Westfälische Wilhelms-Universität Münster

Institut für Kreditwesen

Direktor: Prof. Dr. Andreas Pfingsten

Institut für Kreditwesen

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Economic Integration and Decentralized Redistribution: A Case for Interregional Transfer Mechanisms

Prof. Dr. Andreas Pfingsten

Dipl.-Volksw. Andreas Wagener

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Andreas Pfingsten
Andreas Wagener

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Authors' address:

Institut fuer Kreditwesen, University of Muenster
Universitaetsstrasse 14-16, D-48143 Muenster
email: 21anpf@wiwi.uni-muenster.de

1 Introduction

There is a widely held but not undisputed view in the literature (cf. Brown/Oates (1987)) that Musgrave's "Redistribution Branch" should be assigned to the central authority in a multi-level federation. Otherwise, the poor would not be supported sufficiently and moving from decentralized to centralized distribution policy would increase the level of support.

In the present paper, we offer an additional analysis of this problem, where the importance of economic integration and intergovernmental relations will be emphasized. The process of establishing the European Union may serve as an example for our story which goes as follows:

We start out with some country or region which lives in autarky.[1] In particular, its labour force is given. Each region follows an internally optimal policy without caring about its effects outside the region (Section 3). After some time each region realizes that it acts in a competitive setting in the sense that changes in the assistance to the poor affect its labour force by attracting or repelling workers (Section 4). Still later, it becomes obvious that not only do the workers respond to changes in regional policies, but that this is also true for the policy-makers in other regions. These interdependencies increase, respectively they become more important, when economic integration moves on, e.g., by abolishing preferential treatment (jobs and social security) for natives. Intraregional redistribution must be seen as an interjurisdictional fiscal game with strong strategic interactions (Section 5).

Economic integration also yields a new layer of jurisdictions, namely a new central (top) government. Thus, it is a natural question whether or not this new level should be responsible for redistribution instead of the original national governments which now are on the second level only, i.e., which are now centers of decentralized power. From a theoretical perspective, a centralized (first-best) redistribution policy seems natural (Section 6). Practical matters, however, suggest that countries will neither be happy to follow the central government's (say, the EU commission's) policy nor be willing to pay transfers. Hence it could be attractive to install some kind of second-best solution. Two alternatives we discuss in this paper are, first, to refrain from requiring compulsory transfers between regions (Section 7), and second, to design mechanisms for interregional transfers which still leave discretion about distribution policy with the regions (Section 8).

When economic integration becomes still closer, one could also imagine that regional or national borders fall with regard to redistribution activities, i.e., that the beneficiaries of such policies are not only the poor living within the own jurisdiction, but that subsidies are also payable to poor living abroad. Payment schemes of this kind can be organized and administered

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1 In the sequel we mainly use the term "region" to describe the jurisdictional entities of our model. If you think, e.g., of the economic integration in the EU, you should replace this by "country".

by the central government, but, as the transfer paradox from the theory of international trade suggests, they may also work on a voluntary base. We will discuss both versions (Section 9).

The specific emphasis of our study lies in the discussion of interregional transfer mechanisms. We establish a general framework which incorporates a number of approaches taken in the literature as special cases. The central message of our paper is that interregional transfer mechanisms are a promising alternative to the traditional remedy against inefficient decentralized policy-making, namely to assign policy issues to the central authority. With cleverly designed transfer mechanisms decentralized redistribution may work efficiently. The loss of political sovereignty for the regions envolved with centralization can perhaps be circumvented.

Two points are worth to be mentioned at this time. Firstly, throughout our analysis the new central government will have a zero budget, i.e., it will not influence distributional policies by own resources. This could be modified at the cost of making the focus of our analysis less visible. Secondly, the regions may become more sophisticated over time: While they understand the direct effects of used control mechanisms on themselves right away, they might learn about indirect effects caused by the other regions' adaptation later. The unfortunate consequence would be that the behavioural implications derived, and hence some efficiency properties, might collapse.

2 Some general assumptions

Moving from one scenario to the other, there are several assumptions we will always make (cf. Wildasin (1991) for comments on these assumptions and further references).

We assume a federation with a finite number I of regions. In each region i there is one (representative) rich household who is immobile and owns the fixed factors.

The number of workers (full employment is assumed throughout), each of whom is endowed with one unit of labour which is inelastically supplied, will be denoted by l_i. Production follows a Ricardian technology $f_i(l_i)$, *i.e.*, $f_i'(l_i) > 0$ and $f_i''(l_i) \leq 0$ for all $l_i > 0$. The fixed factors (say, land or capital) and possibly the labour input of immobile (rich) households are assumed to be embodied in f_i. Workers are paid their marginal product $f_i'(l_i)$ plus a subsidy z_i (net of any taxes), such that their net income (or consumption) is

(1) $$c_i = f_i'(l_i) + z_i.$$

The subsidy z_i in principle may be positive or negative.

The (residual) income of the rich, y_i, is obtained by taking into account not only the profit from production and the subsidies, but also any other transfers to or from outside the region, T_i. These transfers, which can be positive or negative, need not be constant but may depend on several variables such as the population of the region, the population of the other regions, the subsidy paid by region *i* and that paid by the other regions, i.e.,

(2) $$T_i = T_i(l_1,\ldots,l_I,z_1,\ldots,z_I).$$

The income of the rich living in region *i* is then given by

(3) $$y_i = f_i(l_i) - f_i'(l_i)\cdot l_i - z_i \cdot l_i - T_i(\cdot).$$

The rich have the political power, and hence their utility function $U^i(y_i,c_i)$ matters for any regional decisions. It is assumed to be strictly quasiconcave and to have positive first-order partial derivatives, i.e., to exhibit some altruism for the poor. The partials will be denoted by U_1^i and U_2^i, respectively. We shall assume that concern for the poor and production functions are such that a negative subsidy will never be an optimal solution. (Notice, however, that in scenarios with migration it is not just altruism but also the allocation of labour which determines the subsidies.)

Some remarks concerning this somewhat peculiar approach of regional policy-making seem in place: First, unless it is assumed that the rich have the majority within each region, assigning the political powers to the rich is far away from any kind of democratic politics. We can partly justify this with the fact that the poor are mobile and that migrant workers are often not allowed to take part in polls and elections. However, one may still feel uncomfortable with this "Marie-Antoinette approach". In addition, it does not seem too unrealistic to assume that only a minority of people is mobile. Second, it is tempting (and we will do so) to interpret U^i as a social welfare function for region *i*. However, a critical remark on that is in order since the number of poor households does not matter, but only their (average) income. If U^i were a social welfare function, then with mobile worker issues of variable population size and poverty (e.g. according to the head-count ratio) should be incorporated.[2]

By *L* we denote the total number of workers which we assume to be fixed in the federation:

(4) $$L := l_1 + \ldots + l_I.$$

2 See Bossert (1989) for a discussion of variable population size issues in welfare economics.

We will specify further assumptions when working through a number of different cases.

3 Autarky

To start with, we consider some region i with n_i poor workers living there. By autarky, we mean that workers are not mobile (i.e. $l_i = n_i$), and that there are no interregional transfers (i.e. $T_i \equiv 0$).

In this setting, the welfare maximization problem is as follows:

(P1) $$\max_{z_i} U^i(f_i(l_i) - f_i'(l_i) \cdot l_i - z_i \cdot l_i,\ f_i'(l_i) + z_i).$$

We obtain the following first-oder condition:

(5) $$U_1^i \cdot (-l_i) + U_2^i \overset{!}{=} 0.$$

Keeping in mind that we have one (representative) rich and l_i poor, it makes indeed sense to equate the marginal rate of substitution between the rich and the poor to l_i.

4 Competitive regions

Now assume that economic migration lowers the mobility constraints for workers. This implies a possible difference of original population and final labour force, i.e., $l_i = n_i$ need not hold any more. Workers now migrate, and we assume that they can do so at zero costs. Hence they will go where their net income c_i is maximized, equating c_i over all regions:3

(6) $$c_i = c \quad \text{for all } i.$$

Region i notes this migration and knows that l_i is determined endogeneously to satisfy (1) and (6). If there is little experience with migration so far, or if region i is small with respect to the whole set of regions, it is reasonable to assume that c is taken as exogeneously given. (This will be different in Section 5.) In other words, i ignores its effect on c caused by variations in z_i and the implied migration. Hence the new problem is:

3 We assume that every poor who is working in region i obtains the subsidy. We thus ignore any aspects of preferential treatment of natives or discrimination with respect to nationality.

(P2) $$\max_{z_i} U^i(f_i(l_i) - f_i'(l_i) \cdot l_i - z_i \cdot l_i, c)$$

Combining (1) and (6) yields

(7) $$c - f_i'(l_i) - z_i = 0$$

and hence by implicit differentiation

(8) $$\frac{\partial l_i}{\partial z_i} = -\frac{1}{f_i''} > 0.$$

Since the objective function is simplified to $U^i(f_i(l_i) - c \cdot l_i, c)$, we obtain

$$U_1^i \cdot \left[f_i'(l_i) \cdot \left(-\frac{1}{f_i''} \right) - c \cdot \left(-\frac{1}{f_i''} \right) \right] \overset{!}{=} 0$$

as first-order condition which can be rearranged to yield

(9) $$f_i'(l_i) \overset{!}{=} c.$$

This result is trivial and striking at the same time. First of all, the regions *i = 1,...,I* considered as a union seem to reach efficient production since all marginal products of labour are equal according to (9). But one ought to be careful with this interpretation: Efficient production requires full employment in the union. Condition (9) holding for all *i* is therefore not sufficient, only necessary for production efficiency.

There exists a certain *c** such that efficient production in the union is obtained, but what forces will yield this outcome? Starting from a high *c* and unemployment, e.g., the usually assumed competition between unemployed and employed for jobs may do so. This would lower wages paid (and marginal productivities) such that eventually full employment at a lower wage rate (and hence at a lower *c*) will be reached.

Combining conditions (7) and (9), it turns out that no region will pay any assistance to the poor. This is true for each exogenous value *c* and regardless of the utility and production functions. In particular our assumption of nonnegative subsidies was not used to derive this result. It is fairly obvious from one point of view: workers would otherwise be paid more than their marginal product. Yet on the other hand it is somewhat surprising because the altruism of the rich does not imply a subsidy. This is, however, also easily explained: workers are "guaranteed" a consumption c exogeneously, no more nor less, and so it is rational for the rich to get as much work done for this per-capita income as possible.

Comparing the solutions of the autarky problem (P1) and the competitive problem (P2), we observe that (given a mechanism to realize the value c^*) production efficiency is certain in the competitive setting, whereas it is only coincidently reached in autarky. In the latter scenario we also will usually have different utility levels for workers in different regions, which ist not true under competition.

Moving from autarky to competition will make some people gain from the increase in production efficiency. Whether or not there are also losers depends on the size of the gains and on the specific situation under consideration.

5 Decentralized redistribution

Becoming more acquainted with the migration of workers and the economic forces at work, the regions might abandon their competitive behaviour after some time, if there are "not too many" regions. They will not take the consumption level c as given, but will realize that they themselves influence c by their own decisions. Their awareness of the strategic interaction will let them take into account the total labour force in the union, i.e., condition (4), and will let them replace condition (6) by assuming equal endogeneously determined incomes of the poor in all regions.

In any migration equilibrium the following conditions must be satisfied:

(4) $$L = l_1 + \ldots + l_I ,$$

(10) $$f_i'(l_i) + z_i = f_j'(l_j) + z_j \text{ for all } i \neq j ,$$

From these constraints we can evaluate the effects of a change in region i's subsidy on the allocation of labour in the federation. Totally differentiating conditions (4) and (10), where all other subsidies are held constant (i.e. $\mathrm{d}\, z_j = 0 \quad \forall j \neq i$), yields:

$$\mathrm{d}\, l_i = -\sum_{k \neq i} \mathrm{d}\, l_k ,$$

and

$$f_i'' \mathrm{d} l_i + \mathrm{d}\, z_i = f_j'' \mathrm{d}\, l_j \qquad \forall j \neq i .$$

Dividing both sides of all equations by $\mathrm{d}\, z_i$ and plugging the second set of equations into the first, we obtain after some rearrangements:

(11)
$$\frac{\mathrm{d}l_i}{\mathrm{d}z_i} = -\frac{1}{f_i''}\cdot\left[1-\frac{\frac{1}{f_i''}}{\sum_{k=1}^{I}\frac{1}{f_k''}}\right] > 0\,.$$

Using this result, we can derive

(12)
$$\frac{\mathrm{d}\, l_j}{\mathrm{d}\, z_i} = \frac{\frac{1}{f_i''}\cdot\frac{1}{f_j''}}{\sum_{k=1}^{I}\frac{1}{f_k''}} \;<\; 0$$

for $i \neq j$. These migration effects have to be considered by region i in choosing its optimal transfer to the poor.

Region i's problem can be expressed as

(P3)
$$\max_{z_i} U^i\,(\,f_i(l_i) - f_i{}'(l_i)\cdot l_i - z_i\cdot l_i\,, c_i)\,,$$

where the values of the z_j $(j \neq i)$ are taken as given (Nash assumption made by region i). Differentiation yields a first-order condition which can be conveniently expressed as

(13)
$$\frac{U_2^i}{U_1^i} = l_i - z_i\cdot\sum_{k\neq i}\frac{1}{f_k''}\,.$$

Comparing the uncorrected Nash equilibrium which emerges from decentralized redistribution policy with the previous scenarios, some observations can be made. The first one concerns production efficiency, the second one relates to the subsidy levels.

The first-order conditions yield no indication that production is overall efficient in the union. Suppose, for example, that one region is very much in favour of high incomes for the poor. Then there are basically two different strategies to achieve this. Firstly, pay a high subsidy (and possibly only minor wage due to a low marginal product as a consequence of the large inflow of poor workers), and secondly, pay no or little subsidy and end up with flew relatively wealthy poor (with a considerable marginal product). These strategies, should tend to attract more, respectively less, poor than in the efficient competitive situation. (In choosing among these strategies, and the others available, the region has to take into account of course, the residual income of the rich, i.e., how "costly" the strategies are.) The rather typical inefficiency of Nash equilibria is the cause for this outcome.

From the above example it is also apparent that equal subsidies cannot be expected in general. Moreover, it is quite unlikely that many regions will pay no subsidy at all. The popular view, decentralized redistribution policy would provide too little assistance to the poor, requires therefore a careful definition of the reference situation. It may well be that all regions pay a higher subsidy than if they were feeling themselves as acting in a competitive setting where they paid none. At the same time, however, it is conceivable that all regions pay a lower subsidy than in autarky.

6 First-best solution

Economic integration usually goes along with the implementation of a central authority, say, e.g. the Commission of the EU. Such an institution may be an additional candidate for carrying out redistribution policies. One way of modelling this is to assume a central social welfare function which has to be maximized. As possible evaluation criteria for central policies one could imagine a Bergson-Samuelson function with the regional utility levels as arguments, or, alternatively, an index which simultaneously measures inequality within and between the regions.[4] We will follow neither of these approaches, but will take a purely efficiency based perspective. This means: Being endowed with the right to levy taxes and to distribute transfers, a central authority engaged in resdistributive policies faces a typical central planner's problem. to allocate people among regions such that there exist no reallocations that permit to make some region or workers better off without another region or workers being made worse off (Pareto efficiency). The central authority's instruments are region specific lump sum taxes or transfers for the rich (T_i) and region specific transfers to the poor (z_i), its constraints are the overall budget being balanced and net incomes of the poor being equalized amongst regions.

As all the functions involved are (weakly) concave, we have the equivalence that a configuration $(z_i, T_i, l_i)_{i=1,\ldots,n}$ is Pareto optimal if and only if there exist $l^i \geq 0$ for all i and $l^j > 0$ for some j such that $(z_i, T_i, l_i)_{i=1,\ldots,n}$ maximizes

(P4) $$\sum_{i=1}^{I} l^i \cdot U^i\left[f_i(l_i) - f_i{}'(l_i)\cdot l_i - T_i,\ f_i{}'(l_i) + z_i \right]$$

subject to

(4) $$\sum_{i=1}^{I} l_i = L \qquad (j)$$

4 See Oakland (1983) for a model of the first kind and Blackorby/Donaldson/Auersperg (1981) for a discussion of inequality measurement within and among regions.

$$\sum_{i=1}^{I} T_i = \sum_{i=1}^{I} l_i \cdot z_i \qquad (\mu)$$
$$f_i{}'(l_i) + z_i = f_1{}'(l_1) + z_1 \qquad (\pi^i,\ i = 2,\ldots,I),$$

where the Greek letters in brackets denote the corresponding Lagrange multipliers. Differentiating the Lagrange function L with regard to l_i, T_i, z_i, respectively, yields the following necessary conditions for an optimum ($i = 1,\ldots,I$):

$$\frac{\partial L}{\partial l_i} = \lambda^i \cdot \left[-U_1^i \cdot l_i \cdot f_i''(l_i) + U_2^i \cdot f_i''(l_i)\right] + \varphi - \mu \cdot z_i + \pi^i \cdot f_i''(l_i) = 0,$$
$$\frac{\partial L}{\partial T_i} = -\lambda^i \cdot U_1^i + \mu = 0,$$
$$\frac{\partial L}{\partial z_i} = \lambda^i \cdot U_2^i - l_i \cdot \mu + \pi^i = 0,$$

where we defined $\pi^1 := -\sum_{i=2}^{I} \pi^i$. (Note that $-\sum_{i=1}^{I} \pi^i = 0$.) These can be evaluated as follows:

a) Solving the second equation for μ, the third equation for π^i (with μ replaced), and plugging both into the first equation yields $\varphi = \mu \cdot z_i$ for all i and therefore $z_i = z \quad (i = 1,\ldots,I)$ or, equivalently,

(14) $$f_i{}'(l_i) = f_j{}'(l_j) \quad \forall i, j.$$

Not too surprisingly, Pareto efficiency requires marginal productivities of labour to be equal in every region. This condition of world output maximization can only be achieved with a uniform transfer to all poor regardless of their residence.

b) For any i, equating λ^i from the third and the second equation yields

$$\frac{U_2^i}{U_1^i} = l_i - \frac{\pi^i}{\mu}.$$

Summing this over all i we obtain

(15) $$\sum_{i=1}^{I} \frac{U_2^i}{U_1^i} = L,$$

which is the familiar Samuelson condition for the efficient provision of a public good. The public good in our case is the income of the poor which all regions have to „consume“ in common. (15) reflects the view that the well-being of the poor is of international concern in our model: The rich care equally about all poor irrespective of their location. This approach, which was advocated by Ladd/Doolittle (1982) and has also been discussed by Buchanan (1974), is the key to the efficiency failures of decentralized redistribution which emerge from a comparison of first-best and decentralized solution and which already have been indicated in the previous section:

(i) In general, decentralized redistribution will not yield a Pareto efficient outcome. There is neither any hint for transfers to the poor being equal in every region nor does the Samuelson condition hold. Myopic Nash behaviour is not able to correct the fiscal externalities associated with population mobility. This is a standard result. For income redistribution under economic integration it has, e.g., be shown by Burbidge/ Myers (1994).

(ii) Decentralized redistribution results in an inefficiently low net income of the poor. This can be seen by summing up the optimality conditions of the preceeding section. There we obtained

$$\sum_{i=1}^{I} \frac{U_2^i}{U_1^i} = L - \sum_{i=1}^{I} \left[z_i \cdot \sum_{j \neq i} \frac{1}{f_j''(l_j)} \right] > L \; .$$

Increasing the net income of the poor c will, for constant utility, lower the marginal rates of substitution on the LHS of the above equation[5] and thus close the wedge between the sum of the MRS and the MRT. This underpovision of public goods by decentralized allocation mechanisms is a standard and well-understood result.

Production efficiency and the Samuelson condition will together uniquely define the first-best solution of the free migration scenario. The budget balance constraint of the efficiency problem requires the overall budget to be balanced. Thus, national budgets need not and will in general not be balanced (i.e., $T_i \neq l_i \cdot z_i$). Efficiency with positive transfers to the poor can only be achieved in the presence of international transfers (equalization payments). This well-known[6] result is due to the fact that the poor form a homogeneous group in the sense that they all require the same net income (or, more general, utility level). In a world of different production and national utility functions such a condition can only be matched with efficiency if redistribution of resources amongst regions and thus international transfers are allowed.

From a policy viewpoint, the first-best approach has two flaws which most probably will prevent any implementation of such a centralized solution:

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5 Note that $U_2^i / U_1^i = \left| \frac{\mathrm{d}\, y_i}{\mathrm{d}\, c} \right|_{u^i = \bar{u}}$, which is decreasing in c for quasi-concave utility functions.

6 See, e.g., Boadway/Flatters (1982).

(i) First-best allocations are derived from a *dictatorial* approach which gives the right of all decisions on taxes, transfers and labour allocation to the hand of the central authority. National governments are completely deprived of their redistributional competences. They will oppose to such a loss of their national sovereignty and look for solutions which leave at least partial responsibility with them.

(ii) As noted above, the implementation of first-best solutions has in general to be accompanied by international lump sum transfers. Some regions will have to pay for others. The allocation argument that world output will be maximized and all regions benefit from a centralized solution will not be very convincing to myopic policy makers who look at their balance sheets and notice outflows from their regions (and voters) to others.

There are at least three possible reactions to these national complaints:

(i) Ignoring both complaints will allow for a first-best solution but at the high political price of abolishing national sovereignty.

(ii) Obeying both the wishes for national sovereignty and for national budget balance leads immediately back to the decentralized setting of the previous chapter. The outcome of this Nash game is typically inefficient due to migration externalities. This way offers hardly a reasonable solution.

(iii) One only acknowledges one of the preceding national complaints, i.e., either is the determination of redistributional policies left to the central authority under the constraint that national regions face balanced budgets or are tax and transfer regulations left to national governments under the regime of mechanisms which allow for international transfers. In the sequel we will present and discuss both second-best approaches.

7 Social optimum without interregional redistribution

Consider the following second-best scenario: The central authority chooses transfers to the poor and head taxes for the rich for every region under the constraints that every national budget is balanced and that the net income of the poor is equal in all regions. The outcome should be Pareto efficient. With equal incomes of the poor (i.e., $z_i = c - f_i'(l_i)$ for all *i*) and balanced national budgets (i.e., $T_i = l_i \cdot z_i$ for all *i*), the net income of the rich in region *i* can be written as $y_i = f_i(l_i) - l_i \cdot c$, such that second-best solutions can be determined by the following approach:

(P5) $$\max_{c,\, l_i} \sum_{i=1}^{I} \lambda^i \cdot U^i\left[f_i(l_i) - l_i \cdot c, c \right]$$

subject to

(4) $$\sum_{i=1}^{I} l_i = L \qquad (\varphi).$$

By a corresponding Lagrangian approach we obtain:

$$\frac{\partial L}{\partial c} = \sum_{i=1}^{I} \lambda^i \cdot \left[U_2^i - U_1^i \cdot l_i \right] = 0$$

$$\frac{\partial L}{\partial l_i} = \lambda^i \cdot U_1^i \cdot (f_i'(l_i) - c) + \varphi = 0 \quad (i = 1, \ldots, I).$$

From the second of these conditions we see that production efficiency in general fails under this scenario. We get

(16) $$f_i'(l_i) = -\frac{\varphi}{\lambda^i U_1^i} + c,$$

which is not independent of the region index *i* as would be necessary for output maximization. This loss in output in comparison to the first-best world is the price to be paid for national budget balance.

Replacing the λ^i in the first condition by the values obtained from the second set of conditions and recalling that $f_i'(l_i) - c = -z_i$ yields upon dividing both sides by φ:

(17) $$\sum_{i=1}^{I} \frac{1}{z_i} \cdot \left[\frac{U_2^i}{U_1^i} - l_i \right] = 0.$$

Note that this condition must hold regardless of the λ^i in the Lagrangian function. Equation (17) does not coincide with the Samuelson condition unless the national transfers are not equal, which can in general be excluded from (16).

For every region, the bracketed term in (17) is the difference between the marginal rate of substitution of c and y_i (i.e., $\left.\frac{\mathrm{d}\, y_i}{\mathrm{d}\, c}\right|_{U^i = \bar{u}}$) and the national relative price of the transfer to the poor when the budget is balanced (i.e. $\left.\frac{\mathrm{d}\, y_i}{\mathrm{d}\, c}\right|_{T_i = z_i l_i}$). In the autarky optimum (cf. equation (5)), these differences are zero for all regions. In the case of decentralized redistribution discussed above, we obtained $U_2^i / U_1^i > l_i$ for all i, so that condition (16) cannot be fulfilled. Decentralized redistribution thus even fails to be a second-best optimum.

8 Interregional transfer mechanisms

In this section we add to the redistribution within the regions redistribution mechanisms between the regions. We will first discuss this topic in general before giving some specific and familiar examples of such interregional transfer systems. They are intended to implement an efficient solution of the decentralized redistribution game, i.e. to leave redistributional sovereignty with the regions without sacrifying efficiency. All mechanisms we discuss have the following properties:

(i) They are implemented and surveyed by the central authority.
(ii) They are not neutral with regard to regional budgets.
(iii) They are neutral with regard to the overall budget.
(iv) All regional governments are left with redistributional powers.

More formally, an interregional transfer mechanism can be represented by a vector of real-valued functions[7] $T_i(l_1,\ldots,l_I,z_1,\ldots,z_I)$ such that for all $(l_1,\ldots,l_I,z_1,\ldots,z_I)$

$$\Gamma := \sum_{i=1}^{I} T_i(\cdot) = 0 .$$

The last condition ensures that the central budget Γ is balanced. The transfers are paid to or by the rich, such that their disposable income equals

$$y_i = f_i(l_i) - f_i'(l_i)\cdot l_i - z_i \cdot l_i - T_i(l_1,\ldots,l_I,z_1,\ldots,z_I).$$

Note that positive (negative) T_i denote transfers to be paid (received) and hence a reduction (an increase) of the income of the rich.

Our mechanisms try to direct individual behaviour towards efficiency and to internalize the fiscal externalities which result in the free migration Nash game and which are the reason for the efficiency failures of decentralized redistribution. Decentralized redistribution under such mechanisms is still a Nash game, i.e., national governments do not coordinate their actions and take the others' decisions as given. The outcomes of such games are *corrected* Nash equilibria

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7 In an even more general setting, transfers could, of course, be also tied to incomes of the rich and other variables.

which are hoped to improve the situation in comparison to the uncoordinated game. The mechanisms add to the intra-regional redistribution an element of interregional redistribution: resources are transfered amongst regions.

Hence, the general idea of our transfer mechanisms is as follows: In the uncorrected game, there is no compensation for the external benefits which each region's redistribution creates for the other regions. Thus, Nash equilibria are inefficient. To achieve efficiency one has to design a procedure which automatically internalizes the externalities, e.g. by rewarding and encouraging high-level redistributive activities.

We investigate a typical mechanism design problem: Can we add some more rules to the uncoordinated redistribution game which Nash-implement the efficient outcomes or at least improve upon the inefficient outcome of the original game?[8]

Note an interesting property of interregional transfer mechanisms: In *money terms*, sum of cash in- and outflows, interregional redistribution is a zero-sum game. In *output terms*, interregional redistribution is, provided it really improves upon the decentralized setting, a positive-sum game. The rationale of interregional redistribution is an allocative argument, not one of international justice or equity.

8.1 The mechanisms in general

If the rich of region *i* receive a transfer of $T_i(l_1,\dots,l_I,z_1,\dots,z_I)$, their optimization problem is:

(P6) $$\max_{z_i} U^i\left[\, f_i(l_i) - f_i'(l_i)\cdot l_i - z_i\cdot l_i - T_i(l_1,\dots,l_I,z_1,\dots,z_I),\ z_i + f_i'(l_i)\right]$$

The first order condition of this problem can be rearranged to yield:

(18) $$\frac{U_2^i}{U_1^i} = l_i + \frac{\left(z_i - \frac{\partial T_i}{\partial l_i}\right)\cdot\frac{\mathrm{d}\,l_i}{\mathrm{d}z_i} - \frac{\partial T_i}{\partial z_i} - \sum_{j\neq i}\frac{\partial T_i}{\partial l_j}\cdot\frac{\mathrm{d}l_j}{\mathrm{d}z_i}}{f_i''\cdot\frac{\mathrm{d}\,l_i}{\mathrm{d}z_i}+1}.$$

Now note that

$$f_i'' + \frac{1}{\frac{\mathrm{d}\,l_i}{\mathrm{d}\,z_i}} = f_i'' - f_i''\cdot\frac{\sum_j \frac{1}{f_j''}}{\sum_{j\neq i}\frac{1}{f_j''}} = -\frac{1}{\sum_{j\neq i}\frac{1}{f_j''}} \qquad \text{and} \qquad \frac{\mathrm{d}\,l_j/\mathrm{d}\,z_i}{\mathrm{d}\,l_i/\mathrm{d}\,z_i} = -\frac{\frac{1}{f_j''}}{\sum_{k\neq i}\frac{1}{f_k''}}.$$

8 See Hurwicz (1994) for a lucid exposition of the mechanism design problem.

Hence:

$$\frac{\left(z_i - \frac{\partial T_i}{\partial l_i}\right)\cdot\frac{\mathrm{d}\, l_i}{\mathrm{d}z_i} - \frac{\partial T_i}{\partial z_i} - \sum_{j\neq i}\frac{\partial T_i}{\partial l_j}\cdot\frac{\mathrm{d}l_j}{\mathrm{d}z_i}}{f_i''\cdot\frac{\mathrm{d}\, l_i}{\mathrm{d}z_i}+1} = -\sum_{j\neq i}\frac{1}{f_j''}\cdot\left[z_i - \frac{\partial T_i}{\partial l_i} - \frac{\partial T_i/\partial z_i}{\mathrm{d}\, l_i/\mathrm{d}z_i} + \sum_{j\neq i}\frac{\partial T_i}{\partial l_j}\cdot\frac{\frac{1}{f_j''}}{\sum_{k\neq i}\frac{1}{f_k''}}\right]$$

$$= -\sum_{j\neq i}\frac{1}{f_j''}\cdot\left[z_i + \frac{\partial T_i}{\partial l_i} + \frac{\partial T_i/\partial z_i}{\mathrm{d}\, l_i/\mathrm{d}z_i} - \frac{\partial T_i}{\partial l_j}\right].$$

Using this expression, (18) simplifies to

(19) $$\frac{U_2^i}{U_1^i} = l_i - \sum_{j\neq i}\frac{1}{f_j''}\cdot\left[z_i + \frac{\partial T_i}{\partial l_i} + \frac{\partial T_i/\partial z_i}{\mathrm{d}\, l_i/\mathrm{d}z_i} - \frac{\partial T_i}{\partial l_j}\right]$$

Clearly, if there is no transfer mechanism or if the interregional payments are lump sum, (19) is equivalent to condition (13) in the uncorrected decentralized setting.

Note further that from (19) it does not make any sense that transfers to or from region i depend on the subsidies z_j that other regions pay to their poor: Region i would not take into account this dependence. The reason for this is our assumption of Nash behaviour, i.e., that each region acts as if all other regions held their strategies constant. Having this in mind, we will in the sequel only discuss transfer mechanisms where the regional payments do not depend on other regions' subsidies, i.e. we can restrict our analysis to transfers of the form $T_i(\cdot) = T_i(l_1, \ldots, l_I, z_i)$.

In an efficient solution all subsidies must be equal (i.e. $z_i = z_j \ \ \forall i, j$) and the Samuelson condition (15) must hold. Using (19), this last condition can be expressed as:

$$\sum_{i=1}^{I}\sum_{j\neq i}\frac{1}{f_j''}\cdot\left[z_i + \frac{\partial T_i}{\partial l_i} + \frac{\partial T_i/\partial z_i}{\mathrm{d}\, l_i/\mathrm{d}z_i} - \frac{\partial T_i}{\partial l_j}\right] = 0\,.$$

There is no hint that (19) will in general imply that these efficiency requirements are satisfied. A special class of transfer mechanisms which satisfy the Samuelson condition is characterized by the following

RESULT 1: A sufficient condition for an interregional transfer mechanism to Nash-implement the Samuelson condition (15) is:

(20) $$\sum_{j\neq i}\frac{1}{f_j''}\cdot\left[z_i + \frac{\partial T_i}{\partial l_i} + \frac{\partial T_i/\partial z_i}{\mathrm{d}\, l_i/\mathrm{d}z_i} - \frac{\partial T_i}{\partial l_j}\right] = 0 \text{ for all } i = 1, \ldots, I.$$

However, this condition is not necessary.

Again, there is no hint that (20) will be satisfied in general. Besides, the Samuelson condition is only one of the necessary conditions for efficiency. In order to learn something about necessary properties of transfer mechanisms which implement efficient solutions we generalize a procedure introduced in Wildasin (1991). The main idea runs as follows: If interregional transfer mechanisms are at work, decentralized redistribution raises two kinds of externalities: A spillover effect on (all) other regions and a central budget effect. The first of these externalities is the usual one which renders uncoordinated Nash behaviour to be inefficient. The second externality can only occur in the presence of an interregional transfer mechanism. If we sum up the monetary effects of both externalities, we obtain the excess burden of decentralized redistribution. An efficient (second-best) allocation is one in which the sum of all marginal excess burdens is zero, so that all externalities are internalized.

More formally, we have the following: The total marginal excess burden of region i´s redistribution policy then be expressed as:

$$MEB_i := \sum_{j \neq i} \frac{\partial U^j / \partial z_i}{\partial U^j / \partial y_j} + \frac{\partial \Gamma}{\partial z_i}.$$

The second term on the RHS is the effect of i's policy on the central budget, whereas the elements in the sum of the first term describe the externality which region i lays upon another region j by its redistribution policy, measured in terms of real income. Each of these elements can be calculated as

(21) $$\frac{\partial U^j / \partial z_i}{\partial U^j / \partial y_j} = f_j'' \cdot \frac{\mathrm{d}l_j}{\mathrm{d}z_i} \cdot \left[\frac{U_2^j}{U_1^j} - l_j - \frac{z_j}{f_j''} - \frac{\partial T_j / \partial z_i}{f_j'' \cdot \frac{\mathrm{d}l_j}{\mathrm{d}z_i}} - \frac{1}{f_j''} \cdot \sum_{k \neq j} \frac{\partial T_j}{\partial l_k} \cdot \frac{\mathrm{d}l_k / \mathrm{d}z_i}{\mathrm{d}l_j / \mathrm{d}z_i} \right].$$

Next, check that

(22) $$\frac{\mathrm{d}\, l_k / \mathrm{d}\, z_i}{\mathrm{d}\, l_j / \mathrm{d}\, z_i} = \frac{f_j''}{f_k''}.$$

The budget effect is given by:

$$\frac{\partial \Gamma}{\partial z_i} = \sum_{j=1}^{I} \frac{\partial T_j}{\partial z_i} + \sum_{k=1}^{I} \frac{\mathrm{d}\, l_k}{\mathrm{d}\, z_i} \cdot \sum_{j=1}^{I} \frac{\partial T_j}{\partial l_k}.$$

An efficient corrected Nash equilibrium is then characterized by the following set of conditions:

(i) Equation (19) holds for all regions (individual optimization).
(ii) $MEB_i = 0 \;\; \forall i$ (all externalities are internalized).[9]
(iii) $f_i' = f_j'$ for all i,j (production efficiency).

Inserting (19) (for region j) into (21) yields

$$\frac{\partial U^j / \partial z_i}{\partial U^j / \partial y_j} = f_j'' \cdot \frac{\mathrm{d}l_j}{\mathrm{d}z_i} \cdot \left[-\frac{z_j}{f_j''} - \frac{\partial T_j / \partial z_i}{f_j'' \cdot \frac{\mathrm{d}l_j}{\mathrm{d}z_i}} - \frac{1}{f_j''} \cdot \frac{\partial T_j}{\partial l_j} - \frac{1}{f_j''} \cdot \sum_{k \neq j} \frac{\partial T_j}{\partial l_k} \cdot \left(\frac{\mathrm{d}l_k / \mathrm{d}z_i}{\mathrm{d}l_j / \mathrm{d}z_i} - \frac{f_j''}{f_k''} \right) \right.$$

$$\left. - \left(z_j + \frac{\partial T_j}{\partial l_j} + \frac{\partial T_j / \partial z_j}{\mathrm{d}l_j / \mathrm{d}z_j} \right) \cdot \sum_{k \neq j} \frac{1}{f_k''} \right]$$

$$= f_j'' \cdot \frac{\mathrm{d}l_j}{\mathrm{d}z_i} \cdot \left[-(z_j + \frac{\partial T_j}{\partial l_j} - f_j'' \cdot \frac{\partial T_j}{\partial z_j}) \cdot \Phi - \frac{1}{f_j''} \cdot \frac{\partial T_j / \partial z_i}{\mathrm{d}l_j / \mathrm{d}z_i} \right],$$

where (22) was used and we defined

$$\Phi := \sum_{k=1}^{I} \frac{1}{f_k''}.$$

Further simplifications, using (11) and (12), finally lead to:

$$\frac{\partial U^j / \partial z_i}{\partial U^j / \partial y_j} = -\frac{1}{f_i''} \cdot (z_j + \frac{\partial T_j}{\partial l_j} - f_j'' \cdot \frac{\partial T_j}{\partial z_j}) - \frac{\partial T_j}{\partial z_i} .$$

Summing this for all $j \neq i$ and adding the budget effect yields the total marginal excess burden imposed by region i:

$$MEB_i = -\sum_{j \neq i} \left[\frac{1}{f_i''} \cdot \left(z_j + \frac{\partial T_j}{\partial l_j} - f_j'' \cdot \frac{\partial T_j}{\partial z_j} \right) + \frac{\partial T_j}{\partial z_i} \right] + \sum_{j=1}^{I} \frac{\partial T_j}{\partial z_i} + \sum_{k=1}^{I} \left(\frac{\mathrm{d}l_k}{\mathrm{d}z_i} \cdot \sum_{j=1}^{I} \frac{\partial T_j}{\partial l_k} \right)$$

$$= \frac{\partial T_i}{\partial z_i} - \sum_{j=1}^{I} \left[\frac{1}{f_i''} \cdot \left(z_j + \frac{\partial T_j}{\partial l_j} - f_j'' \cdot \frac{\partial T_j}{\partial z_j} \right) \right] + \frac{1}{f_i''} \cdot \left(z_i + \frac{\partial T_i}{\partial l_i} - f_i'' \cdot \frac{\partial T_i}{\partial z_i} \right) + \sum_{k=1}^{I} \left(\frac{\mathrm{d}l_k}{\mathrm{d}z_i} \cdot \sum_{j=1}^{I} \frac{\partial T_j}{\partial l_k} \right)$$

$$= -\sum_{j=1}^{I} \left[\frac{1}{f_i''} \cdot \left(z_j + \frac{\partial T_j}{\partial l_j} - f_j'' \cdot \frac{\partial T_j}{\partial z_j} \right) \right] + \frac{1}{f_i''} \cdot \left(z_i + \frac{\partial T_i}{\partial l_i} \right) + \sum_{k=1}^{I} \left(\frac{\mathrm{d}l_k}{\mathrm{d}z_i} \cdot \sum_{j=1}^{I} \frac{\partial T_j}{\partial l_k} \right)$$

9 Via some tedious algebra one can check that in fact both sets of conditions together imply the Samuelson condition.

Now, the condition $MEB_i = 0$ can be expressed as:

$$\sum_{j=1}^{I}\left[z_j + \frac{\partial T_j}{\partial l_j} - f_j''\cdot\frac{\partial T_j}{\partial z_j}\right] - \sum_{k=1}^{I}\left(f_i''\cdot\frac{\mathrm{d}l_k}{\mathrm{d}z_i}\cdot\sum_{j=1}^{I}\frac{\partial T_j}{\partial l_k}\right) = z_i + \frac{\partial T_i}{\partial l_i}.$$

Note that from (12):

$$f_i''\cdot\frac{\partial l_k}{\partial z_i} = \frac{1}{f_k''\cdot\Phi}.$$

Hence, the LHS of (19) is independent of i. This implies that the conditions $MEB_i = 0$ can only be satisfied for all i=1,...,I if:

(23) $$z_i + \frac{\partial T_i}{\partial l_i} = z_j + \frac{\partial T_j}{\partial l_j} \text{ for all } i,j.$$

Condition (23) requires the marginal transfer effect of migration on the income of the rich (i.e., the marginal effect of an increase in the labour force if production effects are excluded) to be equal amongst regions.

Combining (23) with production efficiency (i.e., $z_i = z_j$), we immediately arrive at the following

RESULT 2: A necessary condition for an interregional transfer mechanism to Nash-implement an efficient allocation in the decentralized redistribution game is:

$$\frac{\partial T_i}{\partial l_i} = \frac{\partial T_j}{\partial l_j} \text{ for all } i,j=1,...,I.$$

Following Result 2, efficiency requires that the interregional transfer mechanism has the same marginal property with regard to the number of domestic poor for every region. This is true regardless of any differences in the production functions or preferences of the regions. Some additional remarks concerning this result:

(i) Result 2 only gives a necessary condition, not a sufficient one.

(ii) Result 2 is only concerned with the marginal properties of a region's transfer payment T_i with respect to its own population l_i. Similar conditions concerning the other variables of T_i we did not find.

(iii) Strictly speaking, the condition $\frac{\partial T_i}{\partial l_i} = \frac{\partial T_j}{\partial l_j}$ must only hold in the optimum, i.e., outside the first-best solution the transfer mechanism may exhibit different partial derivatives. If the central autority wants, however, to make sure that its transfer mechanism will never fail the necessary requirement, it should design the mechanism in the following way:

$$T_i(\cdot) = a \cdot l_i + \tilde{T}_i(z_i, l_{-i}),$$

where l_{-i} denotes all population sizes other than i. Interestingly, the uniform linear dependence of the transfer on the own population size (represented by a) is also found in axiomatic approaches on the design of public funds sharing methods (cf. Buhl/Pfingsten (1990)) and is (in a slightly modified way) applied with the interregional funds sharing system in Germany (so-called Laenderfinanzausgleich).

(iv) Result 2 does not give any hint at the magnitude and even at the sign of the expressions $\frac{\partial T_i}{\partial l_i}$. From the purpose of the interregional transfer mechanism, namely to overcome the externality problem of decentralized redistribution, one would however suggest, that the $\frac{\partial T_i}{\partial l_i}$ be positive. Otherwise an "attractive" regional subsidy payment (i.e. a high z_i and therefore a high l_i) would be punished and the externality problem would become more severe.

In the remainder of this chapter we shall present and discuss a number of different interregional transfer mechanisms. All of them have already appeared in the literature on decentralized redistribution. They are now put into a general framework which will lead to additional insights in their merits and flaws.

8.2 Pigouvian subsidies on the number of the poor

The first concrete mechanism we discuss is a Pigouvian subsidy where each region j pays an amount of $b^{ij} > 0$ to the rich in region i for every poor living in i ($j \neq i$). The idea behind this is that now every region has an incentive to attract poor people by high transfer payments. The positive externalities created by a "generous" region to the "miserly" regions are refunded to the origin region. If we denote by $B^i := \sum_{j \neq i} b^{ij}$ the total amount region i obtains from the rest of the world per capita of the poor, the Pigouvian subsidy can be expressed as an interregional transfer mechanism with transfers to the rich in region i given by

$$T_i(\cdot) = -B^i \cdot l_i + \sum_{j \neq i} b^{ji} \cdot l_j .$$

Net income of the rich in region i is thus given by:

$$y_i = f_i(l_i) - \left[f_i'(l_i) + z_i - B^i \right] \cdot l_i - \sum_{j \neq i} b^{ji} \cdot l_j .$$

To be neutral with regard to the central budget, a Pigouvian subsidy must satisfy

$$\sum_{i=1}^{I} l_i \cdot B^i = \sum_{i=1}^{I} \sum_{j \neq i} b^{ji} \cdot l_j .$$

Equation (19), which implicitly characterizes the best responses of any region with regard to decentralized redistribution, now takes the following form:

(24) $$\frac{U_2^i}{U_1^i} = l_i - \sum_{j \neq i} \frac{1}{f_j''} \cdot (z_i - B^i - b^{ji}) \qquad (i = 1, \ldots, I).$$

Efficiency hence requires that

$$\sum_{i=1}^{I} \sum_{j \neq i} \frac{1}{f_i''} \cdot (z_j - B^i - b^{ji}) = 0 \qquad \text{and} \qquad z_i = z_j \quad \forall i, j .$$

There is no hint that this will be satisfied in general. Applying Result 2, we can however give a simple requirement for Pigouvian subsidies if they are intended to lead to effiency:

RESULT 3: A necessary condition for a system of Pigouvian per capita subsidies to Nash-implement an efficient allocation, is that $B^i = B \ \forall i$, i.e. the total transfer obtained by a region per capita of the poor must be the same for all regions.

A cleverly designed system of per capita Pigouvian subsidies makes decentralized redistribution yield an efficient outcome. Three aspects concerning Result 3 need to be mentioned:

(i) As does Result 2, Result 3 only gives a necessary, not a sufficient condition for efficiency.

(ii) We cannot offer any results concerning the optimal height or structure of the per capita transfers b^{ji} which each region j gives to the rich in region i. We can only state that with uniform subsidies (i.e. with $b^{ji} = b \ \forall i, j$) efficiency and overall budget balance cannot be achieved simultaneously.

(iii) Result 3 does not offer any hint concerning the level B of the uniform transfer to the rich. To give an upper bound for B we reconsider condition (19). Applied to the actual scenario, it reads:

$$\sum_{j=1}^{I} \left[z_j - B^j \right] - \frac{1}{\Phi} \cdot \sum_{k=1}^{I} \sum_{j=1}^{I} \frac{b^{jk}}{f_k''} = z_i - B^i$$

or, equivalently:

$$\sum_{j \neq i} \left[z_j - B^j \right] = \frac{1}{\Phi} \cdot \sum_{k=1}^{I} \sum_{j=1}^{I} \frac{b^{jk}}{f_k''} > 0.$$

As this condition has to hold for all i, we can conclude that on average the transfers B^j received are smaller than the subsidies z_j paid. In a first-best setting, moreover, all z_j and B^j are equal such that we obtain $B < z$. Hence, no region's redistributional policy will be fully financed by transfers from other regions.

8.3 Pigouvian subsidies on the transfers of foreign regions

Inefficiencies in the decentralized setting result from national governments not being credited for the savings that increases in their transfers to the poor bring to the other regions. A Pigouvian remedy near-by-hand therefore would be to let each region subsidize the transfers of its neighbour regions. This method, which has been examined by Brown/Oates (1987), works in the following way: Each region j offers to the rich of any other region i a subsidy of a^{ij} per dollar of their transfer z_i. In terms of an interregional transfer mechanism this means:

$$T_i(\cdot) = \sum_{j \neq i} \left[a^{ji} \cdot z_j - a^{ij} \cdot z_i \right].$$

The net income of the rich in region i then amounts to

$$y_i = f_i(l_i) - l_i \cdot f_i'(l_i) - l_i \cdot z_i + \sum_{j \neq i} (a^{ij} z_i - a^{ji} z_j).$$

As we have $\frac{\partial T_i}{\partial l_i} \equiv 0 \;\; \forall i$, the efficiency condition given in Result 1 is trivially always satisfied by this mechanism. This does of course not imply that Pigouvian subsidies on the transfers of foreign regions lead to efficiency: Result 2 only supplies a necessary property of interregional transfer mechanisms. Therefore, the following proposition may be interesting:

RESULT 4: One particular mechanism (but not the only one) which will Nash-implement the Samuelson condition (15) takes the form

$$a^{ij} = -\frac{\mathrm{d}\, l_j}{\mathrm{d}\, z_i} \cdot z_i > 0 \text{ for all } i, j = 1, \ldots, I \text{ with } j \neq i.$$

Proof:

Using Result 1 we obtain a sufficient condition for the Nash-implementation of (15) in the actual scenario as:

$$-z_i \cdot \frac{\mathrm{d}\, l_i}{\mathrm{d}\, z_i} = \frac{\partial T_i}{\partial z_i} = \sum_{j \neq i} a^{ij}.$$

Due to the fixed number of the poor we have: $\frac{\mathrm{d}\, l_i}{\mathrm{d}\, z_i} = -\sum_{j \neq i} \frac{\mathrm{d}\, l_j}{\mathrm{d}\, z_i}$. Just insert $a^{ij} = -\frac{\mathrm{d}\, l_j}{\mathrm{d}\, z_i} \cdot z_i$ to see that (15) will emerge.

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Note that $a^{ij} = -l_j \cdot h_{ji}$, where $h_{ij} := \frac{\mathrm{d}\, l_j}{\mathrm{d}\, z_i} \cdot \frac{z_i}{l_j} < 0$ is the elasticity of region *j*´s poor population with regard to region *i*´s transfer payment. Then the net inflow to region *i* from region *j* can be calculated as $s_{ij} := -h_{ji} l_j z_i - h_{ij} l_i z_j$, where the s_{ij} coincide (up to a constant) with those subsidies proposed by Brown/Oates (1987) in their two-jurisdiction model.

The problem with Pigouvian subsidies in the form of Result 4 is that the subsidy rates are not constant, but depend on the decision variables z_i of the national governments. Sophisticated national governments will therefore anticipate changes of the subsidy rate in their calculations such that efficiency again is doomed to failure.[10] The mechanism will then in general not Nash-implement any efficient allocation.

8.4 Matching grants

The next proposal (which is due to Wildasin (1991)) to establish an efficient solution of the redistribution problem is to split the transfer the poor receive in a region into two parts: one provided domestically and the other one supplied by the central government as a subsidy granted to the redistributing region. The subsidies are financed by lump-sum taxes paid by the rich. By $s_i \in [0,1]$ we denote the share of the redistribution in region *i* that is financed by central (matching) grants and by t_i the head tax levied on the rich in region *i*. In our notion of an interregional transfer mechanism we thus have:

$$T_i(\cdot) = t_i - s_i \cdot l_i \cdot z_i$$

for the individual net payments and

$$\sum_{i=1}^{I} (s_i \cdot l_i \cdot z_i - t_i) = 0.$$

for the central government’s budget constraint. Net income of the rich living in *i* is thus given by

$$y_i = f_i(l_i) - l_i \cdot f_i'(l_i) - (1 - s_i) \cdot l_i \cdot z_i - t_i.$$

10 Brown/Oates (1987) see this problem as well (p. 326, note 12). They note that with clever governments a more complicated subsidy rule would be needed, but they do not design any example for this.

The following straightforward result can easily be verified:

RESULT 5: One particular mechanism (but not the only one) which will Nash-implement the Samuelson condition (15) takes the form

$$s_i = \frac{1}{1 + h_{ii}^{-1}} \quad \forall i, \qquad (25)$$

where $h_{ii} := \frac{\mathrm{d}\, l_i}{\mathrm{d}\, z_i} \cdot \frac{z_i}{l_i} > 0$ is the elasticity of region i's labour force with regard to ist own transfer payment.

Proof:

Using Result 1, a sufficient condition for a matching grants mechanism to lead to the Samuelson condition is given by:

$$0 = z_i + \frac{\partial T_i}{\partial l_i} + \frac{\partial T_i / \partial z_i}{\mathrm{d}\, l_i / \mathrm{d}\, z_i} = z_i - s_i \cdot z_i - \frac{s_i \cdot l_i}{\mathrm{d}\, l_i / \mathrm{d}\, z_i}$$

or, dividing by z_i:

$$1 - s_i - \frac{s_i}{h_{ii}} = 0.$$

Solving for s_i yields the proposed procedure.

•

With this mechanism, central subsidization of a region´s redistributional activities should be the higher the more sensitively labour supply reacts to the transfer in that region, i.e. the more mobile the poor are with respect to this region. As above, a mechanism like (25) can only work if the national governments do not recognize the repercussions of their policies upon the mechanism parameters. Otherwise, more complex structures are needed.

In almost the same setting as used here, Wildasin (1991) characterizes the optimal subsidy rates which will lead to an efficient outcome for the case of regions with identical preferences[11] and technologies as (all subscripts are dropped):

$$s = \frac{1}{1 + \frac{I}{I-1} \cdot \left(\frac{\partial l}{\partial z} \cdot \frac{z}{l} \right)^{-1}}.$$[12]

Now check that in the case of identical technologies we have

$$\frac{\mathrm{d}\, l}{\mathrm{d}\, z} = -\frac{1}{f''} \cdot \frac{I-1}{I} = \frac{I-1}{I} \cdot \frac{\partial l}{\partial z},$$

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11 Wildasin´s (1991) assumption of identical preferences is superfluous. He does not need it in his proof. Identical technologies are sufficient to establish his result.

12 See Wildasin (1991), Proposition 4.

so that the denominator of Wildasin´s formula just equals $1+h^{-1}$ and (25) results. In Wildasin´s setting of identical regions, the mechanism presented above is a unique characterization of an efficient solution for regions with different characteristics. Wildasin (1991, p. 765) conjectures that in general, i.e. with non-identical regions, efficient central subsidy rates will vary across regions. The application of Result 2 to the matching grant procedure, however, shows that this intuitive conjecture is false:

<u>RESULT 6:</u> A necessary condition for a matching grants mechanism to Nash-implement an efficient allocation in the decentralized redistribution game is that the centrally financed share of redistribution to the poor is equal in every region, i.e.:

$$s_i = s \quad \forall i.$$

<u>Proof:</u>

Following Result 2, it is necessary for efficiency that

$$\frac{\partial T_i}{\partial l_i} = -s_i \cdot z_i$$

is the same for all *i*. Now production efficiency also requires that the z_i are equalized over regions. This implies $s_i = s$ for all *i*.

●

If an interregional transfer mechanism where the transfer to a region depends linearly on the region's total redistribution budget is intended to lead to an efficient decentralized solution, the share of subsidy payments being granted by the central government should be uniform within the federation. In order to take the differences between the regions into account, the central authority should only use the lump sum transfers t_i.

<u>9. Transfers to the poor in foreign regions</u>

So far, the transfer mechanisms presented were designed to change the income of the rich in each region. The last mechanism we discuss in order to achieve an efficient solution aims at the income of the poor. One could try to internalize fiscal spillovers by letting regions not only give transfers to the poor residing in their own jurisdiction, but also subsidize the poor of foreign regions. These transfers can best be understood as immobility premiums paid to the poor. By $g^{ij} \geq 0$ we denote the per capita subsidy the rich of region *j* transfer to the poor of region *i*. The income of the rich in region *i* is then given by

$$y_i = f_i(l_i) - l_i \cdot f_i'(l_i) - l_i \cdot z_i - \sum_{j \neq i} g^{ji} \cdot l_j \,.$$

In this expression the sum $\sum_{j \neq i} g^{ji} \cdot l_j$ corresponds to the $T_i(\cdot)$ in the interregional transfer mechanisms of the last section. However, the immobility premiums should not be understood as an interregional transfer mechanism because there is no central budget which has to be balanced. i.e. there is no condition $\sum_{i=1}^{I} \sum_{j \neq i} g^{ji} \cdot l_j = 0$.

Including the subsidies from other regions, the net income of a poor person living in region *i* now amounts to

(26) $$c_i = f_i'(l_i) + z_i + \sum_{j \neq i} g^{ij} \,.$$

With regard to the design of transfers to the poor in foreign regions one has to draw an important distinction: On the one hand, they can be modelled as a scheme of compulsory payments where the central authority in the federation fixes the per capita subsidies g^{ij} and the regional governments take these values as parameters in their individual optimization. On the other hand, the regions could decide to voluntarily transfer resources to the poor in other region to prevent them from migrating. The next two sections will discuss both versions.

9.1 Compulsory transfers to the poor in foreign regions

We first assume that the central authority of the federation can force the regional authorities to subsidize the poor of other regions. Every region *i* maximizes its utility function with respect to the only strategy variable z_i. Using (19),13 this yields the following necessary condition for an interior solution:

(27) $$\frac{U_2^i}{U_1^i} = l_i - \sum_{j \neq i} \frac{1}{f_j''} \cdot \left[z_i - g^{ji} \right].$$

From this, one can easily derive the following

RESULT 7: If for all regions the premium to the poor of any foreign region is set to

(28) $$g^{ji} = z_i \quad \forall j \neq i \,,$$

where the z_i are the optimal values of the first-best solution, then the first-best solution will be achieved by decentralized utility maximizing redistribution policy as a Nash-equilibrium.

13 Note that we can use condition (19) despite our warning not to misunderstand the subsidies to foreign poor as an interregional transfer mechanism in the sense of Section 8. (19), however, does not use any central budget constraint, but emerges only from individual optimization in the presence of some transfer function $T_i(\cdot)$.

Proof:

Inserting $g^{ji} = z_i$ into (27) we obtain $\frac{U_2^i}{U_1^i} = l_i$, and hence the Samuelson condition (16) holds. Furthermore, from (26) we now have $c_i = f_i'(l_i) + \sum_{j=1}^{I} z_j$ for all i which means that in a migration equilibrium with $c_i = c_j \ \forall i, j$ we must have production efficiency: $f_i' = f_j' \ \forall i, j$.

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The idea behind the proposed mechanism is as follows: All regions pay the same amount to any poor regardless of his residence. All poor have claims to any region´s social system. In a sense, the residence principle of redistribution is abolished which is a rather crude way of avoiding the fiscal externality.

Again, if national governments are clever enough to incorporate (28) into their calculations, the mechanism will fail efficiency and lead to a suboptimally low level of redistribution.[14] However, by construction of (28), production efficiency will always hold.

9.2 Voluntary transfers to the poor in foreign regions

The mechanisms of the previous sections have in common that they have to be implemented and surveyed by a central authority. Alternatively, one could ask whether there is any chance that the national governments voluntarily agree upon transferring resources amongst themselves. After all, redistribution at a high standard in one region attracts poor households to immigrate and harms itself by causing its own break-down. Therefore, incentives for generous regions may exist to voluntarily transfer resources to other regions to prevent the poor of these regions from migration (immobility premiums). From the well-known transfer-problem of international trade theory[15] we learn that such transfers might be advantageous for the donor region.

The case of voluntary transfers is discussed in Wildasin (1994), without yielding any concrete results, however. In trying to see whether there is a case for voluntary international redistribution in the framework of the last section. There the g^{ij} were compulsory payments.

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14 To see this, look at the income of the rich when all poor benefit from national transfers: $y_i = f_i - l_i f_i' - z_i L$. Utility maximization then yields $\frac{U_2^i}{U_1^i} = l_i + \frac{L - l_i}{f_i'' \frac{d\, l_i}{d\, z_i} + 1} > l_i$ for all i.

15 See Bhagwati/Brecher/Hatta (1993) for a detailed presentation of the transfer paradox. Turunen-Red/Woodland (1988) give necessary and sufficient conditions for strict Pareto improving multilateral income transfers for the case of many donors and recipients.

Now suppose that these payments were under the disposal of the respective donor regions and each region had to decide on the optimal (non-negative) transfer to foreign poor. Partial differentiation of region *i*´s utility function with regard to any of the g^{ji} yields ($j \neq i$):

$$\frac{\partial U^i}{\partial g^{ji}} = U_1^i\left[(-f_i'' l_i - z_i)\frac{\mathrm{d}l_i}{\mathrm{d}z_j} - l_j - \sum_{k\neq i} g^{ki}\frac{\mathrm{d}l_k}{\mathrm{d}z_j}\right] + U_2^i\left[f_i''\frac{\mathrm{d}l_i}{\mathrm{d}z_j} + 1\right].$$

The sign of this expression is indetermined. There is however no hint that it is always negative at $g^{ji} = 0$. Hence, there might be situations in which voluntary transfers (up to a certain level) benefit the donor region.
An additional problem concerning voluntary transfer schemes has been mentioned by Brown/Oates (1987): They note that the Pigouvian subsidies discussed in Section 8.2 could in principle work at a voluntary base, but that with more than two regions a free-rider problem occurs which leads governments not to pay the subsidies, but to trust in all others to do so. In the final effect, the original scenario of decentralized redistribution will occur again.

10 Additional remarks and conclusions

The model we used throughout the analysis is quite useful but nonetheles suffers from a number of restrictions some of which should be briefly addressed:

The model follows the Ricardian tradition in that there is only one mobile factor of production, namely labour. In reality, labour is still rather immobile, whereas international capital mobility has rapidly increased. Moreover, labour is regarded as a homogenous factor; different abilities and productivities of different types of labour are ignored. Incorporating an additional (mobile) factor and possible substitution between factors of production into the model would therefore clearly offer a more realistic perspective.

There is a complete lack of political institutions in our analysis. As our story is one of deepening integration, this aspect is not negligible at all: Parallel to economic integration, there is a process of closer political integration (think of the EU, e.g.). Political institutions themselves and there views upon redistribution are likely to change during this process.

Our analysis is essentially efficiency based. Furthermore, redistribution only comes into the model via some altruism of the rich. Normally, redistribution within and among regions is mainly seen as a problem of equity and justice. These aspects are completely banned from this paper. Especially, the effects of different social welfare functions on the outcomes of redistributional policies should be analyzed in more detail.

We have constructed a number of mechanisms in order to overcome the efficiency problem of uncorrected decentralized redistribution. With myopic regional governments there is a good chance for such mechanisms to be succesful. However, all our mechanisms fail to lead to efficiency if regional governments are sophisticated enough to anticipate the repercussions their behaviour has upon the centrally administered mechanism. Speaking technically, our mechanisms are not fully incentive compatible. One direction for further research that emerges from our discussion is to look for reasonable interregional transfer mechanism which Nash-implement efficient allocations in any situation, i.e. also if governments are clever. We expect this to be all but a trivial problem.[16]

Up to now, the degree of labour mobility within the EU is quite low, such that it is sometimes argued (e.g. by Bureau/Champsaur (1992)) that the pressures on the redistribution branches of the EU member states due to economic integration is negligible. This, however, contrasts heavily with the widespread worrying about the effects of integration on the efficacy of decentralized redistribution. From the viewpoint of the model used here, this concern is not without reason. Social standards are driven down by economic integration. The central recommendation of our paper is, however, not to conclude from downward pressures on the social insurance system the necessity of a centralization. This troublesome tool can perhaps be circumvented by cleverly designed mechanisms which leave at least partial redistributive sovereignty to national authorities. The mechanisms discussed in this paper have all in common that they add a redistribution amongst regions to the original problem, namely the redistribution within regions. Both kinds of redistribution can obviously not be seen separately under economic integration, but the construction of an international redistribution scheme is a prerequisite for (intra-)national redistribution to work properly.

16 For a game theoretic discussion see Fudenberg/Tirole (1992), ch. 7.

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