Personal Income Tax Decentralization, Inequality and Social Welfare *

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ABSTRACT

This paper elaborates and evaluates a model for the decentralization of personal income tax which is consistent with the optimal redistribution model proposed by Tresch (2002), within a framework of social welfare *à la* Atkinson and Bourguignon (1987). In our model, the regions have individualistic, symmetrical, additively separable and inequality-averse social welfare functions. Each region applies to its constituents a progressive Personal Income Tax (PIT), which measures the individuals' ability to pay with sole regard to their income. The central government has a social welfare function *à la* Atkinson and Bourguignon (1987). Its tax-raising power is limited to the establishment of a surcharge (or deduction) proportional to the income of individuals, net of the respective regional taxes**.** In accordance with these hypotheses, this paper presents the conditions which permit this model of fiscal decentralization to be recommended, from the point of view of the reduction of inequality and the increase in welfare, in each region and in the country as a whole. The theoretical results are applied to the Spanish IRPF (*Impuesto sobre la Renta de las Personas Físicas)*, by the performance of various microsimulation exercises.

Keywords: Personal Income Tax, Decentralization, Inequality, Social Welfare.

JEL Code: D31, D63, H21, H24.

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1. Introduction

There is no doubt that one of the most frequently debated subjects in the economics of fiscal federalism is that of how to determine the role which each level of government should play in the performance of the function of income and wealth redistribution. Following the seminal contributions of Stigler (1957), Musgrave (1959) and Oates (1972), the prevailing theory is that this function should correspond to the central tier.

The conventional analysis employs, basically, two well-known arguments in its recommendation of the centralization of the redistribution function. In accordance with the first, within a context of individuals' mobility, these will react to differing redistribution policies at the subcentral level by moving from locality to locality, thereby making such policies ineffective and, similarly, producing inefficiencies in the allocation of resources (the "competition problem"). In line with the second argument, whether or not mobility exists, if various government levels intervene in the redistribution function, there might appear conflicts generated by the incompatibility of the objectives pursued by each level (the "incompatibility problem").

Nevertheless, there is a large literature which analyzes the consequences of decentralizing the redistribution function or, even, of jointly entrusting its performance among all government levels[1]. Included within this second group is the, in our view, original and thought-provoking contribution made by Tresch (2002). This author criticizes the recommendation for decentralization derived from conventional analysis for several motives, of which we wish to emphasize one for the moment. According to Tresch (2002: 845-6), and in accordance with the normative theory of the public sector, it would be difficult to affirm that an autonomous government truly existed, if it were to lack the capacity to determine its distributional rankings using a social welfare function. Distribution objectives are the sole element that the government itself brings to the analysis, via a collective political decision; otherwise, the government would restrict itself to accepting the preferences of consumers as the guiding principle and to acting, in effect, as their agent.

As a result, Tresch (2002) maintains that an optimal model of fiscal federalism, within the traditional theory of the public sector, requires a framework in which all the

governments, at their various levels, may simultaneously maximize their own social welfare function. Tresch (2002) himself designs a federalist model consistent with his proposal which, additionally, reduces the importance of the abovementioned problems of competition and incompatibility, associated with the decentralization of the redistribution function.

The aim of this paper is to design a model for the decentralization of personal income tax which allows the practical application of the proposal made by Tresch (2002), within a framework of social welfare *à la* Atkinson and Bourguignon (1987). These authors have proposed a very attractive method for a welfare analysis of the tax treatment applied to different types of taxpayers, according to non-income attributes (for example, the individual's region of residence), namely, the *sequential generalized Lorenz dominance criterion*. This criterion allows the analysis to be performed in terms of income (without needing equivalence scales[2]), thereby maintaining essential elements of the average utility of income approach.

To the best of our knowledge, the approach we employ in this paper is novel[3]. Cubel and Lambert (2002a) have identified the necessary and sufficient condition to ensure the welfare superiority of a marginal reform of PIT; this condition consists of providing a residual-progression-neutral tax cut to the individuals belonging to a certain group (e.g. the rural sub-population of a country), financed by a residual-progression-neutral tax hike for the individuals belonging to the complementary group (the urban sub-population). Cubel and Lambert (2002a) show that their result is maintained for a welfare specification *à la* Atkinson and Bourguignon (1987), which will allow us to use that result in the PIT decentralization model we have designed. However, the objective of the study by Cubel and Lambert (2002a) is different, since they aim to emphasize that tax reform improves welfare, albeit at the cost of introducing a degree of horizontal inequity[4].

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[1] For a review of the literature, see Cremer *et al.* (1996). From amongst the most recent contributions, those of Wellisch (2000) can be recommended.

[2] Regarding the use of equivalence scales and their normative foundations, it is useful to consult Ebert (1997, 1999, 2000) and Ebert and Moyes (2000, 2003).

[3] In Badenes *et al.* (2001) we also designed a model for the decentralization (and simplification) of PIT, but within a different welfare framework.

[4] In our opinion, this conclusion is highly debatable. If the legislator introduces a differential treatment in PIT between individuals, this is because he or she considers that, even having the same income, the individuals belonging to a particular group have greater needs and, as a result, a lower ability to pay than the individuals belonging to the other group. If this is so, the taxation of two individuals who have the same income but different needs is a problem of vertical, not horizontal equity.

Cubel and Lambert (2002b) consider the distributional effects of a marginal PIT reform, moving from a tax system that is uniform across the regions to one that is differentiated among them. The paper provides algorithms to determine the circumstances in which a small tax or tax increase, levied across-the-board without regard to people's region of residence, would be unambiguously welfare inferior to a differentiated new tax with the same yield. Cubel and Lambert (2002b) remark that the sequential welfare dominance criterion of Atkinson and Bourguignon (1987) can be checked using the analytical tool they have provided.

The paper is structured in the following way. The second section describes the "optimal redistribution" model designed by Tresch (2002). The third section elaborates and evaluates a model, consistent with that of Tresch (2002), for the decentralization of the PIT to the subcentral tiers. The fourth section is dedicated to applying the theoretical results obtained, by performing various microsimulation exercises, using the IRPF Taxpayers' Panel of the Spanish Institute of Fiscal Studies (Ministry of Finance). The final section concludes.

2. The Tresch (2002) optimal redistribution model

As stated in the previous section, Tresch (2002) designs, in a first-best context, a model of fiscal federalism in which each government maximizes its own individualistic social welfare function, subject to both resource and generalized production constraints and market clearance. However, in order to avoid the problem of incompatibility between the distribution objectives of various government levels, the author assumes that not all governments will be able to have social welfare functions whose arguments are the utility functions of their constituents. Tresch (2002: 849) proposes the following structure: "Each government has an individualistic social welfare function whose arguments are the social welfare functions of the governments *immediately* below it in the hierarchy of governments. The lowest level governments have individualistic social welfare functions whose arguments are the utility functions of their constituents –that is, the standard Bergson-Samuelson social welfare function".

Tresch (2002) develops a model for two levels of government, central and local, in which:

$U^{hl}(X_k^{hl})$ is the utility function of the individual *h* (*h = 1,…, H*) resident in locality *l* (*l = 1,…, L*) , and X_k^{hl} the k^{th} good (*k = 1,…, N*) consumed by that individual.

$L^l\left[U^{hl}(X_k^{hl})\right]$ is the social welfare function of locality *l*, whose arguments contain the utility functions of all the residents in *l*.

$F\left\{L^l\left[U^{hl}(X_k^{hl})\right]\right\}$ is the national social welfare function, with *L* arguments, $L^1,\ldots, L^L$.

From the problem of the maximization of the social welfare function of each government the usual first-best Pareto-optimal conditions would emerge**.** The difference regarding the conventional model of fiscal federalism is that, additionally, every government will be engaged in a lump-sum redistribution activity, in order to satisfy the conditions of interpersonal equity equilibrium. If *g* is the good affected by the lump-sum redistribution, each local government *l* will have to satisfy the following relationships:

$$\frac{\partial L^l}{\partial U^{hl}}\frac{\partial U^{hl}}{\partial X_g^{hl}} = \text{ for all } h \text{ in } l, \text{ and for all } l = 1,\ldots, L \qquad [1]$$

In turn, the central government will satisfy the following interpersonal equity conditions:

$$\frac{\partial F}{\partial L^l}\frac{\partial L^l}{\partial U^{hl}}\frac{\partial U^{hl}}{\partial X_g^{hl}} = \text{ for all } h = 1,\ldots, H \qquad . \qquad [2]$$

It must be noted that the redistribution undertaken in locality *l* ensures that the last two terms of expression [2] are equal for all its residents. As a result, all that the central government has to do is tax and transfer income lump-sum between localities (which the latter, in turn, will redistribute, in order to maintain social equity on the margin within each jurisdiction) until expression [2] in its entirety is equal for all the individuals in the country. In this regard, overall social welfare will have been maximized.

As stated earlier, the social welfare functions structure designed permits the problem of incompatibility between the redistribution objectives of governments at different levels to be eliminated. Furthermore, in the opinion of Tresch (2002: 852), its schema can correct the competition problem: insofar as the redistribution policies of the central government reinforce those adopted by the subcentral jurisdictions, individuals may have less incentive to change locality in response to the redistribution policies of the local governments.

3. A model for the decentralization of the PIT

Let us consider a country comprised of two levels of government, central and regional. The regions have a welfare function W_i^R, in which $i = 1,\ldots, n$. W_i^R is average utility-of-income within group i; thus, it belongs to the following class of individualistic, symmetrical, additively separable and inequality-averse social welfare functions:

$$W_I = \frac{1}{N}\sum U(x),\ U'>0,\ U''<0,\ \forall x \geq 0 \qquad [3]$$

where N is the population, and x is the income.

Each region applies to its constituents a progressive PIT, which measures individuals' ability to pay on the exclusive basis of income. Up to this point, the model does not diverge from the schema of Tresch (2002).

The central government ranks individuals in n groups, from greater to lesser need, in accordance with their region of residence: $i=1$ corresponds to the neediest region, and $i=n$, to the least needy. The idea is that for each given x, some income units are more deserving of additional resources than others (Atkinson and Burguignon, 1987; Atkinson, Bourguignon and Chiappori (1987); Lambert, 1994, 2001).

The ranking criteria may be extremely varied. For example, the central government may consider that the needs of individuals are inversely related to the average-income of their region of residence. In such a case, the group $i=1$ will correspond to the region with the lowest income, and the group $i=n$ to the highest-income region.

These differences in needs are recognized by the social decision-maker, who assigns a different utility-of-income function $U^i(x)$ to income units in each region. Each $U^i(x)$ is increasing and concave, i.e. the decision-maker is inequality-averse when focusing on income distribution within any region.

The central government has a welfare function W^C that evaluates average utility-of-income across the whole population[5]. It belongs to the class of social welfare functions which take the form:

[5] Recently, Ok and Lambert (1999) have demonstrated that it is not necessary to use the utilitarian method for the aggregation of group welfare levels in order to obtain the overall welfare of the population. The methodology of Atkinson and Bourguignon (1987) is applicable to all increasing and need-based social

$$W_{II} = \sum p_i \cdot W_i \qquad [4]$$

where p_i is the proportion of income units belonging to region *i*, and $W_i \in W_I$ is average utility-of-income within region *i*. Note that $W_i \neq W_i^R$.

On this point, our model differs from that proposed by Tresch (2002). In the latter, the central government has a social welfare function whose arguments are the social welfare functions of the lower level governments. In our approach, such a constraint is not necessary; the arguments of the social welfare function of the central government are the utility functions of the income of all individuals, which, as we shall now show, does not hinder the maintenance of the compatibility of the redistribution policies of both the central and regional governments.

By restricting the vector of utility functions $\langle U^1(x),\ldots,U^n(x)\rangle$ to describe an attitude to needs on the part of the social decision-maker, we can establish necessary and sufficient conditions for an unambiguous welfare recommendation.

These properties of the vector of social utility functions are the following: for each *i:1,2...,n-1*, $[dU^i(x)/dx]-[dU^{i+1}(x)/dx]$ is both positive and decreasing in income *x*. This means that at every level of income, the social decision-maker assigns a higher marginal social utility of income to some types of income units than to others, and also that the systematic difference in marginal social utility at each income level decreases with income.

The central government can establish its own income tax, but with certain restrictions. Its tax-raising power is limited to the establishment of a surcharge or deduction proportional to individuals' income, net of the respective regional taxes. Under this restriction, the central level may, for example, impose surcharges differentiated between regions, or instead authorize deductions in the tax paid in certain regions, financed by surcharges on the taxes of the others. This latter case would be consistent with the system of taxes and transfers contained in the model designed by Tresch (2002).

In the model proposed by Tresch (2002), only the lowest level of government redistributes among individuals. The higher governments use grants-in-aid to redistribute

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welfare functions, i.e. functions which record an increase in overall welfare when a cardinal welfare transfer is made from the less needy to the needier.

among governments immediately below it. Nevertheless, in our approach, both central and regional governments can redistribute among individuals by means of their respective PIT[6].

We shall now examine the results produced by this model in terms of inequality and social welfare. Firstly, each region applies to its constituents a progressive PIT, whose tax bill depends exclusively upon taxpayers' income. Furthermore, the tax policy of the central government is neutral in terms of residual progression (Pfähler, 1984), which means that it does not affect the inequality of income distribution derived from the tax policy of each regional government. The well-known results produced by Atkinson (1970), Fellman (1976) and Jakobsson (1976) enable us to state the following proposition:

Proposition 1

In a model of tax decentralization, in which:

a) each region applies to its own residents a progressive PIT, which measures the individuals' ability to pay with sole regard to their income, and

b) the central government applies a PIT which differentiates among regions and which is neutral in terms of residual progression;

the aggregated regional + central tax policy ensures that inequality is reduced and welfare improved in each region, with regard to an equal-yield proportional tax, for all $W \in W_I$.

Therefore, our model is totally consistent with that proposed by Tresch (2002).

Nor is evaluation from the perspective of inequality and national welfare complicated. In accordance with Atkinson and Bourguignon (1987), the following theorem applies:

Theorem 1 (Atkinson and Bourguignon, 1987)

It is necessary and sufficient for welfare improvement -for all $W \in W_{II}$*- that there is generalized Lorenz dominance of an income tax involving differences in tax treatment over an equal-yield proportional tax, for the sub-populations consisting of the j most needy groups, for each j=1,…,n.*

[6] One possible objection to our approach is the unconstitutionality of varying tax treatment by region under the central personal income tax. In response, it could be argued, firstly, that the Constitution demands that taxation is in accordance with individuals' ability to pay, and this depends not only on their income, but also on other attributes. Thus, two individuals with the same income, but resident in different regions, may have a different ability to pay (see note 4). Secondly, the personal income tax in force in many countries already allows different tax treatment by region via, for example, tax credits.

The first subpopulation [j=1] is made up of the neediest group [i=1]. The second [j=2], of the two most needy groups, [i=1] + [i=2], and so forth until we consider the last sub-population [j=n], which includes all the groups [i=1] + [i=2] +…+ [i=n] and therefore all the taxpayers.

The necessary condition for post-tax income means, μ, is the following:

$$\sum_{i=1}^{j} p_i\left(\mu_{x-IR}^{i} - \mu_{x-IP}^{i}\right) > 0, \quad \forall j \qquad [5]$$

where *IR* is the progressive income tax, and *IP* is the proportional tax.

Theorem 1 shows the sequential generalized Lorenz dominance criterion. From Theorem 1, we can obtain the following necessary condition:

Theorem 2 (Atkinson and Bourguignon, 1987)

Unambiguous overall inequality reduction is a necessary condition for welfare superiority of an income tax involving differences in tax treatment over an equal-yield proportional tax, for all $W \in W_{II}$.

If there are only two types of income units, the conditions of the Theorem 1 can be simplified as follows:

Theorem 3 (Lambert, 1994)

In the case of two income unit types, it is necessary and sufficient for welfare enhancement -for all $W \in W_{II}$- *that there is unambiguous overall inequality reduction and that, if between-groups redistribution takes place, it should be to the needy.*

Between-group redistribution to the needy occurs if the effective average tax rate in the group *i=1* is not above the effective average tax rate in the group *i=2*:

$$t_1 \leq t_2 \qquad [6]$$

In accordance with the preceding results, we can formulate the following proposition:

Proposition 2

In the model of tax decentralization described in Proposition 1, the aggregated regional + central tax policy ensures overall inequality reduction and welfare improvement, with regard to an equal-yield proportional tax, for all $W \in W_{II}$, *iff this policy guarantees the fulfilment of theorem 1 (or 3).*

Once again, our model for PIT decentralization fits satisfactorily within the schema proposed by Tresch (2002).

If, for the sake of simplicity, we focus on the case of two regions, it is not difficult to design a regional+central PIT that ensures the fulfilment of expression [6]. The fulfilment of the first condition of theorem 3 is not so simple, though. Lambert (1993) has proved that conditions for overall inequality reduction are not trivial, and that separate progressive taxation -with between-groups redistribution to the needy and within-group redistribution to the poor- does not necessarily entail overall inequality reduction[7]. Nevertheless, the literature offers some results which permit us to design some inequality-reduction tax policies. A sufficient condition for overall inequality reduction is the following:

Theorem 4 (Lambert, 1993)

A progressive income tax in which two groups of taxpayers are treated differently will unambiguously reduce overall inequality provided these three conditions are fulfilled:

a) Pre-tax income is less concentrated among the poor in the richest group, R, *than in the other,* P.

b) The richest group is taxed at a higher effective average tax rate than the other.

c) Reranking (a between-groups effect), if it takes place, should be outweighed by aggregate progressivity (a within-classes effect).

Condition a) can be stated so that:

$$S_R(y) \leq S_p(y), \ \forall y \geq 0 \qquad [7]$$

where:

$$S_i(y) = \int_0^y x\, f_i(x) dx / \mu_x^i \qquad [8]$$

$f_i(x)$ is the frequency density function for pre-tax income, and μ_x^i the mean of pre-tax income.

By using the above condition a), Lambert (1992) and Cubel and Lambert (2002a) have obtained the following result for a marginal residual-progression-neutral income tax reform:

Theorem 5 (Lambert, 1992; Cubel and Lambert, 2002a)

The necessary and sufficient condition for achieving a reduction in overall inequality in a marginal residual-progression-neutral tax hike in the richer group and cut in the poorer is that the pre-reform post-tax income is less concentrated among the poor in the richer group than in the other.

Finally, and for every number of groups, we have an easy sufficient condition for achieving a reduction in overall inequality, with interesting implications for social well-being assessment:

Theorem 6 (Lambert, 1988, 1994)

A progressive income tax which involves different treatments will unambiguously reduce overall inequality if there is within-group redistribution to the poor and no between-groups redistribution.

If the poorest group is also the neediest, the fulfilment of Theorems 4, 5 or 6 implies the fulfilment of expression [6] and, then, also of Theorem 3[8]. In other terms, the progressive regional+central personal income tax induces a welfare enhancement in relation to the proportional equal-yield tax.

4. A simulation exercise for the Spanish IRPF

In this section, we apply the theoretical results obtained in the preceding section, by performing various microsimulation exercises, using the IRPF Taxpayers' Panel of the Spanish Institute for Fiscal Studies (Ministry of Finance). Let us suppose that the central government groups Spanish taxpayers into two regions, A and B, demarcated by their fiscal average income. They comprise the individuals resident in the following Autonomous Communities:

REGION A: Madrid, Catalonia, the Balearic Islands, the Canary Islands, Cantabria, Asturias, and Aragón.

REGION B: Valencia, Galicia, Castille and León, La Rioja, Andalusia, Murcia, Castille and La Mancha, and Extremadura.

Table 1 shows the fulfilment of condition a) of theorem 4, as reflected in expression [7].

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[7] See also Moyes and Shorrocks (1998).
[8] The fulfilment of Theorem 6 implies that of Theorem 3, even though the richest group is also the neediest.

The regional governments have powers to impose upon their constituents a progressive IRPF, whose tax bill depends exclusively on individuals' income. To simplify, let us assume that regions A and B apply, in their respective territories, a tax equivalent to the IRPF in force in Spain since 1999.

Let us now consider the tax policy of the central government. We shall assume that it ranks individuals in the following two groups, in accordance with their needs:

i=1: taxpayers resident in region B.

i=2: taxpayers resident in region A.

We have simulated two types of central government tax policy, based on the conditions contained in Theorems 4 and 5. In the first policy (hereafter, Policy 1), the central government is empowered to permit a deduction to the tax liability corresponding to the regional tax paid by the residents of region B, proportional to their post-tax income, and financed by a surcharge on the regional tax paid by the residents of region A (also proportional to their post-tax income). The region B deduction rates analyzed, as percentage on post-tax income, are 0.587 per 100 (5 per 100 on tax liability), 1.762 per 100 (15 per 100 on tax liability) and 2.937 per 100 (25 per 100 on tax liability). For financing these respective deductions, the surcharge rates applied in region A are 0.516 per 100 (3.232 per 100 on tax liability), 1.547 per 100 (9.692 per 100 on tax liability), and 2.578 per 100 (16.153 per 100 on tax liability). Table 2 presents the main results provided by Policy 1, in terms of tax collection, average tax rates, and indices of inequality, progression, and redistribution.

In the second tax policy considered (hereafter, Policy 2), the central government establishes a surcharge in both regions. In particular, two tax designs have been analyzed. First, the constituents of region A pay a surcharge of 2.394 per 100 on their post-tax income (15 per 100 on tax liability), and the residents of region B pay a surcharge of 0.587 per 100 (5 per 100 on tax liability). Second, the respective surcharge rates on post-tax income are 3.193 per 100 and 1.175 per 100 (20 per 100 and 10 per 100 on tax liability). The most significant results are given in Table 3.

Figures 1, 2 and 3 show the results of the social welfare assessment using the sequential generalized Lorenz dominance criterion. The main results coincide for both types of policy:

1) In both policies considered, the aggregated (regional+central) tax paid by residents in regions A and B reduces unambiguously inequality, and as a consequence, increases social welfare in each region, in relation to an equal-yield proportional tax. Since the central government tax policy enforced is residual-progression-neutral, it does not modify the income inequality reached by each regional government tax policy (Tables 2 and 3, and Figure 1).

2) In both policies, the overall average tax rate paid by the residents of the richer region A is higher than the one paid in region B (Tables 2 and 3). This result guarantees, in region B, the generalized Lorenz dominance of the post-central and regional tax income over the post-equal-global yield proportional tax income (Figures 2.1 and 3.1).

3) As Theorems 4 and 5 state, and Figures 2.2 and 3.2 reflect, overall income inequality is unambiguously reduced.

4) In accordance with Theorem 3, the above results assure that a tax shared between the central and the regional level of government achieves overall welfare superiority over an equal-yield proportional tax under the social welfare approach suggested by Atkinson and Bourguignon (1987).

In short, our model of PIT decentralization allows inequality reduction and social welfare enhancement, in each region and in the nation as a whole, with regard to an equal-yield proportional tax, as well as the compatibility of the redistribution policies of central and regional governments. Moreover, the hypothetical substitution of the current IRPF by a tax shared between the regional and central levels, in line with Policy 1, would also be supported by a social welfare function *à la* Atkinson and Bourguignon (1987). The fulfilment of Theorem 3 is now reflected in Figure 4.

5. Concluding remarks

In this paper we have designed a model for the decentralization of personal income tax which permits the practical application of the optimal redistribution model proposed by Tresch (2002), in a context of social welfare *à la* Atkinson and Bourguignon (1987). In our framework**,** the regions have individualistic, symmetrical, additively separable and inequality-averse social welfare functions. Each region applies to its constituents a progressive PIT, which measures individuals' ability to pay on the exclusive basis of their

incomes. The central government has a social welfare function *à la* Atkinson and Bourguignon (1987). Its tax-raising power is limited to the establishment of a surcharge or deduction proportional to individuals' income, net of the respective regional taxes. Employing these hypotheses, this paper presents the conditions which permit this model of fiscal decentralization to be recommended, from the viewpoint of reduced inequality and increased welfare, within each region and in the country as a whole. The theoretical results have been applied to the Spanish IRPF, by the performance of various microsimulation exercises.

It should be pointed that this paper is merely intended to suggest a procedure to put into practice the proposal made by Tresch (2002). This does not mean that there exist no alternative schemes for the decentralization of PIT, which could also be approached using the methodology of Atkinson and Bourguignon (1987). This line of investigation will be the subject of future research.

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Figure 1. Within-region income inequality reduction

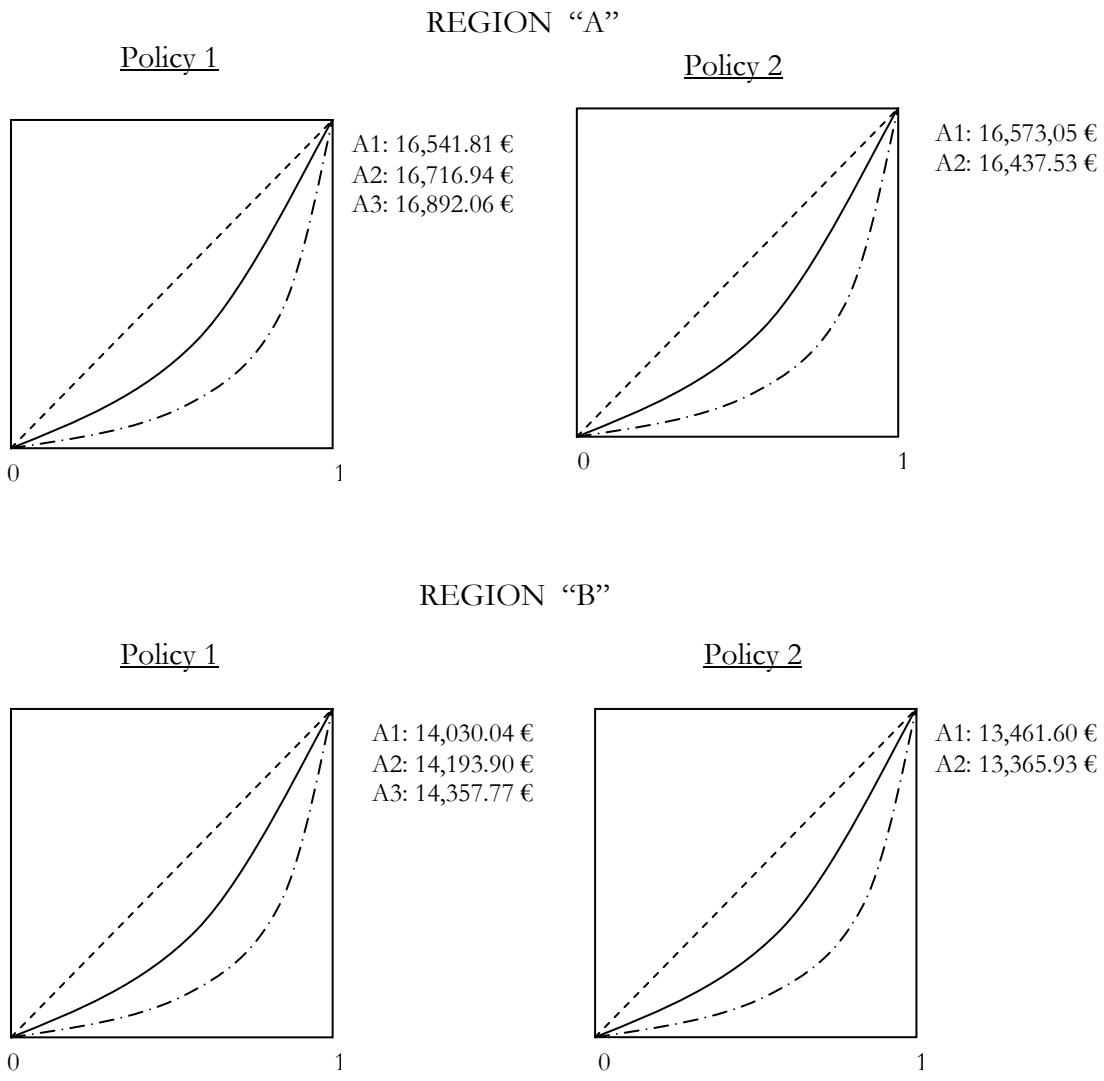
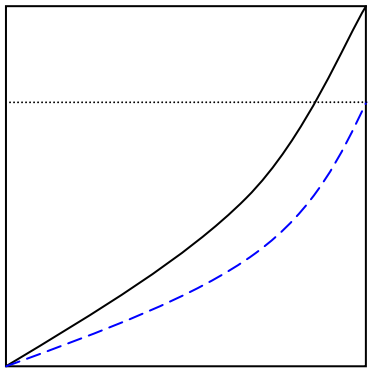
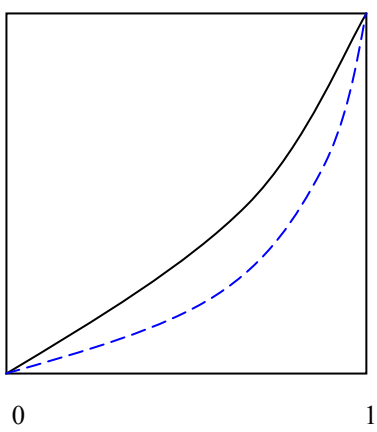


Figure 2. Sequential generalized Lorenz dominance (Policy 1)

Alternative 1	Alternative 2	Alternative 3
Surcharge/Deduction on tax liability:	Surcharge/Deduction on tax liability:	Surcharge/Deduction on tax liability:
Region A: +3.232% Region B: -5%	Region A: +9.692% Region B: -15%	Region A: +16.153% Region B: -25%



(2.1) REGION "B"



(2.2) REGION "B" + REGION "A"

Post-progressive regional+central tax income

Post-equal-yield proportional tax income

Figure 3. Sequential generalized Lorenz dominance (Policy 2)

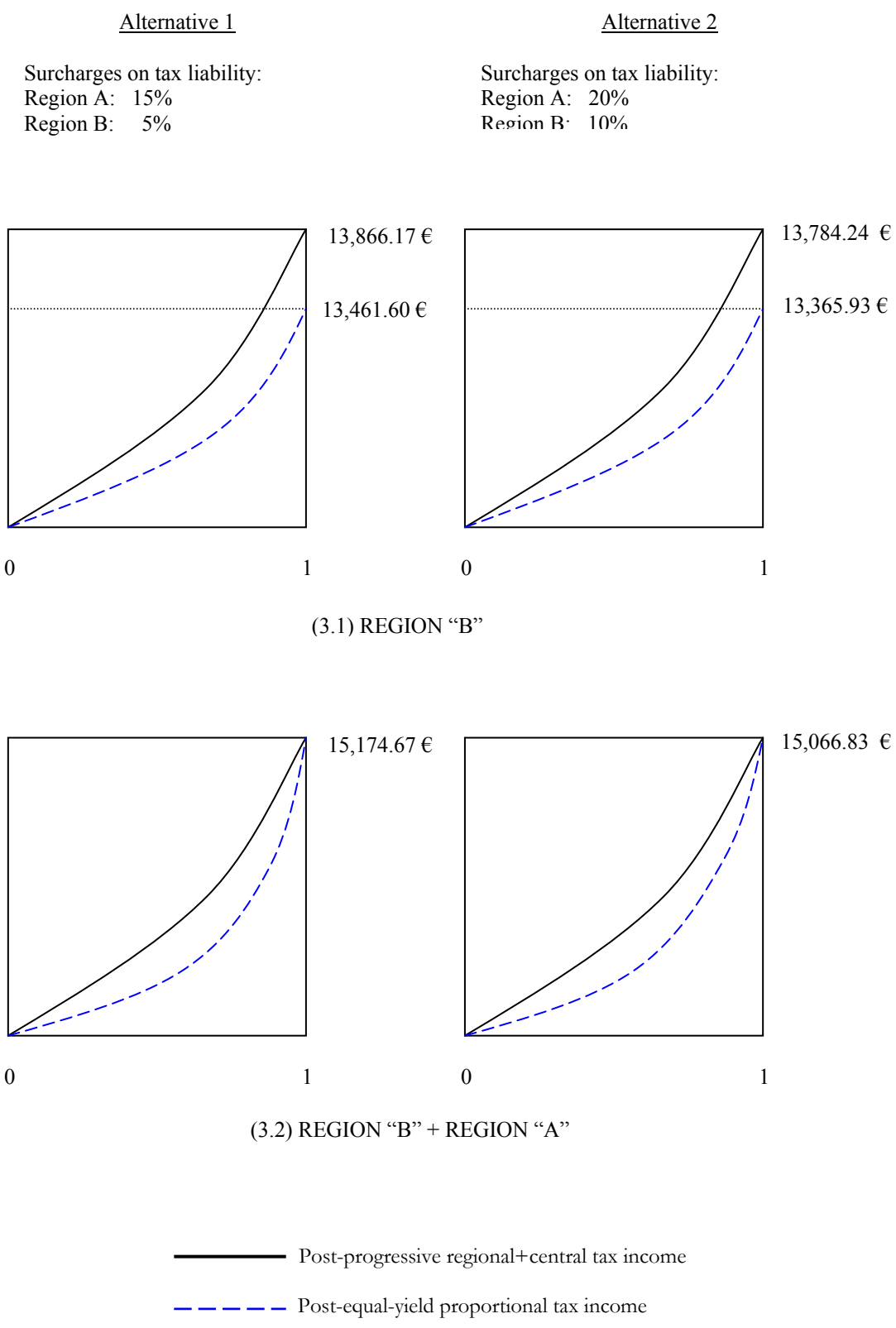
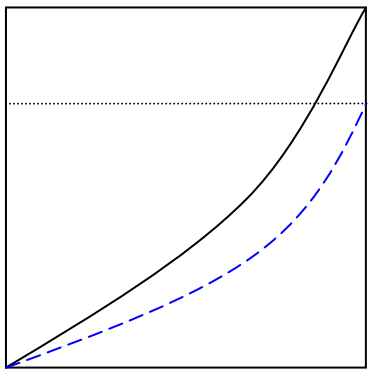
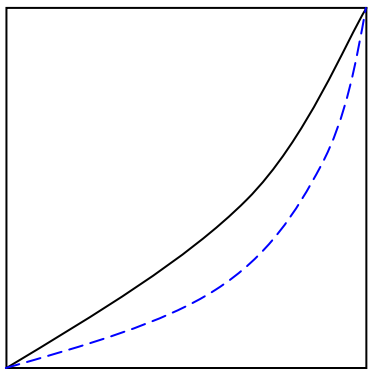


Figure 4. Sequential generalized Lorenz dominance (Policy 1 - current IRPF)

Alternative 1	Alternative 2	Alternative 3
Surcharge/Deduction on tax liability:	Surcharge/Deduction on tax liability:	Surcharge/Deduction on tax liability:
Region A: +3.232% Region B: -5%	Region A: +9.692% Region B: -15%	Region A: +16.153% Region B: -25%



(4.1) REGION "B"



(4.2) REGION "B" + REGION "A"

Post-progressive regional+central tax income

Post-equal-yield proportional tax income

Table 1. Income concentration in regions A and B

Incomes not Exceding (€)	$S_A(y)$	$S_B(y)$
3,005.00	0,0026	0,0051
6,010.00	0,0196	0,0382
9,015.00	0,0712	0,1242
12,020.00	0,1592	0,2440
15,025.00	0,2502	0,3512
18,030.00	0,3382	0,4449
21,035.00	0,4180	0,5254
24,040.00	0,4919	0,5972
27,046.00	0,5589	0,6568
30,051.00	0,6120	0,7049
36,061.00	0,6968	0,7861
42,071.00	0,7595	0,8420
48,081.00	0,8064	0,8805
54,091.00	0,8421	0,9080
60,101.00	0,8673	0,9262
66,111.00	0,8890	0,9393
72,121.00	0,9046	0,9492
78,132.00	0,9170	0,9582
84,142.00	0,9256	0,9636
90,152.00	0,9309	0,9694
120,202.00	0,9535	0,9808
150,253.00	0,9641	0,9878
180,304.00	0,9679	0,9903
240,405.00	0,9731	0,9910
300,506.00	0,9762	0,9941
601,012.00	0,9815	0,9952
1,202,024.00	0,9829	0,9952
3,005,061.00	0,9882	1,0000
2,103,542.00	1,0000	1,0000

Table 2. Decentralization of the IRPF with deduction/surcharge from central government. Average tax rates. Indices of inequality, progressivity, and redistribution.

				Tax revenue neutrality					
d(T)(B)	d(Y)(B)	t(X)(B)	t(d)(X)(B)	Reduction T(B)	Increase T(A)	s(T)(A)	s(Y)(A)	t(X)(A)	t(s)(X)(A)
0.05	0.005874	0.105132	0.099875	11,836.56	11,836.56	0.032305	0.005157	0.137655	0.142102
0.15	0.017622	0.105132	0.089362	35,509.68	35,509.68	0.096916	0.015471	0.137655	0.150996
0.25	0.029371	0.105132	0.078849	59,182.80	59,182.80	0.161527	0.025784	0.137655	0.159890

	s(T)(A) # d(T)(B)	t(X)	Gini (X)	Gini (Y)	Con.Index (T)	R-S Index	t(s,d)(X)	K Index	R
Region A	0.0000	0.1377	0.405066	0.360329	0.694281	0.044737	0.1377	0.289214	0.001430
Region B	0.0000	0.1051	0.398103	0.361516	0.715263	0.036587	0.1051	0.317160	0.000673
Overall A + B		0.1228	0.406381	0.365417	0.704106	0.040964	0.1228	0.297725	0.000695
Region A	0.0323	0.1377	0.405066	0.360329	0.683785	0.044737	0.1421	0.278719	0.001430
Region B	-0.0500	0.1051	0.398103	0.361516	0.733917	0.036587	0.0999	0.335814	0.000673
Overall A + B		0.1228	0.406381	0.364915	0.703271	0.041466	0.1228	0.296890	0.000076
Region A	0.0969	0.1377	0.405066	0.360329	0.664649	0.044737	0.1510	0.259582	0.001430
Region B	-0.1500	0.1051	0.398103	0.361516	0.777808	0.036587	0.0894	0.379705	0.000673
Overall A + B		0.1228	0.406381	0.363982	0.701603	0.042399	0.1228	0.295222	-0.001090
Region A	0.1615	0.1377	0.405066	0.360329	0.647641	0.044737	0.1599	0.242575	0.001430
Region B	-0.2500	0.1051	0.398103	0.361516	0.833404	0.036587	0.0788	0.435301	0.000673
Overall A + B		0.1228	0.406381	0.363145	0.699934	0.043236	0.1228	0.293553	-0.002161

d(T)(·): deduction rate as percentage of tax liability.
d(Y)(·): deduction rate as percentage of post-tax income (Y=X–T).
t(X)(·): effective average tax rate (current IRPF).
t(d))X)(·): effective average tax rate (after deduction applied).
s(T)(·): surcharge rate as percentage of tax liability.
s(Y)(·): surcharge rate as percentage of post-tax income (Y=X-T).
t(s)(X)(·): effective average tax rate (after surcharge applied)

RS: Reynolds-Smolensky index.
K: Kakwani index.
R: Reranking effect.

Table 3. Decentralization of the IRPF with surcharges from central government. Average tax rates. Indices of inequality, progressivity, and redistribution.

				Tax revenue change					
s(T)(B)	s(Y)(B)	t(X)(B)	t(s)(X)(B)	Increase T(B)	Increase T(A)	s(T)(A)	s(Y)(A)	t(X)(A)	t(s)(X)(A)
0.0500	0.005874	0.105132	0.110388	11,836,560.12	54,959,448,09	0.1500	0.023944	0.137655	0.158303
0.1000	0.011748	0.105132	0.115645	23,673,120.24	73,279,264.12	0.2000	0.031926	0.137655	0.165186

	s(T)(A) # s(T)(B)	t(X)	Gini (X)	Gini (Y)	Conc. Index (T)	R-S Index	t(s)(X)	K Index	R
Region A	0.0000	0.1377	0.405066	0.360329	0.694281	0.044737	0.1377	0.289214	0.001430
Region B	0.0000	0.1051	0.398103	0.361516	0.715263	0.036587	0.1051	0.317160	0.000673
Overall A + B		0.1228	0.406381	0.365417	0.704106	0.040964	0.1228	0.297725	0.000695
Region A	0.1500	0.1377	0.405066	0.360329	0.650535	0.044737	0.1583	0.245469	0.001430
Region B	0.0500	0.1051	0.398103	0.361516	0.698386	0.036587	0.1104	0.300283	0.000673
Overall A + B		0.1228	0.406381	0.364595	0.669036	0.041786	0.1363	0.262655	-0.000321
Region A	0.2000	0.1377	0.405066	0.360329	0.638384	0.044737	0.1652	0.233317	0.001430
Region B	0.1000	0.1051	0.398103	0.361516	0.683043	0.036587	0.1156	0.284940	0.000673
Overall A + B		0.1228	0.406381	0.364497	0.655791	0.041884	0.1425	0.249409	-0.000443

s(T)(·): surcharge rate as percentage of tax liability.
s(Y)(·): surcharge rate as percentage of post-tax income (Y=X-T).
t(X)(·): effective average tax rate (current IRPF).
t(s)(X)(·): effective average tax rate (after surcharge applied)

RS: Reynolds-Smolensky index.
K: Kakwani index.
R: Reranking effect.