policy.

If region 1 chooses p₁ optimally, the welfare of region 1, as a function of θ₂ is given by the following expression:

\[ W₁(θ₂) = u₁(p₁^*, θ₂ - T₁, y₁ - p₁^* + T₁) \]

Now we are ready to state our first result.

Lemma 4.2 Initially, suppose both regions choose tax as optimizing variable. Then, region 1 (region 2) does not have any incentive to switch to expenditure maximization if the nature of spillover is strong complementary or weak substitute. On the other hand, if there exists strong substitutability or weak complementarity across public good and region 1 (region 2) gets high marginal benefit from its own public good than that produced by region 2 (region 1) that is, \( u_j^i << u_j^i \), then region 1 (region 2) will shift to expenditure maximization as region 1 (region 1) chooses tax optimization.

Proof. We have, for region 1,
\[
W'_1(\theta_2) = u^1_2 \left( 1 - \frac{\partial T_1}{\partial \theta_2} \right) + u^1_2 \frac{\partial T_1}{\partial \theta_2}
\]
\[
= u^1_2 + \frac{\partial T_1}{\partial \theta_2} (u^1_1 - u^1_2)
\]
\[
= u^1_2 - \frac{\partial T_2}{\partial \theta_2} (u^1_1 - u^1_2) \text{ (since } T_1 = -T_2)\]
\[
= u^1_2 - \frac{\partial T_2}{\partial \theta_2} (u^1_1 - u^1_2) \text{ (since } u^1_1 \left( 1 + \frac{\partial T_1}{\partial \theta_1} \right) - u^1_2 \frac{\partial T_1}{\partial \theta_1} = u^1_1 \text{ at equilibrium})\]
\[
= u^1_2 - \frac{\partial T_2}{\partial \theta_2} (u^1_1 - u^1_2)\]
\[
= u^1_2 \left( 1 + \frac{\partial T_2}{\partial \theta_2} \right) - \frac{\partial T_2}{\partial \theta_2} u^1_1
\]

If \( \frac{\partial T_2}{\partial \theta_2} < 0 \) (spillovers are strong complementary or weak substitute), then \( W'_1(\theta_2) \) is always positive. If \( \frac{\partial T_2}{\partial \theta_2} > 0 \), then the expression is negative if benefit of its province from its own public good \( (u^1_1) \) is much higher than the cross provincial good \( (u^1_2) \). To put matters in perspective, we have \( u^1_2 = s_1 u^1_1 \) and \( s_1 > 0 \) but very close to 0. Similarly we can show this for region 2 as well. 9

Second, assume that both regions are optimizing with expenditure \((p_1, p_2)\) equilibrium. Suppose that region 1 deviates and chooses local revenue \((\theta_1)\) as optimizing variable. We know that, in this case, region 2 boosts public expenditure. The effect on region 1’s welfare, in terms of \( p_2 \) is given by the following lemma.

**Lemma 4.3** Suppose region 2 is optimizing through expenditure. Then the best response for region 1 is tax optimization if the nature of spillover is strong complementary or weak substitute. On the other hand, if the goods are strong substitute or weak complementary and the sufficient conditions

9If we take an LQ example, let \( u^1(p_1, p_2) = A p_1 - \frac{\alpha_1}{2} p^2_1 + B p_2 - \frac{\alpha_2}{2} p^2_2 + \lambda_1 p_1 p_2 \) with \( \lambda_1 < 0 \). Then \( u^1_1 = A - \alpha_1 p_1 + \lambda_1 p_2 \) and \( u^1_2 = B - \alpha_2 p_2 + \lambda_1 p_1 \). The condition is satisfied if, ceteris paribus, we impose appropriate constraints on \( A \) and \( B \).
mentioned in lemma 1 are satisfied, then the best response for region 1 is expenditure optimization.

**Proof.** Here. \( W_1(p_2) = u^1(\theta^*_1 + \bar{T}_1, p_2, y_1 - \theta^*_1) \)

Thus

\[
W'_1(p_2) = u^1 \left( -\frac{\partial T_2}{\partial p_2} \right) + u^2_2 \\
= u^1 \left( -\frac{\partial T_2}{\partial \theta_2} \right) + u^2_2 \\
= \frac{1}{1 + \frac{\partial T_2}{\partial \theta_2}} \left( -\frac{\partial T_2}{\partial \theta_2} u^1_1 + u^2_2 \left( 1 + \frac{\partial T_2}{\partial \theta_2} \right) \right) \\
= \frac{1}{1 + \frac{\partial T_2}{\partial \theta_2}} \left( u^2_1 \left( 1 + \frac{\partial T_2}{\partial \theta_2} \right) - \frac{\partial T_2}{\partial \theta_2} u^1_1 \right)
\]

Note that this term is same as we have encountered in lemma 1. If \( \frac{\partial T_2}{\partial \theta_2} < 0 \) then \( W'_1(p_2) > 0 \), i.e. it pays region 1 to deviate to tax optimization given region 2 is going expenditure optimization. On the other hand, if there exists strong substitutability across public good \( \left( \frac{\partial T_2}{\partial \theta_2} > 0 \right) \) and province 1 gets high marginal benefit from its own public good than that produced by region 2, then region 1 will remain to expenditure maximization.\(^{10}\)

Combining lemma 4.2 and 4.3, one gets the following result:

**Proposition 4.1** In the policy-choice game, tax optimization by both regions is the equilibrium choice if spillovers are strong complementary or weak substitutes. On the other hand, if spillovers are strong substitutes or weak complementary and \( |u^1_i| >> |u^2_i| \), then both regions switch to expenditure as choice variable.

\(^{10}\)Note that, the result is not valid for all substitutes. If substitutes are such that they can be added up (e.g. both provinces produce clean air), such that \( u_1(p_1, p_2, c_1) = u_1(p_1 + \beta p_2, c_1) \), where \( \beta \) captures the degree of spillover, then the choice variable is always tax. In that case, \( W'_1(\theta_i) > 0 \) and \( W'_1(p_i) > 0 \). So \( p_1, p_2 \) has to be such that they are of different nature, for example clean air and clean water (in case water is shared in a transboundary fashion). See, for example, Koethenbuerger(2008) or Sengupta (2011).
5 Effect of Politics

We assume that by through political compulsion, central government discriminates against one of the provincial government (say province 2). More specifically, while distributing transfers, the authority conducting the second phase of central grant chooses $T_1$ to maximize

$$u^1(T_1 + \theta_1, \theta_1 + S - T_1, y_1 - \theta_1) + Au^2(\theta_1 + T_1, \theta_2 + S - T_1, y_2 - \theta_2)$$

Where $A < 1$ is politically determined weight on province 2’s welfare.\(^\text{11}\)

Then, the modified FOC is

$$u^1_1 - u^2_2 = A(u^2_2 - u^1_1)$$

Here, of course, $T_i = T_i(\theta_1, \theta_2, A)$

And hence

$$\frac{\partial T_1}{\partial \theta_1} \Big|_{\text{uncommitted}} = -\frac{(u^1_{11} + Au^2_{11}) - (u^1_{11} + Au^2_{21})}{[u^1_{11} + u^1_{22} + Au^2_{11} + Au^2_{22}] - 2(u^1_{21} + Au^2_{21})}$$

$$\frac{\partial T_2}{\partial \theta_2} \Big|_{\text{uncommitted}} = -\frac{(u^1_{22} + Au^2_{22}) - (u^1_{12} + Au^2_{22})}{[u^1_{11} + u^1_{22} + Au^2_{11} + Au^2_{22}] - 2(u^1_{21} + Au^2_{21})}$$

In order to get sharper results, we can invoke a linear quadratic form of utility. Let $u^1_{11} = -\alpha_1, u^1_{22} = -\beta_1, u^2_{11} = -\alpha_2, u^2_{22} = -\beta_2, u^i_{ij} = \lambda_i$

$$\frac{\partial T_1}{\partial \theta_1} = m_1 - \frac{\alpha_1 + A\alpha_2 + (\lambda_1 + A\lambda_2)}{\alpha_1 + \beta_1 + A\alpha_2 + A\beta_2 + 2(\lambda_1 + A\lambda_2)}$$

$$\frac{\partial T_2}{\partial \theta_2} = m_2 - \frac{\beta_1 + A\beta_2 + (\lambda_1 + A\lambda_2)}{\alpha_1 + \beta_1 + A\alpha_2 + A\beta_2 + 2(\lambda_1 + A\lambda_2)}$$

\(^\text{11}\)This can be justified by many ways. For example, province 1 and centre may share same political alignment, and central grant may be inherently partisan in nature. On the other hand, the central grant may entirely be strategic in nature, in order to attract swing voters in each jurisdiction (e.g. as in Dixit and Londregan, 1996). An application of the latter was done by Sengupta (2011, pp 106-107) in the context of inter-jurisdictional spillover. The appendix contains the details from the paper.
Note that the only interesting case occurs when the sign of $\frac{\partial T_i}{\partial \theta_i}$ changes as politics in introduced. We begin with the case of substitutes, and indicate some possibilities.

1. Assume the apolitical case, that is, $\frac{\partial T_1}{\partial \theta_i}|_{\theta=1}$ is negative, and the uncommitted part is negative due to weak substitute. If we denote $\lambda_1 = -\phi_1$, then this is implied by $\alpha_1 + \alpha_2 > \phi_1 + \phi_2$. For marginal incentive to be positive under politically motivated grants, we need $\phi_1 + A\phi_2 > \alpha_1 + A\alpha_2$. The latter inequality holds for $A \to 0$ (the weight on the non-favorite province goes down), if we have $\phi_1 > \alpha_1$. In other words, $|u_{11}^1| > |u_{11}^1|$. If this condition is not satisfied, then $\frac{\partial T_1}{\partial \theta_i}|_{\theta \neq 1}$ remains negative. Otherwise, there is a certain $A$ beyond which $\left(\frac{\partial T_1}{\partial \theta_i}\right)_{uncommitted}$ becomes positive and hence $\frac{\partial T_1}{\partial \theta_i}$ is positive.

2. $\frac{\partial T_1}{\partial \theta_i}|_{\theta=1}$ is positive to begin with, and associated with strong substitute. Thus, $\phi_1 + \phi_2 > \alpha_1 + \alpha_2$. For $\phi_1 + A\phi_2 < \alpha_1 + A\alpha_2$, we must have $\phi_1 < \alpha_1$ as $A \to 0$. In other words, a sufficient condition is $|u_{12}^1| < |u_{11}^1|

3. Similarly, for state 2, the relevant condition for a negative $\frac{\partial T_2}{\partial \theta_2}$ (weak substitute) to turn into a positive term as $A \to 0$ is $|u_{12}^2| > |u_{22}^1|

4. For a positive $\frac{\partial T_2}{\partial \theta_2}$ (strong substitute) to turn into a negative term as $A \to 0$, the necessary condition is $|u_{12}^1| < |u_{22}^1|

Combining these results, we have the following interesting result

**Proposition 5.1** Suppose that the public goods are substitutes such that $u_{ij} < 0$ to begin with. If $|u_{12}^1|$ is such that $|u_{22}^1| < |u_{12}^1| < |u_{11}^1|$, then region 1 is punished for raising more funds and region 2 is rewarded for raising more funds as grant dispensation becomes more and more politically motivated.
Next, suppose the spillover effect is complementary. That is, $\lambda_1, \lambda_2 > 0$. If complementarity is strong, $(\frac{\partial T_i}{\partial \theta_i})_{\text{uncommitted}} < 0$ and of high value, we have $\frac{\partial T_i}{\partial \theta_i} < 0$. Notice that with decreasing $A$, both numerator and the denominator falls, so it is not immediately clear whether the value of $\frac{\partial T_i}{\partial \theta_i}$ remain positive or not. One needs to figure out the sign of $\frac{\partial}{\partial A} \left( \frac{\partial T_i}{\partial \theta_i} \right)$. Unfortunately, nothing can be said unless we impose the symmetry conditions that $u_{ii}^j = k_1 = \beta_2$ and $u_{ii}^j = \beta_1 = \alpha_2 = g$, say. Then it can be derived that, for region 1,

$$\frac{d}{dA} \left( m_1 - \frac{k + Ag + (\lambda_1 + A\lambda_2)}{k + g + Ag + Ak + 2(\lambda_1 + A\lambda_2)} \right) = (k-g) \frac{g + k + \lambda_1 + \lambda_2}{(g + k + 2\lambda_1 + 2A\lambda_2 + Ag + Ak)^2}$$

Thus, if $|u_{ii}^j| > |u_{ii}^j|$, then, with decreasing $A$, $\frac{\partial T_i}{\partial \theta_i}$ will fall. If it was negative to begin with due to strong complementarity, it will remain negative with political grant dispensation. In other words, politics cannot change sign of marginal derivative in region 1.

On the other hand, for region 2,

$$\frac{d}{dA} \left( m_2 - \frac{g + Ak + (\lambda_1 + A\lambda_2)}{k + g + Ag + Ak + 2(\lambda_1 + A\lambda_2)} \right) = (g-k) \frac{g + k + \lambda_1 + \lambda_2}{(g + k + 2\lambda_1 + 2A\lambda_2 + Ag + Ak)^2}$$

Given the same assumption, marginal incentive for region 2 in fact increases. It could be the case that the marginal incentive becomes positive as $A \to 0$.

Second, assume complementarity is weak enough, such that even if $(\frac{\partial T_i}{\partial \theta_i})_{\text{uncommitted}} < 0$, we have $\frac{\partial T_i}{\partial \theta_i} > 0$ with grant without political element. Then, maintaining the same assumption on the relative strengths of $|u_{ii}^1|$ and $|u_{ii}^2|$, decreasing $A$ will cause marginal incentive of region 1 to fall, and hence (potentially) be negative as $A \to 0$. At the same time, marginal incentive to region 2 will rise, and hence remain positive. We summarize our observations and the effect on tax-expenditure choice below.
Proposition 5.2 Suppose $|u^i_{ii}| > |u^j_{ii}|$, and $\frac{\partial T^i_1}{\partial a^i_1} < 0$ due to strong complementarity. Then as $A$ falls, $\frac{\partial T^i_1}{\partial a^i_1}$ falls (remains negative) and $\frac{\partial T^i_2}{\partial a^i_2}$ increases (may become positive) if $m^i_2$ is low. So region 2 will be rewarded for raising more taxes and region 1 will be punished. On the other hand, suppose $\frac{\partial T^i_1}{\partial a^i_1} > 0$ due to weak complementarity. Then, with decreasing $A$, $\frac{\partial T^i_1}{\partial a^i_1}$ falls and may become negative, while $\frac{\partial T^i_2}{\partial a^i_2}$ increases (remains positive). So region 2 will be rewarded for raising more taxes and region 1 will be punished.

5.1 Choice of Optimizing Variable

Politics may possibly create an asymmetry in marginal transfers. It is possible that locally produced public goods are substitutes. Further, we assume that $|u^i_{22}| < |u^j_{12}| < |u^j_{11}|$ and $A$ is low enough (or the degree of political favoritism is high enough). Then, looking back at lemma 4.1 and 4.2, as $\frac{\partial T^1_2}{\partial a^1_2} > 0$, region 1 can select an expenditure policy optimally (irrespective of action of region 2), and as $\frac{\partial T^1_1}{\partial a^1_1} < 0$, region 2 will stick to tax policy (irrespective of what region 1 does). If $|u^i_{22}| > |u^j_{12}| > |u^j_{11}|$ then $\frac{\partial T^1_2}{\partial a^1_2}$ remains negative and $\frac{\partial T^1_1}{\partial a^1_1}$ becomes positive. Hence region 1 sticks to tax optimization and region 2 may stick to expenditure optimization if the conditions listed on lemma 1 and 2 are satisfied. Finally, if $|u^j_{12}| > \max(|u^j_{22}|, |u^j_{11}|)$, both $\frac{\partial T^1_1}{\partial a^1_1}$ and $\frac{\partial T^1_2}{\partial a^1_2}$ are positive numbers with increasing political element in grants. If, again, the sufficient conditions are met, then both regions will choose an expenditure policy. This is summarized in the following proposition.

Proposition 5.3 (1) If the spillover between provinces are strong complementary in nature, political dispensation of grants may lead to expenditure optimization by region 1 and tax optimization by region 2, starting from an initial position of $\{tax, tax\}$.

(2) If the spillover between provinces are weak complementary in nature (initial condition of $\{expenditure, expenditure\}$), with increasing political dispensation, region 1 will stick to expenditure policy, while region 2 moves to tax policy.
The choice is altered if spillovers are substitute in nature (and does not show the "adding up" property). Then, if grant disposal is sufficiently politically motivated (in the sense that $A$ is sufficiently low), then a politically favorite region (say region $i$) may go for tax (expenditure) policy and a non-favorite region will go for expenditure (tax) policy depending on the strength of utility of cross border public good (that is $w_{ij}^1$). As a result, one may observe sudden change in behavior depending on $A$.

6 Conclusion

In this paper, we have attempted the following question: to what extent the tax-spending choice by the sub-national governments are influenced by politics? To answer it, we have constructed a model of a federation with two provinces and two political parties. Provinces produce public goods with (costly) own revenues and federal grants. Federal grants are partly discretionary and they arrive after the provinces raise their resources. The nature of such grants depend on provincial revenue through the nature of spillover of inter-provincial public good. Provinces can either raise the revenue first and provide the public good later (tax optimization) or they may provide the public good first and adjust the taxes residually (expenditure optimization). If a province alters its behavior from tax to expenditure maximization, the tax price of public good in the neighboring region changes, thus the incentive for providing the public good (or raising tax for it) also alters. If the federal grants are politically motivated to maximize votes, the responsiveness of federal grants vis-a-vis local taxation may change, depending on how politically motivated the grant is as well as the nature and strength of the spillover. Conditional on these two factors, a host of behavior can be predicted.

The analysis can be extended to other directions. One immediate response is to take the theory to data and test for the implications, and a robustness check with other types of grants and expenditure pattern as well.
Since grants and provincial performances are determined in a temporal fashion, it needs a proper dynamic analysis. Thus there exist avenues for future research.
Appendix A
The Political Framework

In a two party scenario, let party L be in power in centre as well as in province 1, while party R governs province 2. There is an election at the federal level. Each province chooses one representative to the centre. The party governing the centre determines the transfer in such a way that its own vote share is maximized from both provinces.

Voters in a province care for net relative utility (e.g. as in yardstick competition literature in Besley and Case, 1995). In province 1, a voter \( i \) will vote for the incumbent if and only if \( u^1_i \geq u^2 + \varepsilon_{1i} \). Here \( \varepsilon_{1i} \) is a random variable that captures the voter heterogeneity for voter \( i \) in province 1. Provincial governments are naive because they ignore the spillover as well as any political economy aspects of their action.

Here, the voter who is indifferent between choosing the incumbent or challenger is situated at \( \varepsilon^*_{1i} = u^1 - u^2 \). All voters with \( \varepsilon_{1i} \leq \varepsilon^*_{1i} \) will vote for the incumbent. Thus the proportion of votes for L in province 1 is given by \( \Theta_1(u^2 - u^1) \), where \( \Theta_1(.) \) is the cdf of the variable \( \varepsilon_{1i} \). We assume that The distribution \( \Theta_i \) is uniform and is symmetric around zero. In a similar fashion, in province 2, the proportion of votes for party L is \( 1 - \Theta_2(u^2 - u^1) = \Theta_2(u^2 - u^1) \).

Then the maximand of the federal government, partly Benthamite and partly vote share maximising, is

\[
\Lambda = u^1 + u^2 + \zeta(\Theta_1(u^2 - u^1) + \Theta_2(u^2 - u^1))
\]

which is to be maximized with respect to \( T_1 \). The F.O.C. of (9) is given by:

\[
u^1 - u^2 - u^2 + \zeta(\Theta'_1(u^1 - u^2 - u^2) + \zeta(\Theta'_2(u^1 - u^2 - u^2)) = 0
\]

\footnote{The section here follows Sengupta (2011). Alternate versions are also possible.}
Since the distribution function is assumed to be uniform, let \( \Phi'_i = m_i \) (a constant), and \( m = m_1 + m_2 \). Then, the above equation reduces to

\[
(1 + \zeta m) (u^1_1 - u^1_2) = (1 - \zeta m) (u^2_2 - u^2_1)
\]

or,

\[
u^1_1 - u^1_2 = A (u^2_2 - u^2_1)
\]

(10)

Here, \( A = \frac{1-\zeta m}{1+\zeta m} \) is a positive fraction, assuming that \( \zeta m < 1 \). If either \( m \) (voters are more responsive to utility difference) or \( \zeta \) (central government attached more importance to vote share) goes up, then the value of \( A \) goes down.

At the end, we get the result that federal government maximises a weighted sum of utilities, i.e. \( u^1 + Au^2 \).
References


