Interregional Redistribution as a Cure to the Soft Budget Syndrome in Federations

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Abstract: The soft budget syndrome is ubiquitous in federations. It emerges whenever a high tier in a fiscal system provides extra resources to a lower tier to prevent the latter from failing to reach a mutually agreeable predetermined target. Interregional income redistribution is also an endemic feature of most federations. We show that the center's ability of making interregional transfers ex-ante and ex-post cures the soft budget syndrome whenever the center is perfectly informed ex post. Under these circumstances, the interregional transfer scheme makes it a dominant strategy for each regional government to truthfully reveal its privately held information ex-ante.

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1. Introduction

The soft budget syndrome is ubiquitous in hierarchical fiscal systems.[1] The syndrome emerges whenever a high tier in the fiscal system provides extra resources to a lower tier to prevent the latter from failing to reach a mutually agreeable predetermined target. A common example is the situation in which a central government provides a regional government with a grant to undertake a highly desirable regional infrastructure project whose cost had been understated by the privately informed regional government. The initial grant, being insufficient to cover the total realized cost of the project, would have to be supplemented in the future in order to complete the project. The center, facing the dire problem of whether or not to provide an additional grant to complete the project, would decide to supplement the initial grant whenever completion yields a net social gain relative to failure. The higher the chance of the center providing an additional grant ex-post, the higher will be the incentive of the privately informed regional government to understate cost ex-ante.

The soft budget literature informs us that the main cause of the syndrome is the inability of the sponsor of making dynamic commitments (see, e.g., Dewatripont and Makin (1995), Kornai, Maskin and Roland (2003) and Maskin (1996)). In terms of our example above, were the center – i.e., the sponsor – able to credibly state that it would not provide an additional grant ex-post, the regional government would not gain from understating cost ex-ante. It should also be clear that the syndrome materializes only if there is verifiable project differentiation ex-post, with some projects being verifiably more successful than others. If all projects fail equally and there is no differentiation ex-

[1] Kornai (1979, 1980, 1986) is the father of the soft budget literature. See Qian and Roland (1988) and Wildasin (1997) for applications of the soft budget problem to fiscal systems.

post, there will be no margin for a regional government to understate cost ex-ante. Thus, in the settings examined in the soft budget literature the sponsor faces uncertainty ex-ante with respect to the type of agent it is dealing but verifiable type differentiation ex-post.

The sponsor's inability of making dynamic commitments is also the key issue in the rotten kids' literature (see, e.g., Becker (1981), Bergstrom (1989) and Cornes and Silva (1999)). Within the context of a family, a loving parent – i.e., the sponsor – is unable to implement incentive schemes to motivate his/her kids to be well behaved because of his/her unconditional love for the kids. The kids know how much they are loved by their parent and thus also know that punishment threats voiced by their parent to induce them to carry out activities in accordance with their parent's wishes are not credible. The kids are rotten because they are selfish, they only care about themselves. The parent, however, may have at his/her disposal a powerful instrument to induce the kids to be well behaved – the parent is able to redistribute family income. Knowing that their parent will redistribute family income after he or she observes their actions, the selfish kids may be inclined to behave as the parent wishes them to behave. They will do so whenever the material gain to be had outweighs the cost of deviating from their selfish actions.

The inability of the sponsor of making dynamic commitments, being the common aspect of the soft budget and rotten kid literatures, is the main driving force behind this paper. The ubiquity of the soft budget problem is equally matched by the ubiquity of income redistribution in fiscal systems. Most federations, if not all the currently existing ones, are built upon the premise that their residents should have equal opportunities and be equally serviced by the public sector in spite of their residential locations. Such egalitarian objectives are clearly spelled out in the constitutions of the United States, European Union, Canada, Australia, Brazil, to name just a few countries, and provide the underpinnings for the sizeable interregional transfers that occur in these federations. By considering the central government as an egalitarian parent who cares about the welfare of the regional governments, its kids, the framework of the rotten kids' literature is readily applicable to federations.

In this paper, we marry the two branches of literature described above by examining a setting in which the center does not attempt to credibly commit to an incentive scheme, the regional governments are privately informed ex-ante about their inherent unit costs of producing a homogeneous regional public good, the center is perfectly informed about the privately held pieces of information ex-post and the center is able to make interregional transfers, both ex-ante and ex-post. Our main contribution is to show that the center's ability of making interregional transfers ex-ante and ex-post completely eliminates the soft budget problem, since the regional governments find it desirable to truthfully reveal their cost types ex-ante. To effectively make this message clear, we proceed in easy steps. First, we consider a centralized fiscal system in which the role played by the regional governments is restricted to production of the regional public good. We show that the allocation of resources in this case corresponds to the full information social optimum. Then, we modify this model by allowing the regions to levy taxes and choose their own regional public projects subject to the center's ability of promoting interregional transfers after it observes the choices made by the regional governments. We demonstrate that the equilibrium for such a "decentralized leadership" game also corresponds to the full information social optimum. Later, we show that by keeping the original model intact, except for denying the center the ability of promoting interregional income transfers, the incentives faced by the regional governments change. Their best strategies are to understate their unit cost reports in order to produce regional public projects whose sizes are larger than socially desirable. The center responds by providing them with additional resources to complete their projects. In other words, the regional budgets become "soft" in equilibrium. Thus, we show that it is the inability of the center of making income redistribution the reason for the soft budget syndrome.

The fact that the sponsor is unable to make dynamic commitment denies it the ability of designing a revelation mechanism to elicit the pieces of privately held information. Thus, a direct comparison between our framework and the commonly advanced framework in the mechanism design literature is inappropriate. However, there is an important comparison that can be made. Riley (1988), Riordan and Sappington (1988) and Strauz (2005) demonstrate that the availability of more accurate ex-post information about a privately informed agent enables the principal to reduce the informational rent earned by the agent. In fact, Riordan and Sappington (1988) and Strauz (2005) provide us with conditions under which there is complete informational rent elimination. In such cases, the principal is able to implement the first best allocation. Thus, the common ground covered between our paper and Riordan and Sappington (1988) and Strauz (2005) is the resulting outcome from availability of more accurate ex-post information. Although the principal or sponsor is able to commit to an incentive scheme in the mechanism design literature but not in the current setting, the principal's most desirable allocation is implementable in each case whenever the principal is sufficiently informed ex-post about the ex-ante privately held pieces of information.

Our paper contributes to two strands of literature, soft budget and rotten kids. Our contribution to the soft budget literature is to demonstrate that income redistribution may solve the soft budget syndrome. Our contribution to the rotten kids' literature is to show that the rotten kids' theorem can be extended to situations in which there is privately held information.[2]

2. Interregional Redistribution

Consider a nation that contains J ≥ 2 regions. In this nation, there is a fiscal system consisting of a central government, which we shall call "center" henceforth, and J regional governments, indexed by j, j = 1,…,J. We shall initially examine a setting in which the fiscal system is highly centralized. Tax policy, tax collection and the quantities of regional public goods are all decided by the center. The center, however, delegates production of regional public goods to regional governments. This is the sole role played by the regional governments.

There are possibly two types of goods in the economy, one private and the other regionally public. The regional public goods are homogeneous. The consumption benefits derived from a regional public good are confined to residents of the particular region in which the good is provided. There are no spillovers. The center collects units of the private good from every national resident (citizen) in order to finance the provision of the regional public goods. The amount of per capita tax collected will be equal to the sum of costs of producing all regional public goods.

The center knows that the per unit cost of producing the regional public good in region j, c_j, cannot be smaller than $c_L > 0$ or larger than $c_H > c_L$, that is, $c_j \in [c_L, c_H]$.

[2] The following statement is enough evidence: "It is worth noticing, but not very surprising, that the Rotten Kid Theorem fails to apply when there is asymmetric information." Bergstrom (1989), p. 1040.

Regional government j, however, is privately informed ex-ante about its true unit cost of production. As it is customary in the soft budget literature, we assume that the true state of nature, $\mathbf{c} = (c_1, ..., c_J)$, will become common knowledge ex-post, after the regional production processes start. The center receives signals that accurately inform it about the regional unit costs of production.

We assume that the center cannot elicit privately held information ex-ante because it is unable to make dynamically credible commitments. As we discussed in the Introduction, this assumption is in accordance with both the soft budget and rotten kid literatures.

Regional government j can produce g_j units of the regional public good at a true total cost of $c_j g_j$. The realized total cost is unverifiable ex-ante, but verifiable ex-post. Henceforward, we shall refer to the quantity of the regional public good as the "size of the regional public project." To keep things simple, we assume that it is prohibitively costly to modify the size of a regional public project once it has been initiated.[3] In case of deficit, the options open to the center ex-post will be either to shut down the project or supply additional funds to complete it. If the project is shut down, the cost expended in it will be sunk. In case of surplus, the options open to the center will be either to extract the surplus or inaction.

The center and regional governments play a three-stage game. The first two stages of the game occur prior to the center becoming fully informed about the true state of

[3] This assumption simplifies our analysis but it is not restrictive in the sense that if we relaxed it, allowing the sizes of the public projects to be adjustable ex-post, the incentives of the regional governments to cheat or not to cheat would remain unaltered. A formal proof of this claim can be obtained from the authors upon request.

nature. The third stage occurs when the center becomes fully informed. For expositional purposes, it will be convenient to separate the game in two periods, ex-ante and ex-post.

Ex-ante, the center plays a two-stage game with the regional governments. In the first stage, each regional government reports its unit cost to the center, taking the reports submitted by the other regional governments as given. The vector of unit-cost reports sent by the regional governments to the center shall be denoted $\hat{\mathbf{c}} = (\hat{c}_1,...,\hat{c}_J)$. Each regional government chooses the report which maximizes its objective function fully anticipating the reactions of the center in the subsequent stages. In the second stage, the center observes the regional-cost reports and chooses the sizes of the regional public projects in order to maximize its objective function subject to the budget balance condition. In doing so, the center essentially believes that the regional governments report their true unit costs and thus there will not be necessary to adjust regional costs in the future. The vector of project sizes chosen by the center is $\hat{\mathbf{g}}(\hat{\mathbf{c}}) = (\hat{g}_1(\hat{c}_1),...,\hat{g}_J(\hat{c}_J))$. The center then delegates authority to the regional governments to produce the regional projects at these sizes. Consistent with their reports, the regional governments receive grants from the center in amounts equal to the total costs of production, $\hat{C}_j = \hat{c}_j\hat{g}_j$, j = 1,…,J, to carry out the production processes.

In possession of funds to undertake their delegated activities, the regional governments start their production processes. As we mentioned above, the true technological parameters become common knowledge sometime after the commencement of production activities. The ex-post problem to be solved by the center becomes perfectly clear at this very moment. If the regional governments reported their inherent unit costs truthfully, consistently with the center's beliefs in the second stage, there is nothing else to be done. Production processes will continue to fruition and realized costs will be equal to the ex-ante grant amounts dispensed by the center. However, if any regional government does not report its inherent unit cost truthfully, then either it will be able to complete the project at a realized cost smaller than the ex-ante grant amount provided by the center or it will be unable to complete the planned project with the initial grant. The center will then decide whether or not the initial total cost should be adjusted.

Ex-ante, the center collects $\hat{t}^a > 0$ units of private good from every citizen to finance the provision of the J regional public projects. There are $N > 0$ citizens. Since the grant amount given to region j is $\hat{C}_j$, the center's ex-ante budget balance condition is

$$N\hat{t}^a = \sum_{j=1}^{J} \hat{C}_j. \tag{1}$$

In addition to the uniform per capita tax instrument, the center has an instrument to promote interregional income transfers. Even though the uniform per capita tax instrument will ensure that the regional public projects are fully financed, the sizes of the regional public project will generally differ across regions. Hence, an instrument to promote interregional income transfers becomes essential to the center if it wishes to treat equals equally ex-ante in what respects the planned utility level for each citizen, irrespective of his or her region of residence.

There are $n_j > 0$ identical residents in region j. Since the nation's population is N, we have $\sum_{j=1}^{J} n_j = N$. Let $\hat{\tau}_j^a$ be the ex-ante income transfer received (if positive) or paid (if negative) by the representative resident of region j. Since these transfers are redistributive, $\sum_{j=1}^{J} n_j \hat{\tau}_j^a = 0$. The center can also transfer income from one region to another ex-post. Let τ_j^p be the ex-post income transfer received (if positive) or paid (if negative) by the representative resident of region j. Again, redistribution requires that $\sum_{j=1}^{J} n_j \tau_j^p = 0$.

To establish the center's ex-post budget balance condition, we first need to examine regional cost adjustments, if they occur. If, in its cost report, regional government j understates its inherent unit cost, $\hat{c}_j < c_j$, its ex-post total cost net of the grant received from the center will be either zero, if the center decides to shut down the project, or the following amount if the center decides to provide an additional grant to complete the project:

$$\Delta C_j \equiv C_j - \hat{C}_j \equiv c_j \hat{g}_j\left(\hat{c}_j\right) - \hat{c}_j \hat{g}_j\left(\hat{c}_j\right) = \left(c_j - \hat{c}_j\right) \hat{g}_j\left(\hat{c}_j\right) > 0. \tag{2}$$

Note that since the size of the public good project is fixed ex-post, the realized total cost of production in region j is $C_j \equiv c_j \hat{g}_j\left(\hat{c}_j\right)$. It should also be clear that if regional government j overstates its true unit cost in its report to the center, $\hat{c}_j > c_j$ and thus $\Delta C_j < 0$. In this case, it is the regional government that reimburses the center for the excess grant received.

We can now express the center's ex-post budget balance condition as follows:

$$Nt^p = \sum_{j=1}^{J} \pi_j \Delta C_j, \tag{3}$$

where t^p is the ex-post per capita tax and $\pi_j \in \{0,1\}$, j = 1,…,J, are indicator functions, which inform us about the center's decision of whether or not to adjust regional costs ex-post. If no adjustment is desirable, we have $\pi_{\rm j} = 0$ for all j. If $\Delta C_{\rm j} \neq 0$ for some j, and the center finds it desirable to adjust this region's cost of production, then $\pi_{\rm j} = 1$. Note that the ex-post per capita tax can be positive, negative or zero.

The utility function for the representative resident of region j is assumed to be quasilinear, $u\left(x_{\rm j}, g_{\rm j}\right) = x_{\rm j} + v\left(g_{\rm j}\right)$, where $x_{\rm j}$ represents the quantity of private good consumed by this individual and the subutility $v(\cdot)$, which measures this individual's benefit from consuming $g_{\rm j}$ units of the regional public project, is assumed to be increasing, strictly concave and to satisfy the following Inada condition, $v' \to \infty$ as $g_{\rm j} \to 0$. This individual is initially endowed with $I_{\rm j} > 0$ units of the private good.

In order to emphasize the implications associated with regional differences in the per unit costs of production of the regional public project, we shall assume henceforth that $n_{\rm j} = n$ and $I_{\rm j} = I$, j = 1,…,J. This assumption implies that the constraints the center faces with respect to its ex-ante and ex-post redistribution policies become $\sum_{\rm j=1}^{\rm J} \hat{\tau}_{\rm j}^{a} = 0$ and $\sum_{\rm j=1}^{\rm J} \tau_{\rm j}^{p} = 0,$ respectively.

Since the center has the ability to tax and transfer income ex-ante and ex-post and the taxes and transfers are borne by each citizen, each resident of region j faces the following budget constraint:

$$x_{\rm j} + \hat{t}^{a} + t^{p} = I + \hat{\tau}_{\rm j}^{a} + \tau_{\rm j}^{p}, \;\; {\rm j} = 1, \ldots, {\rm J}. \tag{4}$$

Each regional government's objective function is the utility of its representative resident. The center cares about efficiency and interregional equity. Its objective function corresponds to our notion of social welfare in this paper: $W\left(u_1,...,u_J\right) \equiv \sum_{j=1}^{J} \phi\left(u_j\right)$, where $\phi' > 0,\ \phi'' < 0,\ \phi' \to \infty$ as $u_j \to 0$.

Following the center's decision of whether or not to adjust regional costs, all the subsequent fiscal transactions take place and each regional public project is either completed or shut down. Since these fiscal actions determine the final allocation of private and public goods for each citizen, they also determine each individual's ex-post utility level.

2.1. The Center's Ex-Post Problem

Suppose that the center decides to adjust a region's production cost ex-post whenever the reported unit cost differs from the true unit cost. Later, we will demonstrate that this decision rule is indeed socially optimal. Thus, $\pi_j = 1$ whenever $\Delta C_j \neq 0$. Since $\Delta C_k = 0$, whenever $\hat{c}_k = c_k$, for any k = 1,…,J, there is no harm in concluding that the ex-post budget balance condition can be written as follows:

$$Nt^p = \sum_{j=1}^{J} \Delta C_j \ . \tag{5}$$

As we shall demonstrate below, the solution to the center's ex-ante problem yields equal utilities within and across regions. The ex-ante redistribution mechanism satisfies horizontal equity. Let $\hat{u}\left(\hat{\mathbf{c}}\right)$ denote the per capita utility level implied by the ex-ante two-stage game. Then, given the interregional income transfer and the per capita uniform tax following the center's decision rule (5), the ex-post per capita utility level in region j is $\hat{u}(\hat{\mathbf{c}})+\tau_{\mathrm{j}}^{p}-(1/N)\sum_{\mathrm{k}=1}^{\mathrm{J}}\Delta C_{\mathrm{k}}$. The problem for the center is to choose $\{\tau_{1}^{p},...,\tau_{\mathrm{J}}^{p}\}$ to maximize

$$\sum_{\mathrm{j}=1}^{\mathrm{J}}\phi\left(\hat{u}(\hat{\mathbf{c}})+\tau_{\mathrm{j}}^{p}-(1/N)\sum_{\mathrm{k}=1}^{\mathrm{J}}\Delta C_{\mathrm{k}}\right). \tag{6}$$

subject to $\sum_{\mathrm{j}=1}^{\mathrm{J}}\tau_{\mathrm{j}}^{p}=0$. The solution is given by

$$\tau_{\mathrm{j}}^{p}=0,\quad \forall \mathrm{j}. \tag{7}$$

The center's most preferred allocation ex-post is the one which yields equal individual utilities across regions – i.e., horizontal equity. Since the center's most preferred allocation ex-ante is also characterized by horizontal equity and since the center's uniform tax ex-post taxes all individuals equally, there is no need to promote interregional income transfers in order to obtain horizontal equity ex-post. This provides the rationale underlying equations (7). Note also that, by inserting equations (7) into the objective function (6), the center's indirect utility can be written as follows:

$$W\left(u_{1}(\hat{\mathbf{c}};\mathbf{c}),...,u_{\mathrm{J}}(\hat{\mathbf{c}};\mathbf{c})\right)=W\left(u(\hat{\mathbf{c}};\mathbf{c}),...,u(\hat{\mathbf{c}};\mathbf{c})\right)=J\phi\left(\hat{u}(\hat{\mathbf{c}})-(1/N)\sum_{\mathrm{j}=1}^{\mathrm{J}}\Delta C_{\mathrm{j}}\right). \tag{8}$$

Equations (8) make it clear that, contingent on regional unit-cost reports, maximization of social welfare is equivalent to maximization of per capita utility.

2.2 The Ex-Ante Two-Stage Game

Consider the second stage of the two-stage subgame played ex-ante. Having observed $\hat{\mathbf{c}}=(\hat{c}_{1},...,\hat{c}_{\mathrm{J}})$ and believing that $\Delta C_{\mathrm{j}}=0$, j = 1,…,J, the center chooses $\{\hat{t}^{a},\hat{\tau}_{\mathrm{j}}^{a},\hat{g}_{\mathrm{j}}\}_{\mathrm{j}=1,...,\mathrm{J}}$ to maximize:

$$\sum_{j=1}^{J}\phi\left(\hat{x}_j+v\left(\hat{g}_j\right)\right) \tag{9}$$

subject to the ex-ante budget balance condition (1), $\sum_{j=1}^{J}\hat{\tau}_j^a=0$ and

$$\hat{x}_j=I+\hat{\tau}_j^a-\hat{t}^a\geq 0,\ \ \forall j\,, \tag{10a}$$

$$\hat{g}_j\geq 0,\ \ \forall j. \tag{10b}$$

Assume that I is sufficiently large so that in the solution to the center's problem above we have $\hat{x}_j>0$, j = 1,…,J.[4] Given our assumptions for $v(\cdot)$, we are also assured that $\hat{g}_j>0$, j = 1,,,,,J, in the solution to the center's problem. Since $\phi(\cdot)$ is increasing, strictly concave and satisfies the Inada condition, the center's objective function is strictly concave, the solution to the center's problem is globally unique and the information-constrained social optimum is characterized by strictly positive levels of individual utility.

Let us now derive the information-constrained, socially-optimal, allocation. Use equation (1) to solve for $\hat{t}^a$ and plug the implied per capita tax into the center's objective function (9). Using (10a), the center's objective function becomes:

$$\sum_{j=1}^{J}\phi\left(I+v\left(\hat{g}_j\right)+\hat{\tau}_j^a-\left(1/N\right)\sum_{k=1}^{J}\hat{c}_k\hat{g}_k\right). \tag{11}$$

Maximizing (11) with respect to $\left\{\hat{\tau}_j^a,\hat{g}_j\right\}_{j=1,\dots,J}$ subject to $\sum_{j=1}^{J}\hat{\tau}_j^a=0$ yields

$$\phi'\left(\hat{u}_j\right)=\lambda,\ \forall j\ \Rightarrow\ \hat{u}_k=\hat{u}_1,\ k=2,\dots,J,\ \Rightarrow\ \hat{\tau}_i^a=\left(1/J\right)\left[\sum_{j=1}^{J}v\left(\hat{g}_j\right)-Jv\left(\hat{g}_i\right)\right],\ i=1,\dots,J, \tag{12a}$$

$$nv'\left(\hat{g}_j\right)=\hat{c}_j,\ \ j=1,\dots,J, \tag{12b}$$

[4] All allocations examined in this paper feature strictly positive consumption levels of private good if $I>v\left(g\left(c_L\right)\right)$ such that $g\left(c_L\right)$ is the solution to $nv'\left(g\left(c_L\right)\right)=c_L$.

where $\lambda > 0$ is the Lagrangian multiplier associated with the constraint.

The first set of J equations in (12a) state that it is socially optimal to equate marginal social utilities across regions. Since $\phi'' < 0$, these equations imply that the utilities of the representative residents should be equalized; hence, as we mentioned above, the solution satisfies horizontal equity. The second set of J equations in (12a) immediately implies the third set of J equations in (12a). To equalize individual utilities across regions, the interregional transfer received (or paid) by each region should be equal to the average of the benefits from consumption of regional public projects in the nation minus the benefit from consumption of the regional public project produced in that particular region.

Equations (12b) are the information-constrained Samuelson conditions for optimal provision of the regional public projects. Each condition states that the optimal size of a region's public project is determined by equating the sum of the marginal benefits from consumption of the regional public project to the reported regional marginal cost of production. Note that the size of the public project in a region is a function of that region's unit cost report, but not of any other region's unit cost report. From equations (12b) we obtain the regional public project demands, $\hat{g}_j\left(\hat{c}_j\right)$, for all j. It follows that $\hat{g}_j'\left(\hat{c}_j\right) = \left[nv''\left(\hat{g}_j\right)\right]^{-1} < 0$, for all j.

The per capita utility level implied by the solution to the center's problem above can be written as follows:

$$\hat{u}_j\left(\hat{\mathbf{c}}\right) = \hat{u}\left(\hat{\mathbf{c}}\right) = I + \left(1/N\right)\sum_{j=1}^{J}\left[nv\left(\hat{g}_j\left(\hat{c}_j\right)\right) - \hat{c}_j\hat{g}_j\left(\hat{c}_j\right)\right], \quad \forall j. \tag{13}$$

Thus, contingent on the regional cost reports, the last equation in (13) provides us with the ex-ante socially optimal per capita utility level.

Consider now the first stage of the subgame played ex-ante. Each regional government knowing that the ex-ante per capita utility level will be given by the last equation in (13) also knows that the ex-post per capita utility level will be given by

$$u(\hat{\mathbf{c}};\mathbf{c}) = \hat{u}(\hat{\mathbf{c}}) - (1/N)\sum_{\mathrm{j}=1}^{\mathrm{J}} \Delta C_{\mathrm{j}} = I + (1/N)\sum_{\mathrm{j}=1}^{\mathrm{J}}\left[nv\left(\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right) - c_{\mathrm{j}}\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right]. \tag{14}$$

Regional government j knows that if it sends a false unit-cost report, $\hat{c}_{\mathrm{j}} \neq c_{\mathrm{j}},\ \Delta C_{\mathrm{j}} \neq 0$ ex-post. It also knows that the center will either provide additional funds to the regional government in order to complete the public project in case of deficit or take funds away from the regional government in case of surplus. Hence, regional government j chooses $\hat{c}_{\mathrm{j}} \in [c_{\mathrm{L}}, c_{\mathrm{H}}]$ to maximize $x_{\mathrm{j}} + v\left(\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right)$ subject to the budget constraint faced by its representative resident, equation (4). This budget constraint can be rewritten as follows, for j, k = 1,2 and j $\neq$ k:

$$x_{\mathrm{j}} = \hat{x}_{\mathrm{j}} - t^{p} = I + (1/J)\sum_{\mathrm{k}=1}^{\mathrm{J}} v\left(\hat{g}_{\mathrm{k}}\left(\hat{c}_{\mathrm{k}}\right)\right) - v\left(\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right) - (1/Jn)\sum_{\mathrm{k}=1}^{\mathrm{J}}\left(\hat{C}_{\mathrm{k}} + \Delta C_{\mathrm{k}}\right)$$

or

$$x_{\mathrm{j}} = I + (1/J)\sum_{\mathrm{k}=1}^{\mathrm{J}} v\left(\hat{g}_{\mathrm{k}}\left(\hat{c}_{\mathrm{k}}\right)\right) - v\left(\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right) - (1/Jn)\sum_{\mathrm{k}=1}^{\mathrm{J}} C_{\mathrm{k}}. \tag{15}$$

Substituting equation (15) into the regional government's objective function, we obtain:

$$I + (1/N)\left[nv\left(\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right) - c_{\mathrm{j}}\hat{g}_{\mathrm{j}}\left(\hat{c}_{\mathrm{j}}\right)\right] + (1/N)\sum_{\mathrm{k}\neq\mathrm{j}}^{\mathrm{J}}\left[nv\left(\hat{g}_{\mathrm{k}}\left(\hat{c}_{\mathrm{k}}\right)\right) - c_{\mathrm{k}}\hat{g}_{\mathrm{k}}\left(\hat{c}_{\mathrm{k}}\right)\right], \tag{16}$$

since $Jn = N$ and $C_{\mathrm{i}} \equiv c_{\mathrm{i}}\hat{g}_{\mathrm{i}}\left(\hat{c}_{\mathrm{i}}\right),\ \mathrm{i} = 1,...,\mathrm{J}$. Note that the objection function for regional government j, expression (16), corresponds exactly to the ex-post per capita utility level to be determined by the center, equation (14). Taking the choices of all other regional governments as given, the function that regional government j wants to maximize by choosing c_j is exactly the same that the center would want to maximize under the same circumstances. Thus, independently of the choices made by any other regional government, regional government j's best strategy is to report its unit cost truthfully to the center. In other words, truth telling is a dominant strategy for regional government j. Since this line of reasoning is applicable to every other region, the dominant strategy Nash equilibrium in the first stage is $(\hat{c}_1,...,\hat{c}_J) = (c_1,...,c_J)$.

Because the regional governments report their unit costs truthfully in the first stage, the center's beliefs in the second stage are confirmed in equilibrium and its most preferred allocation corresponds to the full information social optimum. Although there is no cost adjustment ex-post, the center's decision to adjust cost whenever necessary is socially optimal since the center cares about equity. If one region were to misinform the center about its true unit cost, the cost adjustment would then bring every region to the same level of utility ex-post. Hence, the center's decision to adjust costs ex-post makes each region realize that it will not benefit from lying about its inherent unit cost. The following proposition summarizes the results of the analysis so far:

Proposition 1: The equilibrium allocation for the game played by regional and central governments in which regional governments are privately informed ex-ante but the center is perfectly informed ex-post in the context of a centralized fiscal system, as described above, corresponds to the full information social optimum.

2.3. Decentralized Leadership

Suppose now that each regional government can collect taxes from its regional residents to finance the cost of providing the public project. Suppose also that each regional government can choose the size of its public project. The center's role is limited to the choices of interregional income transfers, both ex-ante and ex-post.

As we observed above, the size of the regional public project is a function of the region's reported unit cost. Hence, if a regional government reports its unit cost as before, the center will immediately be able to calculate the size of the regional project the region intends to produce. Since we assume that it is prohibitively expensive to adjust the size of the regional public project after the commencement of production and since the ex-post allocation of regional utility levels depends on the sizes of regional projects, the center may be eager to promote interregional transfers ex-ante.

Consider the problem faced by the center ex-post. Suppose that it makes interregional transfers ex-ante and that regional cost adjustments are entirely borne by the regions. The regional governments are able to capture potential cost savings or to cover potential cost increases through their regional tax mechanisms. The center does not directly interfere with these regional fiscal actions.

Let $\hat{u}(\hat{\mathbf{c}}) + \tau_{\mathrm{j}}^{p} - \Delta C_{\mathrm{j}}/n$ be the ex-post utility of any resident of region j. The center chooses $\{\tau_1^p, \ldots, \tau_{\mathrm{J}}^p\}$ to maximize $\sum_{\mathrm{j}=1}^{\mathrm{J}} \phi\left(\hat{u}(\hat{\mathbf{c}}) + \tau_{\mathrm{j}}^{p} - \Delta C_{\mathrm{j}}/n\right)$ subject to $\sum_{\mathrm{j}=1}^{\mathrm{J}} \tau_{\mathrm{j}}^{p} = 0.$

The first order conditions are:

$$\phi'\left(\hat{u}(\hat{\mathbf{c}}) + \tau_{\mathrm{j}}^{p} - \Delta C_{\mathrm{j}}/n\right) = \lambda^{p} > 0,\ \forall \mathrm{j},\ \Rightarrow\ \tau_{\mathrm{j}}^{p} = (1/Jn)\left[J\Delta C_{\mathrm{j}} - \sum_{\mathrm{k}=1}^{\mathrm{J}} \Delta C_{\mathrm{k}}\right],\ \forall \mathrm{j}, \qquad (17)$$

where λ^p is the Lagrangian multiplier associated with the ex-post interregional redistribution constraint. The first set of J equations in (17) state that the center implements interregional transfers in order to equate marginal social utilities of income across regions. As before, these conditions imply that we obtain horizontal equity ex-post. The second set of J equations in (17) follows immediately from horizontal equity. They make it clear that the interregional transfers will effectively make the regions share their cost reductions or increases.

Now, consider the problem faced by the center ex-ante. Having observed the first-stage reports, $(\hat{c}_1,...,\hat{c}_J)$, the center deduces the corresponding vectors of project sizes and production costs, $(\hat{g}_1,...,\hat{g}_J)$ and $(\hat{C}_1,...,\hat{C}_J)$, respectively. Believing that $\Delta C_j = 0, \forall j$, the center chooses $\{\hat{\tau}_1^a,...,\hat{\tau}_J^a\}$ to maximize $\sum_{j=1}^{J}\phi\left(I+\hat{\tau}_j^a+v(\hat{g}_j)-\hat{C}_j/n\right)$ subject to $\sum_{j=1}^{J}\hat{\tau}_j^a=0$. Letting λ^a denote the Lagrangian multiplier associated with the ex-ante interregional redistribution constraint, the first order conditions are:

$$\phi'(\hat{u}_j)=\lambda^a>0,\ \forall j,\ \Rightarrow\ \hat{\tau}_j^a=(1/J)\left[\sum_{k=1}^{J}\left(v(\hat{g}_k)-\hat{C}_k/n\right)-J\left(v(\hat{g}_j)-\hat{C}_j/n\right)\right],\ \forall j. \quad (18)$$

Thus, the per capita transfer received or paid by region j equals society's average per capital net benefit from consumption of regional public projects minus the net per capita benefit from consumption of the public project in that region.

In the first stage, each regional government chooses its unit cost report and the size of its regional project taking the choices of all other regional governments as given but fully anticipating the center's ex-ante and ex-post redistribution policies. Regional government j wishes to maximize $I+\hat{\tau}_{\mathrm{j}}^{a}+\tau_{\mathrm{j}}^{p}+v(\hat{g}_{\mathrm{j}})-\hat{C}_{\mathrm{j}}/n$. This function becomes $I+(1/J)\left(v(\hat{g}_{\mathrm{j}})-c_{\mathrm{j}}\hat{g}_{\mathrm{j}}/n\right)+(1/J)\sum_{\mathrm{k}\neq\mathrm{j}}^{\mathrm{J}}\left(v(\hat{g}_{\mathrm{k}})-c_{\mathrm{k}}\hat{g}_{\mathrm{k}}/n\right)$ after we plug the optimal transfers given in equations (17) and (18) into it. Thus, again, taking the choices of all other regions as given, the regional government's objective coincides perfectly with the center's objective under similar circumstances – i.e., if the center is in possession of region j's piece of private information and does not know the other region's pieces of private information. It follows that the dominant strategy Nash equilibrium in the first stage is characterized by $(\hat{\mathbf{c}},\hat{\mathbf{g}}(\hat{\mathbf{c}}))=(\mathbf{c},\mathbf{g}(\mathbf{c}))$, where the entries of the vector $\hat{\mathbf{g}}(\hat{\mathbf{c}})$ are the solutions to the Samuelson conditions (12b).

The results of this section are gathered in the following proposition:

Proposition 2. The equilibrium for the decentralized leadership game described in this section corresponds to the full information social optimum.

We conclude that the centralized fiscal system analyzed in the previous section can be almost completely decentralized. The center can delegate authority to regional governments to levy and collect taxes to finance public projects and to choose the sizes of such projects. Provided that the center retains the instrument to make interregional transfers ex-ante and ex-post, the allocation of resources in the economy will be socially optimal.

3. The Soft Budget Syndrome

We now show that the centralized fiscal system suffers from a soft budget syndrome in the absence of interregional redistribution. Thus, the interregional redistribution instrument gives the center the ability of curing the fiscal system from such a syndrome.

Let us again consider the original model. But, suppose now that $\hat{\tau}_{\mathrm{j}}^{a}=\tau_{\mathrm{j}}^{p}=0,\ \forall \mathrm{j}$. To simplify exposition, let J = 2, $c_1 > c_2 = c_{\mathrm{L}}$. Assume that the unit cost in region 2 is common knowledge. Regional government 1 sends a report $\hat{c}_1 \in [c_{\mathrm{L}}, c_H]$ to the center in the first stage of the game, as before. Assume that the center will adjust the production cost for region 1 ex-post if $\hat{c}_1 \neq c_1$. Thus, it follows that $\hat{u}_{\mathrm{j}}(\hat{\mathbf{c}}) - (1/N)\Delta C_1$ will be the ex-post level of utility for the representative resident of region j, j = 1,2. Unlike before, there will no longer be horizontal equity ex-ante in general. The ex-ante uniform tax collected by the center to grant the regional governments with funds to produce the regional public projects will necessarily equate private good levels across regions, but the ex-ante regional utility levels will differ whenever the size of the regional public project varies across regions.

Having observed $\hat{c}_1$ and ignoring the possible ex-post cost adjustment, the center in the second stage chooses $\{\hat{t}^a, \hat{g}_1, \hat{g}_2\}$ to maximize $\sum_{\mathrm{j}=1}^{2}\phi(\hat{u}_{\mathrm{j}}) = \sum_{\mathrm{j}=1}^{2}\phi(\hat{x}_{\mathrm{j}} + v(\hat{g}_{\mathrm{j}}))$ subject to the ex-ante budget balance condition (1), $\hat{x}_{\mathrm{j}} = I - \hat{t}^a \geq 0$ and $\hat{g}_{\mathrm{j}} \geq 0$, j = 1,2. Assuming, as before, that I is sufficiently large to ensure strictly positive consumption of the private good in the solution to the center's problem, we can neglect the non-negativity constraints. Note that the solution to the center's problem now necessarily satisfies:

$$\hat{x}_{\mathrm{j}} = I - (\hat{c}_1\hat{g}_1 + c_{\mathrm{L}}\hat{g}_2)/2n,\ \ \mathrm{j}=1,2. \tag{19}$$

Given equations (19), the center's problem becomes the choice of $\{\hat{g}_1, \hat{g}_2\}$ to maximize:

$$\hat{W}(\hat{g}_1, \hat{g}_2) = \sum_{\mathrm{j}=1}^{2}\phi(\hat{u}_{\mathrm{j}}(\hat{g}_1, \hat{g}_2)) = \sum_{\mathrm{j}=1}^{2}\phi\left(I + v(\hat{g}_{\mathrm{j}}) - (\hat{c}_1\hat{g}_1 + c_{\mathrm{L}}\hat{g}_2)/2n\right). \tag{20}$$

The first order conditions are as follows, for j,k = 1,2, j ≠ k:

$$\hat{W}_1 = \phi'(\hat{u}_1)\left[v'(\hat{g}_1) - \hat{c}_1/2n\right] - \phi'(\hat{u}_2)\left[\hat{c}_1/2n\right] = 0, \;\Rightarrow\; nv'(\hat{g}_1)\sigma_1(\hat{g}_1,\hat{g}_2) = \hat{c}_1, \qquad (21a)$$

$$\hat{W}_2 = \phi'(\hat{u}_2)\left[v'(\hat{g}_2) - c_L/2n\right] - \phi'(\hat{u}_1)\left[c_L/2n\right] = 0, \;\Rightarrow\; nv'(\hat{g}_2)\sigma_2(\hat{g}_1,\hat{g}_2) = c_L, \qquad (21b)$$

where $\sigma_j(\hat{g}_1,\hat{g}_2) \equiv 2\phi'(\hat{u}_j(\hat{g}_1,\hat{g}_2)) \big/ \left[\phi'(\hat{u}_1(\hat{g}_1,\hat{g}_2)) + \phi'(\hat{u}_2(\hat{g}_1,\hat{g}_2))\right]$, $j = 1,2$. Equations (21) are modified Samuelson conditions. To better understand them, note that because $\hat{c}_1 \geq c_L$, $nv'(\hat{g}_1)\sigma_1(\hat{g}_1,\hat{g}_2) \geq nv'(\hat{g}_2)\sigma_2(\hat{g}_1,\hat{g}_2)$. Thus, $\phi'(\hat{u}_1)v'(\hat{g}_1) \geq \phi'(\hat{u}_2)v'(\hat{g}_2)$, which in turn yields $\hat{g}_2 \geq \hat{g}_1$ and $\hat{u}_2 \geq \hat{u}_1$. Hence, we obtain $\sigma_1(\hat{g}_1,\hat{g}_2) \geq 1 \geq \sigma_2(\hat{g}_1,\hat{g}_2)$.

Equation (21b) indicates that the center chooses the size of the public project in region 2 by equating a fraction of the sum of the marginal benefits from consumption of the regional public project in that region to its marginal cost of production. Equation (21a), on the other hand, shows that the center chooses the size of the public project in region 1 by equating the perceived marginal regional benefit from provision of the public project for that region, which is no less than the sum of the marginal benefits from consumption of the public project, to the reported marginal cost of production. The center faces a trade off between equity and efficiency in determining the sizes of the regional public projects. Efficiency considerations alone induce the center to determine the sizes of the regional public projects by utilizing the Samuelson conditions. However, if the reported unit cost for region 1 is higher than c_L, satisfaction of the Samuelson conditions will necessary lead to a larger regional public project in region 2. This discrepancy in the sizes of the regional public projects, in turn, necessarily implies that the ex-ante per capita utility in region 2 will be higher. Equity considerations, however, motivate the center to distort the Samuelson conditions in order to reduce the difference in the sizes of the regional public projects. Since such a reduction necessarily leads to a reduction in the differential in per capita utilities, relative to the undistorted allocation, the center obtains an allocation of per capita utility levels closer to the horizontal equity ideal. Thus, the center's optimal rules in this case narrow the gap between the sizes of regional public projects relative to the previous case in which the sizes of the regional projects were determined according to the Samuelson conditions.

The local sufficient second order condition is satisfied since:

$$\hat{W}_{11}\hat{W}_{22}-\hat{W}_{12}^2=\frac{\hat{c}_1^2\phi''(\hat{u}_1)v''(\hat{g}_2)\left(\phi'(\hat{u}_2)\right)^3}{\left(2n\phi'(\hat{u}_1)\right)^2}+\frac{c_{\mathrm{L}}^2\phi''(\hat{u}_2)v''(\hat{g}_1)\left(\phi'(\hat{u}_1)\right)^3}{\left(2n\phi'(\hat{u}_2)\right)^2}>0.$$

Let $\hat{g}_{\mathrm{j}}(\hat{c}_1)$, $\mathrm{j}=1,2$ be the center's reaction functions defined implicitly by (21). The center's marginal reaction functions are as follows:

$$d\hat{g}_1/d\hat{c}_1=\left[\phi'(\hat{u}_2)/2n\right]\hat{W}_{22}\Big/\left[\hat{W}_{11}\hat{W}_{22}-\hat{W}_{12}^2\right]<0, \tag{22a}$$

$$d\hat{g}_2/d\hat{c}_1=-\left[\phi'(\hat{u}_2)/2n\right]\hat{W}_{12}\Big/\left[\hat{W}_{11}\hat{W}_{22}-\hat{W}_{12}^2\right]<0, \tag{22b}$$

where $\hat{W}_{22}=\phi'(\hat{u}_2)v''(\hat{g}_2)+c_{\mathrm{L}}^2\left[\phi''(\hat{u}_1)\left(\phi'(\hat{u}_2)\right)^2+\phi''(\hat{u}_2)\left(\phi'(\hat{u}_1)\right)^2\right]\Big/\left[2n\phi'(\hat{u}_2)\right]^2<0$ and $\hat{W}_{12}=-\hat{c}_1c_{\mathrm{L}}\left[\phi''(\hat{u}_1)\left(\phi'(\hat{u}_2)\right)^2+\phi''(\hat{u}_2)\left(\phi'(\hat{u}_1)\right)^2\right]\Big/4n^2\phi'(\hat{u}_1)\phi'(\hat{u}_2)>0.$ Equations (22) inform us that the center's optimal reaction functions are strictly decreasing in the reported unit cost of region 1.

Consider now the first stage of the game. Regional government 1 chooses $\hat{c}_1$ to maximize $u_1(\hat{c}_1;c_1)=I+v\left(\hat{g}_1(\hat{c}_1)\right)-\left(c_1\hat{g}_1(\hat{c}_1)+c_{\mathrm{L}}\hat{g}_2(\hat{c}_1)\right)/2n$ subject to $\hat{c}_1\in\left[c_{\mathrm{L}},c_{\mathrm{H}}\right]$. To demonstrate that the solution to this problem is interior, let us first consider the choice $\hat{c}_1=c_{\mathrm{L}}$. Then, from equations (21) we obtain $\hat{g}_1(c_{\mathrm{L}})=\hat{g}_2(c_{\mathrm{L}})$. Given this, it follows that

$u_1(c_L;c_1) = I + v(\hat{g}_1(c_L)) - (c_1 + c_L)\hat{g}_1(c_L)/2n$. Evaluating $du_1/d\hat{c}_1$ at $\hat{c}_1 = c_L$, we have $du_1/d\hat{c}_1 = [v'(\hat{g}_1) - (c_1 + c_L)/2n](d\hat{g}_1/d\hat{c}_1)$. Since $v'(\hat{g}_1) = c_L/n$, the following result is immediate: $du_1/d\hat{c}_1 = (c_L - c_1)(d\hat{g}_1/d\hat{c}_1)/2n > 0$. We thus conclude that $\hat{c}_1 > c_L$. Differentiating $u_1(\hat{c}_1;c_1)$ with respect to $\hat{c}_1$ yields:

$$du_1/d\hat{c}_1 = \left[v'(\hat{g}_1) - (1/2n)\left(c_1 - c_L\left(\hat{W}_{12}/\hat{W}_{22}\right)\right)\right](d\hat{g}_1/d\hat{c}_1). \tag{23}$$

In writing equation (23), we accounted for the fact that $d\hat{g}_2/d\hat{c}_1 = -\left(\hat{W}_{12}/\hat{W}_{22}\right)(d\hat{g}_1/d\hat{c}_1)$. Let us now evaluate the derivative (23) at $\hat{c}_1 = c_1$. Utilizing equation (21a), we have

$$\frac{du_1}{d\hat{c}_1} = \left[\frac{c_1\phi'(\hat{u}_2)\hat{W}_{22} + c_L\phi'(\hat{u}_1)\hat{W}_{12}}{2n\phi'(\hat{u}_1)\hat{W}_{22}}\right]\left(\frac{d\hat{g}_1}{d\hat{c}_1}\right) = \left[\frac{c_1 v''(\hat{g}_2)(\phi'(\hat{u}_2))^2}{2n\phi'(\hat{u}_1)\hat{W}_{22}}\right]\left(\frac{d\hat{g}_1}{d\hat{c}_1}\right) < 0, \tag{24}$$

after some algebraic manipulations. Thus, we conclude that $\hat{c}_1 < c_1$. We can now certainly affirm that the solution is given by the following first order condition:

$$nv'(\hat{g}_1(\hat{c}_1)) = \left(c_1\hat{W}_{22}(\hat{c}_1) - c_L\hat{W}_{12}(\hat{c}_1)\right)/2\hat{W}_{22}(\hat{c}_1). \tag{25}$$

Utilizing equation (21a), equation (25) yields

$$\hat{c}_1 = \sigma_1(\hat{g}_1(\hat{c}_1), \hat{g}_2(\hat{c}_1))\left[c_1\hat{W}_{22}(\hat{c}_1) - c_L\hat{W}_{12}(\hat{c}_1)\right]/2\hat{W}_{22}(\hat{c}_1). \tag{26}$$

For future reference, it becomes important to show that $nv'(\hat{g}_1(\hat{c}_1)) > c_1 - \hat{c}_1$. Using equations (25) and (26) this condition holds if $(\sigma_1 - 1)c_1 - (\sigma_1 + 1)c_L\hat{W}_{12}/\hat{W}_{22} > 0$. This is true since $\sigma_1 > 1$. Because $v(\cdot)$ is strictly concave, $v(\hat{g}_1)/\hat{g}_1 > v'(\hat{g}_1)$, $\forall \hat{g}_1 > 0$. Thus, it follows that $nv(\hat{g}_1(\hat{c}_1)) > (c_1 - \hat{c}_1)\hat{g}_1(\hat{c}_1) = \Delta C_1(\hat{c}_1)$.

Given these results, we conclude that $\hat{g}_1(c_1) < \hat{g}_1(\hat{c}_1) < \hat{g}_2(\hat{c}_1) < \hat{g}_j(c_L)$, $j = 1,2$. Hence, $\hat{u}_2(\hat{c}_1) > \hat{u}_1(\hat{c}_1)$. Since $\hat{c}_1 < c_1$, we have $\Delta C_1(\hat{c}_1) = (c_1 - \hat{c}_1)\hat{g}_1(\hat{c}_1) > 0$. Thus, the center needs to supply additional funds to complete region 1's project. If the project in region 1 is completed, consistently with our working assumption that the center always adjusts cost ex-post whenever the report sent by region 1 is false, the ex-post per capita utility in region j is $u_j^A = u_j(\hat{c}_1; c_1) = \hat{u}_j(\hat{c}_1) - \Delta C_1/2n$, $j = 1,2$, where the superscript "*A*" denotes the ex-post allocation in which the cost in region 1 is adjusted. Hence, $u_2^A > u_1^A$.

Next, we demonstrate that the center's decision of completing the project in region 1 is indeed optimal. Let u_j^S be the ex-post individual utility level in region j if region 1's project is shut down. Then, $u_1^S = \hat{u}_1(\hat{c}_1) - v(\hat{g}_1(\hat{c}_1))$ and $u_2^S = \hat{u}_2(\hat{c}_1)$. Since $nv(\hat{g}_1) > \Delta C_1$, it follows that $u_1^A > u_1^S$. We also know that $u_2^S > u_2^A$. We must show that $\sum_{j=1}^{2}(u_j^A - u_j^S) \geq 0$. For this to be satisfied, $\phi(u_1^A) - \phi(u_1^S) \geq \phi(u_2^S) - \phi(u_2^A) > 0$. As $u_2^A > u_1^A$, $\phi' > 0$ and $\phi'' < 0$, $\left\{\left[\phi(u_1^A) - \phi(u_1^S)\right] / \left[v(\hat{g}_1) - \Delta C_1/2n\right]\right\} > \left\{\left[\phi(u_2^S) - \phi(u_2^A)\right] / \left[\Delta C_1/2n\right]\right\}$. Utilizing again the fact that $nv(\hat{g}_1) > \Delta C_1$ yields $\sum_{j=1}^{2}(u_j^A - u_j^S) > 0$.

The proposition below gathers all the results of this section:

Proposition 3: When the center is unable to make interregional income transfers, the federal system suffers from the soft budget syndrome, since it is optimal for the ex-ante privately informed region to understate its true unit cost of production and for the center to adjust this region's total cost ex-post in order to complete the regional public project.

4. Conclusion

Soft budgets and income redistribution are endemic features of fiscal systems. We demonstrate that under certain circumstances the soft budget syndrome is completely wiped out by the center's ability of making interregional income transfers. We also show that soft budgets arise naturally in the same fiscal systems when the center is unable to make interregional income transfers. Exogenous limitations on the center's ability to promote interregional income transfers may, therefore, lead to efficiency distortions within fiscal systems.

References

Baron, D. and R. B. Myerson (1982), Regulating a monopolist with unknown costs, *Econometrica* 50, 911-930.

Becker, G. S. (1974), A theory of social interactions, *Journal of Political Economy* 82, 1063-1094.

Bergstrom, T. C. (1989), A fresh look at the rotten kid theorem – and other household mysteries, *Journal of Political Economy* 97, 1138-1159.

Cornes, R. C. and E. C. D. Silva (1999), Rotten kids, purity and perfection, *Journal of Political Economy* 107, 1034-1040.

Dewatripont, M. and E. Maskin (1995), Credit and efficiency in centralized and decentralized economies, *Review of Economic Studies* 62, 541-555.

Fudenberg, D. and J. Tirole (1991), *Game Theory*. Cambridge, Mass.: MIT Press.

Groves, T. (1973), Incentives in teams, *Econometrica* 41, 617-631.

Kornai, J. (1979), Resource-constrained versus demand-constrained systems, *Econometrica* 47, 801-819.

Kornai, J. (1980), *Economies of Shortage*. Amsterdam: North-Holland.

Kornai, J. (1986), The soft budget constraint, *Kyklos* 39, 3-30.

Kornai, J., E. Maskin and G. Roland (2003), Understanding the soft budget constraint, *Journal of Economic Literature* 41, 1095-1136.

Maskin, E. S. (1996), Theories of the soft budget-constraint, *Japan World Economy* 8, 125-133.

Mirrless, J. (1971), An exploration in the theory of optimal income taxation, *Review of Economic Studies* 38, 175-208.

Qian, Y. and G. Roland (1998), Federalism and soft budget constraint, *American Economic Review* 88, 1143-1162.

Riley, J. G. (1988), Ex post information in auctions, *Review of Economic Studies* 55, 409-430.

Riordan, M. and D. Sappington (1988), Optimal contracts with public ex post information, *Journal of Economic Theory* 45, 189-199.

Strauz, R. (2005), Interim information in long term contracts, Discussion paper no. 40, Governance and Efficiency of Economic Systems, University of Mannheim, Mannheim, Germany.

Wildasin, D. E. (1997), Externalities and bailouts: hard and soft budget constraints in intergovernmental fiscal relations, World Bank Policy Research working paper 1843, Washington, DC: World Bank.