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Implementing Equal Living Conditions in a Federation

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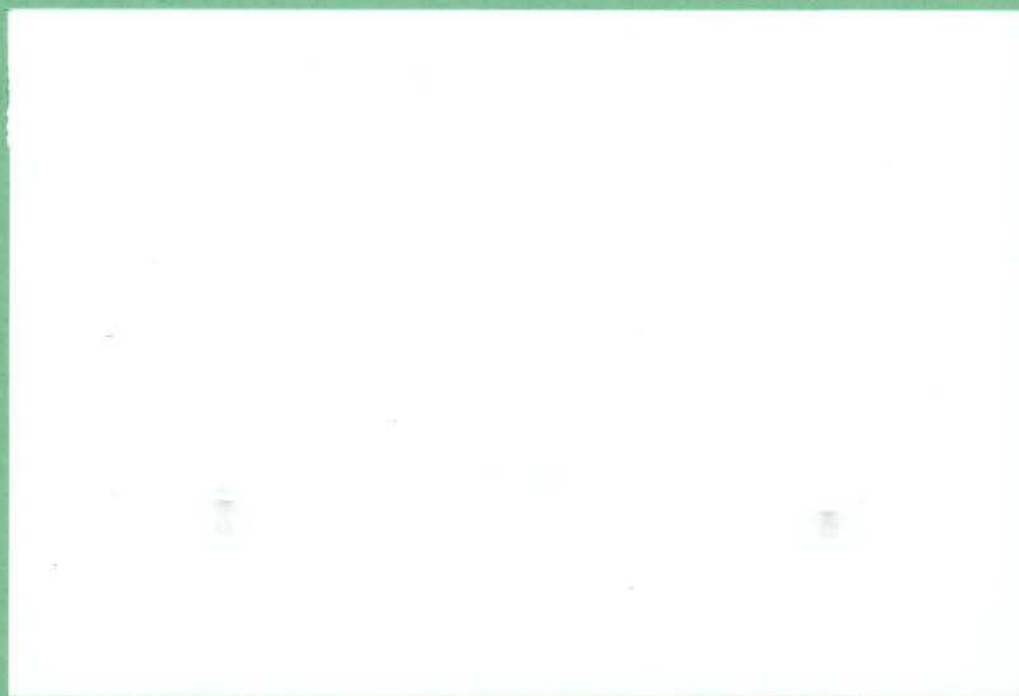
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Implementing Equal Living Conditions in a Federation

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Abstract: Critical-level (CL) utilitarianism with both fixed and variable critical levels is applied to the problem of redistribution in a federation with free mobility. We are interested in intra-regional inequality when redistribution policies are organized decentrally in a federation. Due to free mobility, this topic cannot be analysed independently of normative issues of variable population sizes. In our two-region model, the recipients of welfare payments are two classes of mobile, "poor" workers, whereas the contributors to the welfare system are immobile. Regional governments are CL utilitarians and behave non-cooperatively. Under autarky, CL utilitarians implement an egalitarian solution. With free mobility, some degree of intra-regional inequality proves to be optimal in general. However, a full equalization within and across regions can be reached as a Nash equilibrium if (and only if) regional governments regard the immigration of average income earners as welfare neutral.

JEL-classification: H71, D63

Keywords: Decentralized Redistribution, Fiscal Federalism, Utilitarianism

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1. Introduction

The design of redistributive policies in federal economies has recently attracted much attention in economic theory. In its mainstream, the debate seems to confirm the classical assertion due to Oates (1972) that redistribution in a federation can be carried out efficiently only at the central level of government. A somewhat technical version of the argument is as follows: If "the poor", i.e., the recipients of social assistance, are costlessly mobile in the economy, then in a migration equilibrium their utilities must be equal in all regions of the federation.¹ This equal-utility constraint creates a fiscal externality which regional authorities tend to ignore when they redistribute income from the rich to the poor in their jurisdictions on a residence base (see Wildasin 1991 or Mansoorian/Myers 1993). The interjurisdictional externality precludes both an efficient distribution of the population and an efficient provision of the public good "utility of the poor". In general, strategic regional governments will undersupply social assistance.

These are *efficiency* arguments against decentralized redistribution. In fact, nearly all contributions in the literature on decentralized redistribution consider their subject from an allocative perspective. They focus on production efficiency, the Samuelson condition for the provision of the public good "welfare of the poor", and the inefficiency of Nash equilibria in the fiscal game. Paradoxically, the literature on decentralized redistribution does not seem to be interested in distributional issues insofar as questions of inequality, income dispersion, etc. are not explicitly dealt with. Often they are deliberately "assumed away" by the equal-utility constraint associated with the free-mobility assumption. If the poor form a homogeneous group and receive the same level of utility regardless of where they live, there is no *intra*-group inequality amongst them and naturally distributional issues in this respect cannot arise. A question, however, which should be dealt with even in the standard framework of decentralized redistribution is that of *inter*-group inequality between the sponsors and the recipients of social benefits. After all, reducing inter-group inequality may be seen as a primary objective of any social policy. Moreover, in models with free mobility it is the only objective - as intra-group equality among the poor will always be reached, even in the absence of subsidies and transfers. Largely ignoring the question of inter-group inequality may thus be considered a serious shortcoming of the literature on redistribution in the presence of mobility.

This paper investigates into the distributive implications of decentralized redistribution policies in a federation. We focus on *intra*-regional inequality, i.e., we look at income disparities amongst the different groups living within a certain region. We do not discuss the issue of *inter*-regional equality (i.e., disparities between the regions themselves) which has found

¹ Similar effects occur if, instead of the poor, the "rich" (i.e., the net contributors to the welfare system) are mobile or if, in the absence of any personal mobility, the tax base out of that the welfare system is supposed to be financed can move freely.

considerable attention in the literature on fiscal federalism and inter-regional funds sharing (e.g. Hartwick 1980, Boadway/Flatters 1982 or Burbidge/Myers 1994). This paper uses the "canonical" model of decentralized redistribution due to Wildasin (1991), but modifies it in two respects. First, we assume that there are two types of labour instead of only one. This modification, which can be similarly found in Wellisch (1996), does not only lead to comparative statics quite different from those for the case of a single class of workers, but allows us to deal - in the simplest possible way - with issues of intra-group inequality among the welfare recipients. Second, we assume that regional governments explicitly care for distributional issues. More specifically, we assume that governments are utilitarians and thus biased towards egalitarianism: Faced with the task to distribute a *fixed* amount of income amongst a *constant* populacy, they would give an equal (utility of) income to all inhabitants. However, in a federation with free migration, regional population sizes (and outputs, too) are endogenous and vary with the policy choices of the regions. In a variable population setting, classical utilitarianism is no longer an ethically appealing social welfare function (see Section 3 or Roemer 1996, pp. 153ff). A prominent generalization of utilitarianism to the case of variable population sizes is *critical-level* (CL) *utilitarianism* which was first suggested and axiomatically characterized by Blackorby/Donaldson (1984). CL utilitarians wish to maximize the sum of the excesses of individual utility levels over some critical utility level. The central idea is that there exists a critical level of utility such that adding to a society an individual with exactly that utility level leaves social welfare unchanged. Critical levels need not and, as has been argued by Bossert (1989) and Broome (1991), often should not be constant. Instead they should somehow vary with the state of affairs in the economy. Allowing for variations in the critical levels, however, comes at the cost that the (utilitarian) social welfare function has a less solid axiomatic foundation and possibly lacks monotonicity in income levels.

In this paper we apply both constant and variable CL utilitarianism in a fiscal federalism framework. After presenting a simple model of a federal economy in Section 2, we briefly discuss some of the problems involved in the choice of social welfare functions with variable populations in Section 3. As CL utilitarianism has some desirable features from that viewpoint, we choose to apply it to the problem of decentralized redistribution. In Section 4 we show that under constant CL utilitarianism the egalitarian prescription for the immobility case is no longer valid under free mobility; instead some inequality will prove to be optimal. Generally, this is also true with variable critical levels. However, in Section 5 we prove that if and only if both regions choose their critical levels to be *regional* average incomes, then a complete equalization *within and across regions* can be reached as a Nash equilibrium of the decentralized redistribution game. This holds even if technologies and regional preferences are diverse (provided the latter are of the CL utilitarian type). Egalitarianism can thus be supported decentrally in a federation. Section 6 relates our results to the literature and concludes.

2. The model

2.1 Households, technologies, and migration decisions

We consider a federation with two regions. In each region $i = 1, 2$ there is one (representative) immobile household who owns the fixed factors. For convenience we call him the *rich* household, which does not necessarily coincide with his wealth position, but merely indicates that he is a net payer for the redistributive activities in his region. The restriction to a single immobile household per region is innocuous for our results. Workers are costlessly mobile within the federation. Each worker inelastically supplies one unit of labour in his region of residence. There are two types t and s of workers which differ in their labour productivity (think, e.g., of skilled and unskilled labour). Workers cannot hide their true type. Let \bar{L}_v be the fixed number of workers of type v ($v = s, t$) in the federation and l_v^i the number of workers of type v living in region i ($v = s, t$ and $i = 1, 2$). Full employment always prevails:

$$l_v^1 + l_v^2 = \bar{L}_v \text{ for } v = s, t. \quad (1)$$

We consider a one-good economy. The technology in region i is represented by a well-behaved, strictly concave, Inada-type production function $f^i(l_s^i, l_t^i)$ with positive and diminishing marginal returns $f_v^i = \frac{\partial f^i}{\partial l_v^i}$. The fixed factors are already embodied in the functions f^i . Labour markets are competitive, hence the gross wage of a type- v worker equals his marginal product. Gross incomes differ from disposable incomes and hence from consumption by type-dependent transfer payments, administered on a residence base by the regional governments. Denote by z_v^i the transfer to a type- v worker in region i . Then the consumption of this worker amounts to

$$c_v^i = f_v^i(l_s^i, l_t^i) + z_v^i. \quad (2)$$

Workers are only interested in their net incomes. Due to costless mobility, in an equilibrium all workers of the same type reach the same level of consumption regardless of their residence:

$$c_v^1 = c_v^2 =: c_v \text{ for } v = s, t. \quad (3)$$

The immobile rich is the residual claimant in each region. His disposable income amounts to:

$$y^i = f^i(l_s^i, l_t^i) - f_s^i(l_s^i, l_t^i) \cdot l_s^i - f_t^i(l_s^i, l_t^i) \cdot l_t^i - z_s^i \cdot l_s^i - z_t^i \cdot l_t^i. \quad (4)$$

2.2 Migration equilibrium and comparative statics

We define a *migration equilibrium* as a situation where (1) - (3) simultaneously hold. Set

$$D := (f_{tt}^1 + f_{tt}^2) \cdot (f_{ss}^1 + f_{ss}^2) - (f_{st}^1 + f_{st}^2)^2.$$

To ensure stability of the migration equilibrium, we assume that $D > 0$ (see Boadway 1982). The comparative statics for a change in one of the transfers z_v^i on the migration equilibrium can be obtained from totally differentiating (1) - (3):²

$$\frac{\partial l_v^i}{\partial z_v^i} = -\frac{\partial l_v^j}{\partial z_v^i} = -\frac{1}{D} \cdot (f_{vw}^1 + f_{ww}^2) > 0 \quad (5a)$$

$$\frac{\partial l_v^i}{\partial z_w^i} = -\frac{\partial l_v^j}{\partial z_w^i} = \frac{1}{D} \cdot (f_{st}^1 + f_{st}^2) \quad (5b)$$

$$\frac{\partial c_v}{\partial z_v^i} = 1 + f_{st}^i \cdot \frac{\partial l_w^i}{\partial z_v^i} + f_{vw}^i \cdot \frac{\partial l_v^i}{\partial z_v^i} = \frac{1}{D} \cdot [f_{vw}^j \cdot (f_{vw}^1 + f_{ww}^2) - f_{st}^j \cdot (f_{st}^1 + f_{st}^2)] \quad (5c)$$

$$\frac{\partial c_w}{\partial z_v^i} = f_{st}^i \cdot \frac{\partial l_v^i}{\partial z_v^i} + f_{vw}^i \cdot \frac{\partial l_w^i}{\partial z_v^i} = \frac{1}{D} \cdot [f_{st}^j \cdot f_{vw}^i - f_{st}^i \cdot f_{vw}^j] \quad (5d)$$

$$\frac{\partial y^i}{\partial z_v^i} = -z_v^i \cdot \frac{\partial l_v^i}{\partial z_v^i} - z_w^i \cdot \frac{\partial l_w^i}{\partial z_v^i} - l_v^i \cdot \frac{\partial c_v}{\partial z_v^i} - l_w^i \cdot \frac{\partial c_w}{\partial z_v^i} \quad (5e)$$

From (5a), higher subsidies to workers of type v in region i induce immigration of type- v workers into that region and consequently emigration from the other region. The signs of all other expressions in (5) are ambiguous. They depend on the signs and magnitudes of the cross-partial f_{st}^i . This is especially interesting in eq. (5c). If this expression is negative, an increase in transfer payments to a type- v poor *reduces* his equilibrium level of net income c_v . "Strange" incidence effects of this kind have not been incorporated in the analysis of decentralized redistribution so far, where an increase in a subsidy always results in a higher equilibrium level of income.³ (5b) and (5d) represent the effects of an increase in a subsidy to type- v workers on the allocation and the net income of workers of the other type w . (5e) gives the effect of a change in a subsidy in region i on the disposable income of the rich household in that region. It can further be refined by inserting (5a) to (5d).

The externalities induced by decentralized redistribution become obvious in eqs. (5c) and (5d): The equilibrium "price" of a (type- s or type- t) worker as measured by his level of consumption c_v changes with variations in z_v^i , causing spill-overs to region j (see Mansoorian/Myers 1993). Consequently, Nash equilibria of the decentralized redistribution game will in general be inefficient (see Wildasin 1991 or Pfingsten/Wagener 1997). As an aside note that due to the ambiguity in the sign of (5c) the direction of this inefficiency is unclear. In the standard case, i.e. with (5c) positive, there is a positive externality between regions which typically leads to an underprovision of social assistance to the poor (c_v is too low as compared to the first-best). If

² Unless stated otherwise, different sub- or superscript always denote different variables.

³ Similar effects occur in Wellisch (1996). However, they are not made explicit there.

(5c) is negative, the externality will turn negative, too, now allocating too high a disposable income to group v .

Decisions on the transfers z_s^i and z_t^i are assumed to be made by the government of region i as to maximize a regional social welfare function W^i . Each government takes as given the behaviour of the other government (Nash assumption), but accounts for the comparative statics (5a) to (5e). The outcome of the fiscal game depends, of course, crucially on the choice of the objective functions W^i . As we show in the next section, this choice is by no means unproblematic in a setting with variable populations.

3. Regional objectives with variable populations

Social welfare functions are convenient and powerful tools to represent the positions of a society (or of its decision makers) on inequality and distributive justice.⁴ By using a specific social welfare function in an economic model one (knowingly or not) endows the social decision makers in that model with certain normative principles for distributive questions. Similarly (but perhaps less knowingly), by applying a social welfare function in a setting where the available policy alternatives involve different populations or population sizes one assumes that decision makers hold certain views on how changes in population size and composition should be evaluated. Different populations are a matter of relevance, e.g., in decisions on the pension system, in birth-control programs, and in the federal redistribution problem under scrutiny in this paper.

The relevance of population issues can well be illustrated in our framework by means of the social welfare specification which is commonly used in the literature on decentralized redistribution (e.g. in Wildasin 1991, Wellisch 1996, and, slightly generalized, in Burbidge/Myers 1994). There, the objective functions of regional governments are assumed to depend only on the income (or utility) levels of the various types of individuals living in a region, i.e.: $W^i = \tilde{W}^i(y^i, c_s, c_t)$. Such an approach is not only far too general as to allow for any insights into the intra-regional income distribution emerging in a fiscal game (and it thus fosters the neglect of distributional aspects in that literature). More importantly, social welfare of the form \tilde{W}^i ignores the numbers of individuals of each type who inhabit a region: The population structure only matters indirectly via its impact on disposable incomes. Now suppose that one of the income levels is very low, say $c_t = 0$. All other things being equal, a social welfare function of the \tilde{W}^i -type will indicate social indifference between a situation where there is only

⁴ Roemer (1996) is a recent and extensive overview on the relationships between normative principles and social welfare orderings. For general results on the derivation of ordinal measures of social welfare from inequality indices and vice versa see Ebert (1987).

a single type- t poor and another situation where there are thousands of miserable type- t people. Similar effects occur for very high income levels when \tilde{W}^i says that a society is *ceteris paribus* indifferent between hosting one millionaire or thousands of them. This is certainly not very appealing. A reasonable regional social welfare function W^i should take into account the whole state of affairs in region i , i.e., the income levels and the numbers of all individuals living in region i .

Among the best known principles for variable population evaluation is *classical utilitarianism* (others are average utilitarianism or the Rawlsian maximin principle). It compares different states by means of the sum of the incomes of those currently living in a certain environment. To allow for social inequality aversion classical utilitarianism can be replaced by *generalized utilitarianism* where individual incomes undergo some concave transformation before being added to a social welfare index. An application of (generalized) utilitarianism in a fiscal federalism framework of redistribution can be found in Mansoorian/Myers (1997). However, (generalized) utilitarianism has a severe shortcoming with respect to population issues: It may lead to the *repugnant conclusion* (see e.g. Blackorby et al. 1998). I.e., for every population of arbitrary well-offs, there exists another, suitably larger population of miserables such that utilitarians will prefer the latter to the former. This substitutability of population size for quality of life is ethically unattractive. A widely discussed remedy in order to avoid the repugnant conclusion is the *critical-level population principle*, due to Blackorby/Donaldson (1984). This axiom requires that there exists some "critical" level of income such that adding an individual with this income to a society of otherwise unaffected individuals will not change societal well-being. I.e., the im- or emigration of people with incomes equal to (higher/lower than) the critical level income are neutral for (beneficial/detrimental to) social welfare. In addition to avoiding the repugnant conclusion, evaluation methods for income vectors (of equal and of different lengths) should of course obey several other desiderata as well (for a survey see Bossert 1989). Blackorby/Donaldson (1984) show that any social welfare function which (in addition to some basic axioms) satisfies the critical-level population principle, strict monotonicity in individual incomes, and separability in each partition of the population is ordinally equivalent to

$$W(n, (x_k)_{k=1, \dots, n}) = \sum_{k=1}^n [g(x_k) - g(\alpha)].$$

Here n denotes the population size, x_k is the income of person k , g is an increasing and concave real-valued function, and α is the critical income level, which has to be chosen by the social decision maker. This social evaluation method has become known as (*generalized*) *critical level utilitarianism* and has been applied in a number of economic contexts such as intergenerational distribution and population-control programs (Blackorby et al. 1995, 1997) or animal exploitation (Blackorby/Donaldson 1992). Here we apply it to the problem of redistribution in a federation with free mobility. Transferred to the setting of Section 2, the CL utilitarian welfare function for a region i ($i = 1, 2$) reads:

$$W^i(\cdot) = g_i(y^i) + l_t^i \cdot g_i(c_t^i) + l_s^i \cdot g_i(c_s^i) - (1 + l_t^i + l_s^i) \cdot g_i(\alpha_i). \quad (6)$$

If the g_i are strictly concave, the value functions W^i give more weight to changes in low incomes than to changes in high ones. This reflects the concern for inequality inherent in (6). For the rest of the paper we assume that the g_i are continuously differentiable.

4. Decentralized redistribution with fixed critical levels

As a benchmark, we first consider the implications of (6) for a fixed population in region i . The numbers of the different types of workers residing in region i are thus assumed to be constant at \bar{l}_s^i and \bar{l}_t^i . Maximizing (6) with respect to z_v^i ($v = s, t$) requires

$$\frac{\partial W^i}{\partial z_v^i} = \bar{l}_v^i \cdot [-g_i'(y^i) + g_i'(c_v^i)] = 0 \text{ and thus implies an egalitarian distribution in region } i:$$

$$y^i = c_t^i = c_s^i. \quad (7)$$

For a fixed population, (6) collapses to generalized utilitarianism. The observation that distributing a given cake amongst a given set of anonymous agents, using a utilitarian approach, requires an equal split can be dated back at least to Pigou (1947, pp. 57f). Note that (7) only demands intra-regional equity but does not imply anything for inter-regional comparisons since (3) need not hold. Now assume that labour is costlessly mobile and observe

FACT 1: Assume that regional decision makers are CL utilitarians. When labour is mobile, regional governments will never choose to implement an egalitarian income distribution.

Proof:

We write $l_{vw}^i := \frac{\partial l_v^i}{\partial z_w^i}$. Regional optimality requires for $v = s, t$:

$$\begin{aligned} \frac{\partial W^i}{\partial z_v^i} &= l_v^i \cdot [-g_i'(y^i) \cdot z_v^i + g_i(c_v) - g_i(\alpha_i)] + l_{sv}^i \cdot [-g_i'(y^i) \cdot z_s^i + g_i(c_s) - g_i(\alpha_i)] \\ &\quad + \frac{\partial c_t}{\partial z_v^i} \cdot l_t^i \cdot [g_i'(c_t) - g_i'(y^i)] + \frac{\partial c_s}{\partial z_v^i} \cdot l_s^i \cdot [g_i'(c_s) - g_i'(y^i)] = 0. \end{aligned} \quad (8)$$

Now suppose the contrary of the claim, i.e., that $y^i = c_t^i = c_s^i =: \hat{y}^i$ solves (8). Then

$$[g_i(\hat{y}^i) - g_i(\alpha_i)] \cdot (l_t^i + l_{sv}^i) = g_i'(\hat{y}^i) \cdot (z_t^i \cdot l_{tv}^i + z_s^i \cdot l_{sv}^i) \quad (9)$$

must hold. Check that if (accidentally) $\alpha_i = \hat{y}^i$ holds, this equation is not balanced as its RHS does not equal zero. Hence, both sides of (9) must be non-zero. Now divide (9) for t by the corresponding equation for s to obtain

$$\frac{l_{tt}^i + l_{st}^i}{l_{ts}^i + l_{ss}^i} = \frac{z_t^i \cdot l_{tt}^i + z_s^i \cdot l_{st}^i}{z_t^i \cdot l_{ts}^i + z_s^i \cdot l_{ss}^i},$$

which requires equal transfers to both types of workers: $z_s^i = z_t^i$. This is, however, in general not compatible with equal net incomes $c_t = c_s$. *q.e.d.*

Before discussing this result let us consider the special case that the g_i are linear (w.l.o.g., we set $g_i(x_i) = x_i$). Then CL utilitarianism is equivalent to maximizing $f^i(l_s^i, l_t^i) - \alpha_i \cdot (l_s^i + l_t^i)$ and the social planner behaves like a profit-maximizing entrepreneur who pays the same "wage rate" α_i to workers of different types. The hypothesis of profit-maximizing governments is not uncommon in the literature on fiscal federalism (see e.g. Bewley 1981 or Mansoorian/Myers 1997). It is easy to see that the optimal redistribution scheme is now given by $z_v^i = c_v - \alpha_i$ ($v = s, t$). Hence, regional transfers cover the difference between the equilibrium consumption of type- v workers and the regional critical level. Consequently, in a Nash equilibrium (if it exists) differences in regional transfers exactly reflect differences in critical levels:

$$\alpha^i - \alpha^j = z_s^j - z_s^i = z_t^j - z_t^i.$$

Hence, different types of workers end up with different disposable incomes.

With free mobility (which ensures that same-type workers are equally well off across regions), the egalitarian prescriptions of (CL) utilitarianism under autarky lose validity. Neither is there equality between rich and poor (see Fact 1) nor within the poor group (see the linear example). Furthermore there is no hint why the rich in the two regions should be equally well off (i.e., $y^1 = y^2$). By appropriate numerical examples one can show that any ranking of the incomes y^1 , y^2 , c_s and c_t is possible. In themselves, these observations are not too surprising. Yet, they show that the egalitarian bias inherent in utilitarianism will generally be overridden by population issues which are largely determined by production technologies. Differences in marginal productivities and in migration responses (i.e., both the first- and second-order derivatives of the functions f^i) matter for the determination of transfer payments.

5. Decentralized redistribution with variable critical levels

So far we assumed that the reference level α_i for the CL concept is the same for all possible income distributions and labour allocations. This may be criticized for at least three reasons (also see Blackorby et al. 1996): As has been shown by Ng (1986), the fixed CL approach may rank a situation with a small and poor population socially higher than one with a bigger population of richer people. This is certainly unattractive. Bossert (1989) demonstrates that fixed CL utilitarianism fails to be consistent with the *population replication principle* which

requires that replicating an income distribution should be a matter of social indifference. Furthermore, Bossert (1989) and Broome (1991) point out that constant critical levels are not very intuitive because they create too sharp a rather arbitrary cutoff level (cf. Blackorby et al. 1998). Instead, it seems natural to make the critical levels situation-specific and to somehow relate the social evaluation of adding new people to a given society to the preexisting situation. Several approaches have been suggested, e.g. by Blackorby/Donaldson (1984) themselves, who use the equally distributed equivalent income as a critical level (they call this the *Wicksell population principle*), and, more generally, by Bossert (1989).⁵ For our federal economy we now consider the case that the α_i are regional average incomes (i.e., regional per-capita outputs):

$$\bar{\alpha}_i = \bar{\alpha}_i(z_s^i, z_t^i, z_s^j, z_t^j) := \frac{1}{1 + l_s^i + l_t^i} \cdot (y^i + l_s^i \cdot c_s + l_t^i \cdot c_t) = \frac{f^i(l_s^i, l_t^i)}{1 + l_s^i + l_t^i}. \quad (10)$$

$\bar{\alpha}_i$ can be written as a function of the z_v^i because these transfers fully determine the migration equilibrium (1) - (3). Using $\bar{\alpha}_i$ as a critical level means that regional welfare remains constant if an immigrant earns the regional average income. Bossert (1989, p. 55) finds that the class of welfare orderings which exhibit social indifference when an average income earner enters into society is very large (encompassing, e.g., average utilitarianism). All these social welfare functions disapprove the immigration of below-average earners. To see that this may be unacceptable consider the following situations.⁶ In case A, we have one rich person with an income of $y^i = 12$, one type- s poor with an income of $c_s = 8$ and no type- t poor. In case B, we have the same two persons with exactly the same incomes plus an arbitrary number of type- t individuals with an income of $c_t = 9.99$. Any welfare ordering which uses average income as a critical level prefers A to B - although the population of A is not made worse off by the immigration of the relatively well-off type- t people in situation B. Similar, unpleasant implications arise, however, with all variable CL functions.

To maintain the standard utilitarian framework of the previous section we choose the welfare orderings for regions $i = 1, 2$ to be

$$W^i(\cdot) = g_i(y^i) + l_t^i \cdot g_i(c_t^i) + l_s^i \cdot g_i(c_s^i) - (1 + l_t^i + l_s^i) \cdot g_i(\bar{\alpha}_i(\cdot)) \quad (11)$$

where the g_i now are *strictly* concave. This welfare ordering has some peculiar properties. Due to the strict concavity of g_i , the maximum value of W^i is zero. More seriously, W^i attaches a welfare level of zero to all egalitarian societies, regardless of the level of (average) income in these societies. W^i does not satisfy the property "increasingness-along-the-ray-of-

⁵ Another way to circumvent the difficulties of fixed criticals is to give up the requirement of single-valuedness. Blackorby et al. (1996) allow for *sets* of (fixed) critical levels. The price to be paid for this is that one can only arrive at social quasi-orderings (i.e., incomplete rankings) for states with different population sizes. Social quasi-orderings, however, cannot be represented by real-valued social welfare functions.

⁶ Ng (1986) uses this example to criticise average utilitarianism. Its validity extends, however, to all social welfare functions which use average income as a critical level.

equality" often used in welfare economics, but is constant along the ray of equality (which consists of all egalitarian income distributions). (11) has a strong bias towards equality, completely ignoring efficiency issues. Furthermore check that, with a given population, an increase in the income of a *very* rich person may be welfare reducing according to (11). This should, however, not be seen as a serious flaw, but as a reflex of a strong social preference towards equality to be found in other social welfare functions as well. Finally note that, while constant CL utilitarianism (6) possesses an axiomatic characterization, the welfare function (11) is *ad hoc*.⁷ Using (11), however, has strong implications for our fiscal game:

FACT 2: Assume that both regional governments are variable CL utilitarians and choose their critical levels to be average regional incomes $\bar{\alpha}_i(\cdot)$. Then a situation with

$$y^1 = y^2 = c_s = c_t \quad (12)$$

can be reached as a Nash equilibrium of the decentralized redistribution game.

Proof:

As a first step check that egalitarian income distributions are indeed feasible in our model. The corresponding set of five equations is given by:

$$\frac{f^1(\cdot)}{1+l_s^1+l_t^1} = \frac{f^2(\cdot)}{1+(\bar{L}_s-l_s^1)+(\bar{L}_t-l_t^1)} = f_s^1(\cdot)+z_s^1 = f_t^1(\cdot)+z_t^1 = f_s^2(\cdot)+z_s^2 = f_t^2(\cdot)+z_t^2.$$

There are six independent variables $z_s^1, z_t^1, z_s^2, z_t^2, l_s^1, l_t^1$ to solve this system, implying that there is one degree of freedom. In general, one should thus expect an infinity of feasible egalitarian income distributions. Next verify that:

$$\frac{\partial \bar{\alpha}_i}{\partial z_v^i} = \frac{1}{1+l_s^i+l_t^i} \left[\frac{\partial l_s^i}{\partial z_v^i} (f_s^i - \bar{\alpha}_i) + \frac{\partial l_t^i}{\partial z_v^i} (f_t^i - \bar{\alpha}_i) \right]. \quad (13)$$

Maximizing (11) requires:

$$\begin{aligned} \frac{\partial W^i}{\partial z_v^i} &= \frac{\partial l_t^i}{\partial z_v^i} \left[-g_i'(y^i) \cdot z_t^i + (g_i(c_t) - g_i(\bar{\alpha}_i)) \right] + \frac{\partial l_s^i}{\partial z_v^i} \left[-g_i'(y^i) \cdot z_s^i + (g_i(c_s) - g_i(\bar{\alpha}_i)) \right] \\ &\quad + \frac{\partial c_t}{\partial z_v^i} \cdot l_t^i \cdot [g_i'(c_t) - g_i'(y^i)] + \frac{\partial c_s}{\partial z_v^i} \cdot l_s^i \cdot [g_i'(c_s) - g_i'(y^i)] \\ &\quad - g_i'(\bar{\alpha}_i) \cdot \left[\frac{\partial l_s^i}{\partial z_v^i} (f_s^i - \bar{\alpha}_i) + \frac{\partial l_t^i}{\partial z_v^i} (f_t^i - \bar{\alpha}_i) \right] = 0, \end{aligned} \quad (14)$$

where we used (5e). If (12) holds, then all net incomes in i equal $\bar{\alpha}_i(\cdot)$. Hence, via the definition of c_v , $\bar{\alpha}_i(\cdot) = f_v^i(\cdot) + z_v^i$. Now check that (14) is zero for $i = 1, 2$ and $v = s, t$ if (12)

⁷

As an (bad) excuse one might argue that axiomatic characterizations of welfare orderings with variable critical levels are very rare. Bossert (1989) provides one for the Rawlsian case which chooses minimum income as a critical level and a very general one for welfare orderings which can be represented by equally distributed equivalent incomes in the form of quasi-linear means.

holds. Hence, the corresponding quadruple of z_v^i satisfies the FOCs for a regional welfare maximum which must also hold in a Nash equilibrium of the game. Now recall that the maximum value of the regional social welfare functions W^i is zero. $W^i = 0$ happens if and only if $y^i = c_s^i = c_t^i$ holds, i.e., if incomes are equalized within the region. This is the case in (12) and thus none of the governments has an incentive to deviate once a situation where (12) holds is reached. *q.e.d.*

Fact 2 says that, if regional average income is used by both utilitarian governments as a variable critical level, then an egalitarian income distribution within and across regions can emerge as a Nash equilibrium of the decentralized redistribution game: Both types of workers and the two immobile households obtain the same income. Decentralized redistribution without any central coordination can implement an egalitarian solution even if regional technologies f^i and preferences g_i are different.

Two additional comments seem in order: First, the Nash equilibrium described in Fact 2 is not in dominant strategies. Eq. (14) does not give any hint that a regional government *always* wishes to create a completely flat income distribution within its jurisdiction, regardless of what the other government does. Second, we do not claim that the Nash equilibrium of Fact 2 is unique. Indeed, there may be several quadruples of z_v^i which solve (14) for all i and v and which are thus candidates for (possibly non-egalitarian) Nash equilibria. Given the structure of our model it is, however, hardly possible to verify whether these candidates fully qualify. Just to ensure that regional governments are maximizing rather than minimizing W^i when they solve (14) requires extremely strong assumptions on the third-order derivatives of the preference and production functions g^i and f^i (which then determine the properties of the Hessian matrix of W^i). Making such assumptions would almost entirely rob our model of any generality. In Fact 2, we can luckily circumvent all these complications by exploiting our knowledge of the maximum values of W^i in order to prove that the egalitarian outcome indeed emerges from maximizing behaviour.

One might wonder whether average regional income is the only variable critical level which can induce an egalitarian income distribution. In fact, it is, at least within a slightly restricted class of CL functions. Consider all variable CL functions which satisfy the following weak requirement (for a formal description see Bossert 1989, p. 47):

- (+) *If everybody has the same income within a society (a region), then adding another individual with that income will leave (regional) welfare unchanged.*

Condition (+) requires that the addition of an identical person to a group of identical individuals is a matter of social indifference. The class of variable CL functions satisfying (+)

encompasses (in addition to average income) minimum, median, maximum or any weighted average income and many others. Fixed CL utilitarianism violates condition (+).

FACT 3: Regional average income (10) is the only member in the class of variable CL functions with property (+) that can induce an egalitarian solution as a Nash equilibrium of a redistribution game amongst CL utilitarian governments.

Proof:

Suppose, government i is CL utilitarian and uses an (arbitrary) variable CL function $\alpha^i(\cdot)$.

Regional welfare maximization requires (among others) that the following FOCs hold for all v :

$$\begin{aligned} \frac{\partial W^i}{\partial z_v^i} = & g'_i(y^i) \cdot \frac{\partial y^i}{\partial z_v^i} + \frac{\partial c_t}{\partial z_v^i} \cdot l_t^i \cdot g'_i(c_t) + \frac{\partial l_t^i}{\partial z_v^i} \cdot g_i(c_t) + \frac{\partial c_s}{\partial z_v^i} \cdot l_s^i \cdot g'_i(c_s) + \frac{\partial l_s^i}{\partial z_v^i} \cdot g_i(c_s) \\ & - \left[\frac{\partial l_t^i}{\partial z_v^i} + \frac{\partial l_s^i}{\partial z_v^i} \right] \cdot g_i(\alpha_i(\cdot)) - (1 + l_s^i + l_t^i) \cdot g'_i(\alpha_i(\cdot)) \cdot \frac{\partial \alpha_i}{\partial z_v^i} = 0. \end{aligned}$$

If egalitarianism ($y^i = c_s = c_t = \bar{y}$) is supposed to solve this set of equations and (+) holds (which implies that $\alpha^i(\cdot) = \bar{y}$), then it must be true that:

$$\frac{\partial y^i}{\partial z_v^i} + \frac{\partial c_t}{\partial z_v^i} \cdot l_t^i + \frac{\partial c_s}{\partial z_v^i} \cdot l_s^i - (1 + l_s^i + l_t^i) \cdot \frac{\partial \alpha_i}{\partial z_v^i} = 0. \quad (15)$$

Using (5e), this can be rewritten as ($v = s, t$):

$$-\frac{\partial l_v^i}{\partial z_v^i} \cdot z_v^i - \frac{\partial l_w^i}{\partial z_v^i} \cdot z_w^i = (1 + l_s^i + l_t^i) \cdot \frac{\partial \alpha_i}{\partial z_v^i}.$$

Check from (13) that average income $\alpha^i(\cdot) = \bar{\alpha}^i$ is a solution to this system of partial differential equations. Condition (+) ensures that it is the unique solution. *q.e.d.*

Facts 2 and 3 together provide a strong rationale for using average income as a variable critical level in redistribution games among utilitarian governments. They state that an egalitarian income distribution can be supported as a Nash equilibrium if and only if the immigration of individuals with average incomes is viewed to be welfare neutral by both governments. To get an intuition for this result, suppose that the federal economy is on the ray of equality (i.e., $y^1 = y^2 = c_s = c_t = \bar{y}$) and consider a change in region i 's transfer policies inducing exactly one type- v worker to move from that region to the other region j . This has two effects on social welfare in region i . First, regional welfare changes by the excess utility of the worker over the CL utility, i.e., by $g_i(c_v) - g_i(\alpha_i)$. As we started from the ray of equality, this effect is zero for all welfare functions satisfying condition (+). Second, the emigration changes all incomes y^i , c_s , and c_t as well as the critical level α_i . On the ray of equality, all these changes are weighted with the same marginal utility effect (namely $g'_i(\bar{y})$). Hence, the total change in regional welfare is proportional to the sum of all income changes minus the change of the critical level

multiplied with the regional population size (cf. the LHS of (15)). For best response strategies, the total welfare effect of a change in regional transfer policies must be zero. Thus, if egalitarianism is supposed to be a Nash equilibrium, the second of the two welfare effects just described must vanish for both regions. This happens only if both regional critical levels equal regional average income.

6. Discussion and conclusions

Our analysis started from the observation that theories of decentralized redistribution so far have neglected the issue of intra-regional inequality, but instead preferred efficiency considerations. Our assumption that regional governments are CL utilitarians allows us to be more explicit on distributional questions than the main body of the literature. Seen against the importance attached to efficiency in that literature, it may as well be interesting to briefly analyse the efficiency properties of our game. Notice first that neither with a constant CL nor with average income as a CL total output is maximized in a Nash equilibrium. Output maximization requires equal marginal productivities of same-type labour across regions, and neither (8) nor (14) secure this to hold in a Nash equilibrium. Second, recall that, while output maximization is certainly a prerequisite for a first-best situation under fixed CL utilitarianism (and hence Nash equilibria implicitly defined by (8) are inefficient), this is not true for the welfare specification (11). *Any* egalitarian situation is Pareto-efficient. However, we do not advertise this as an efficiency theorem, but merely as a curiosity emerging from a peculiar property of our objective function.

Dealing with distributive questions requires to be explicit on the regional governments' attitudes towards inequality and hence demands for certain specifications of the regional social welfare functions. Furthermore, in a setting of variable populations, social welfare orderings should also exhibit acceptable properties when it comes to socially evaluating population changes. To the best of our knowledge, this paper is the first one in the literature on decentralized redistribution to address both the issues of variable population size and intra-regional income distribution at once. Yet, there are some related studies.

In a recent paper Mansoorian/Myers (1997) analyse the influence of different government objectives on the efficiency and welfare properties of equilibria in a federal redistribution game. In two of their objective functions (namely, classical and average utilitarianism) regional governments take account of their population sizes in the sense that they are willing to trade residents' utilities from consumption off for migration in- or outflows. Mansoorian/Myers (1997) also discuss profit maximization as a government objective which - under certain

circumstances - can be shown to be ordinally equivalent to a linear specification of fixed CL utilitarianism (see Section 4). However, Mansoorian/Myers (1997) focus solely on efficiency issues. Distributional issues are not and cannot be analysed within their framework. The merits and flaws of the different regional objective functions with respect to equality considerations are not addressed.

Cremer/Pestieau (1996) discuss decentralized redistribution in a classical utilitarian framework (without critical levels). They show that the Nash equilibrium of a non-symmetric fiscal game involves too little redistribution as compared to an egalitarian optimum under autarky. However, their utilitarian welfare function only accounts for the natives, not for the immigrants. This may be criticized as a somewhat chauvinist and hence unappealing government objective. Our Fact 1, however, shows that the Cremer/Pestieau result of insufficient redistribution also carries over to a fiscal game where governments are constant CL utilitarians and thus equally care for both natives and immigrants. Furthermore it is in line with the underprovision results for social security obtained in several studies on redistribution in federal systems (see, e.g., Brown/Oates 1987 or Lopez et al. 1998). Fact 2 then shows that the egalitarian prescription for the autarchic region can be re-established in a fiscal game if utilitarian governments choose average income as critical levels. This assumption may be criticized as being axiomatically questionable and *ad hoc* (although we believe that it is not too far-fetched). Therefore our approach should best be viewed as an example which shows that mobility need not necessarily jeopardize egalitarian positions for social justice.

A great deal of the literature on redistribution in federations is concerned with questions of inter-regional equality (e.g. Boadway/Flatters 1982 or Burbidge/Myers 1994). There are good reasons for this concern since a number of earlier studies on federations with free mobility and voting predicts stratification to occur in an equilibrium, which means that regions are populated only by same-type individuals (e.g. Westhoff 1977 or Epple/Romer 1991). Bewley (1981) shows that such ghettoization must, in principle, also be allowed for when Tiebout's (1956) efficiency conjecture for the provision of local public goods is supposed to be valid in non-voting models. In these models we thus obtain intra-regional homogeneity at the cost of large inter-regional diversity. However, in several real-world federations the creation of equal living conditions for the populations of different regions is an explicit policy objective (in Germany, e.g., it is constitutionally anchored). The stratification results theoretically underpin politicians' fears that this objective cannot be realized if the results from decentralization remain uncorrected. Provisions against unwarranted inter-regional diversity include funds sharing schemes, the coordination of policies or even the centralization of Musgrave's redistribution branch of government. Our approach sets a counterpoint by showing that equal living conditions - both within and across regions - can in fact be decentrally implemented.

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