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28. August-1. September 1998 in Vienna

Welfare Effects of Regional Income Taxes

Results of an Interregional CGE Analysis for Germany*

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Abstract

This paper deals with the question, whether in a federal state the regions should obtain the right to levy regional income taxes. It is shown that a revenue sharing system influences the optimal income tax rates and causes distortions. In a federal system with other distorting taxes, several states and a revenue sharing system the welfare effects of regional income taxes can be positive or negative due to second best problems. Therefore the welfare effects of regional income taxes are computed by means of an interregional computable general equilibrium analysis (CGE). The results suggest that in the German federal economy the sign of the welfare effects of the introduction of regional income taxes is very sensitive to the particular institutional arrangements.

JEL-Classifications: C68, H21, H71, H77, R13, R15

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1. Introduction

Among other things fiscal federalism deals with the optimal degree of fiscal autonomy of the states, for instance the optimal division of the power to tax between different levels of government and the optimal revenue sharing systems. The arguments lie between two extreme points of view: on the one hand the theory of competitive federalism, which is in favor of decentralization and competition between states (e.g. Tiebout 1956 or Brennan and Buchanan 1980), and on the other hand the theory of cooperative federalism with an emphasis on common interests and cooperation (e.g. Kenyon and Kincaid 1991).

Although most federal states have a tax sharing and/or fiscal equalization system, none of the studies of fiscal competition between states (e.g. Shannan 1986, Breton 1987, Dye 1990 or Oates and Schwab 1991) take revenue sharing or refinancing of public expenditure into account¹.

The aim of this paper is to link fiscal competition with a revenue sharing system. As it is not possible to investigate all aspects here, this paper focuses on the question whether in a tax sharing and fiscal equalization system the states in a federal system should obtain the right to levy regional income taxes. This issue is examined by discussing some aspects of efficiency, such as optimal tax rates, price distortions and the regional and national welfare effects of different kinds of fiscal autonomy. For this purpose it will be useful to distinguish between two degrees of fiscal autonomy:

- firstly, no fiscal autonomy at all, i.e. the states do not have any power to tax. The receipts of the national taxes are spread between the states by means of a tax sharing and fiscal equalization system. The governments of the states must spend completely the grants received on a regional public good. In addition they are not allowed to vary transfers to their private households.
- secondly, (constrained) fiscal autonomy, i.e. the states are allowed to levy regional income taxes. In this case the state governments can "transform" public revenue into private incomes by means of changes in the regional tax rates.

The theoretical results are developed in the next section by employing a partial model²: section 2.1 shows the existence of some price distortions caused by regional taxes by comparing the optimality conditions in the two cases of fiscal autonomy. To simplify this analysis

interregional interdependencies are not taken into account. In the following section 2.2 optimal regional labour income taxes and some implications are derived and discussed.

Because of second best problems and many interregional interdependencies it is not possible to derive unequivocal results from the theoretical analysis. Hence the direction of the effects has to be determined by means of an empirical study. Therefore an interregional computable general equilibrium analysis (CGE) for Germany has been carried out. By displaying and discussing the computed welfare effects the proposal of the Wissenschaftlicher Beirat beim Bundesfinanzministerium³ (Wissenschaftlicher Beirat 1992) to introduce state labour income tax supplements is examined and some political conclusions are drawn.

2. Partial analysis

2.1 The model without fiscal autonomy

In the partial model all interregional spillovers or influences are assumed to be exogenous and constant or non-existent⁴. In addition it is assumed that the decisions of the units which produce goods (firms) do not matter. Therefore one can focus entirely on the decisions of the government of one state and the representative private household of this state.

The government of the state maximizes the indirect utility $\nu(G; \tau, p, w, Y)$ of its representative consumer by choosing the optimal amount of the supply of the regional public good G with prices q and the optimal level of the transfers to the private household Tr . The government budget restriction ensures the equality between revenue from the equalization and tax sharing system $Z(\cdot)$ and expenditure on the regional public goods and transfers. There are no government or individual debts or credits. The revenue $Z(\cdot)$ depends on the revenue sharing system used and on public expenditure, i.e. on G and Tr .⁵

The case of no fiscal autonomy can be described by means of a rationing constraint on transfers, i.e. $Tr = \overline{Tr}$. This is the second constraint to the governmental optimization problem.⁶ Therefore the optimization problem of the regional government is given by

$$\begin{aligned}
 (1) \quad & \max_{G, Tr} \nu(G; p, w^n, Y) \\
 & \text{s.t.: (1) } qG + Tr = Z(\cdot) \\
 & \quad \quad (2) Tr = \overline{Tr} .
 \end{aligned}$$

The indirect utility function of the representative consumer is defined as

$$(2) \quad \nu(G; p, w^n, Y) = \left\{ \max_{F, C} H(G; F, C) \text{ s.t.: } pC + w^n F = w^n E + Tr = Y \right\},$$

F is leisure, E the time endowment, C is the *composite commodity* with gross price p , and $w^n = w(1 - \tau)$ is the net wage rate, where the income tax rate is τ .⁷

From the Lagrangean

$$\mathcal{L} = \nu(G; p, w^n, Y) + \lambda [Z(G, Tr) - qG - Tr] + \mu (\overline{Tr} - Tr)$$

one obtains by optimization

$$(3) \quad \frac{\partial \nu}{\partial G} = \lambda \left(q - \frac{\partial Z(\cdot)}{\partial G} \right).$$

and

$$(4) \quad \frac{\partial \nu(\cdot)}{\partial Y} \frac{\partial Y}{\partial Tr} = \lambda \left(1 - \frac{\partial Z(\cdot)}{\partial Tr} \right) + \mu.$$

At optimum the derivative of $\nu(\cdot)$ with respect to G is identical to the derivative of the direct utility $H(\cdot)$ at G (Auerbach 1985 p. 113). Therefore, the equation (3) may be rewritten as

$$(5) \quad \frac{\partial H}{\partial G} = \lambda q \left(1 - \frac{\partial Z(\cdot)}{\partial (qG)} \right).$$

The first order conditions of the private maximization problem (2) are

$$(6) \quad \frac{\partial H(\cdot)}{\partial C} = \alpha p \quad \frac{\partial H(\cdot)}{\partial F} = \alpha w^n,$$

where α is the Lagrange multiplier, i.e. the marginal utility of private income.

To determine the distortions between public and private consumption, one can consolidate the marginal conditions (5) and (6) into

$$(7) \quad \frac{\partial H(\cdot)/\partial G}{\partial H(\cdot)/\partial C} = \frac{\lambda q [1 - \partial Z(\cdot)/\partial (qG)]}{\alpha p}.$$

and

$$(8) \quad \frac{\partial H(\cdot)/\partial G}{\partial H(\cdot)/\partial F} = \frac{\lambda q [1 - \partial Z(\cdot)/\partial (qG)]}{\alpha w^n}.$$

These equations show some preliminary results: the marginal rate of substitution (MRS) between the regional public good and the composite commodity or leisure depends

on the impact of the regional public expenditure qG on the equalization and tax sharing grants $Z(\cdot)$, the ratio of the prices of the goods q/p or q/w^n , and the relationship between the marginal utility of public revenue λ and the marginal utility of private income α . If $\lambda > \alpha$, the region will forgo for one additional unit of the public good more than one unit of the private good, i.e. the private good becomes relatively cheaper.

Since $\alpha = \partial\nu/\partial Y$ and $\partial Y/\partial Tr = 1$, rearranging equation (4) gives

$$\frac{\lambda}{\alpha} = \frac{1}{[1 - \partial Z(\cdot)/\partial Tr] + \mu/\lambda}.$$

By using this to substitute for λ/α in equations (7) and (8) these equations become

$$\frac{\partial H(\cdot)/\partial G}{\partial H(\cdot)/\partial C} = \frac{q[1 - \partial Z(\cdot)/\partial(qG)]}{p[(1 - \partial Z(\cdot)/\partial Tr) + \mu/\lambda]}$$

and

$$\frac{\partial H(\cdot)/\partial G}{\partial H(\cdot)/\partial F} = \frac{q[1 - \partial Z(\cdot)/\partial(qG)]}{w^n[(1 - \partial Z(\cdot)/\partial Tr) + \mu/\lambda]}.$$

The wedge between the relative prices and the MRS depends on the shadow price of rationing μ , the marginal utility of regional public revenue λ , and on the response of the regional public revenue to a change of public expenditure on the public good or transfers.

If Z is independent of public expenditure and there is no rationing, the MRS is equal to the ratio of the prices of goods. Therefore rationing as well as a non-zero relation between regional public expenditure and the revenue from equalization and tax sharing cause distortions.

The derivatives $\partial Z(\cdot)/\partial G$ and $\partial Z(\cdot)/\partial Tr$ depend on the equalization and tax sharing system used. If Z is a function of receipts of taxes T , which is also a function of public expenditure, the modified expressions are

$$(9) \quad \frac{\partial Z(\cdot)}{\partial G} = \frac{\partial Z}{\partial G} + \frac{\partial Z}{\partial T} \frac{\partial T}{\partial G} \quad \text{and} \quad \frac{\partial Z(\cdot)}{\partial Tr} = \frac{\partial Z}{\partial Tr} + \frac{\partial Z}{\partial T} \frac{\partial T}{\partial Tr}$$

where $Z(\cdot) = Z(G, Tr, T(G, Tr))$. These expressions state that higher expenditure on the public good or transfers increase the regional receipts of taxes, for instance, through growing receipts of income or value-added taxes. Since all returns of taxes are shared by the federal and state governments, it is not certain that higher tax receipts result in higher state budgets. To discover the sign and the level of this relationship the institutional arrangements have to be investigated.

The German revenue sharing system as well as most of the proposals to reform it do not include a direct impact of G and Tr on Z . So the first expression on the right hand side of equation (9) becomes zero.⁸ Some computations for the year 1991 show that $\partial Z/\partial T$ is between 0.0 and 0.37 for income, value-added, corporate and capital taxes (see Hirte 1996b). This means that less than 37 % of the increase of the receipts of taxes stays in the tax collecting state. At any rate, $\partial Z/\partial T$ is greater than or equal to zero. Hence, if regional expenditure leads to higher receipts of taxes, the regional expenditures refinance themselves partly through higher revenue, i.e. $\partial Z/\partial G > 0$ and $\partial Z/\partial Tr > 0$.

The second source of distortion is the ratio of the shadow price of rationing μ to the marginal utility of public revenue μ/λ . If the states do not have any fiscal autonomy, the rationing constraint is binding and the states cannot respond to an increase or decrease in revenue. Therefore they have to provide more or less of the public good than they would do without any restrictions.

2.2 Regional taxes

2.2.1 Public decision on public expenditure

Here it is assumed that transfers are exogenous and the states are allowed to impose regional taxes, for example income taxes with tax rate τ . As a result each government of a state maximizes the indirect utility of its representative consumer by choosing G and τ . The corresponding optimization approach is

$$\begin{aligned} \max_{G, \tau} \nu(G; \tau, p, w, Y) \\ \text{s.t.: } qG + Tr = Z(G, \tau), \end{aligned}$$

where equation (2) gives the indirect utility function $\nu(G; \tau, p, w, Y)$.

The solutions to the regional and the private maximization problem with respect to G , C and F are given by the equations (7) and (8). The only modification comes from the choice of τ . The derivative of the Lagrangean with respect to τ then becomes

$$\frac{\partial \mathcal{L}(\cdot)}{\partial \tau} = \frac{\partial \nu(\cdot)}{\partial w^n} \frac{\partial w^n}{\partial \tau} + \frac{\partial \nu(\cdot)}{\partial Y} \frac{\partial Y}{\partial \tau} + \lambda \left(\frac{\partial Z(\cdot)}{\partial \tau} \right) = 0.$$

The last quotient allows for differing institutional tax arrangements. For instance, the receipts of the regional taxes can be subjected to national tax sharing or can change the amount of the equalization payments.

Substituting $\partial\nu/\partial w^n = -\alpha F$ and $\partial\nu/\partial p = -\alpha C$ (Roy's identity, see e.g. Varian 1992 p. 149) and $\partial\nu/\partial Y = \alpha$ the above equation transforms into

$$-\frac{\lambda}{\alpha} = \frac{\partial Y/\partial\tau - F(\partial w^n/\partial\tau)}{\partial Z(\cdot)/\partial\tau},$$

and finally the modified MRS is

$$\frac{\partial H(\cdot)/\partial G}{\partial H(\cdot)/\partial C} = \frac{q[1 - \partial Z(\cdot)/\partial(qG)]}{p \left[-\frac{\partial Z(\cdot)/\partial\tau}{\partial Y/\partial\tau - F(\partial w^n/\partial\tau)} \right]}.$$

This equation shows that the institutional arrangements of the tax sharing and equalization system ($\partial Z(\cdot)/\partial(qG)$ and $\partial Z(\cdot)/\partial\tau$) as well as the response of the marginal private income and expenditure to a change of the tax rate ($\partial Y/\partial\tau$ and $F(\partial w^n/\partial\tau)$) determine the distortions. This outcome is also valid for the MRS between G and F .

2.2.2 Optimal regional income tax rates

With regard to regional taxes the question arises whether the receipts of the regional tax should be subjected to national tax sharing. The answer to this question depends on the impact of the tax sharing system on the optimal regional tax rate. If tax sharing produces disincentives for the states to strengthen their tax efforts, the regional tax rates will be too low compared to the tax rates without tax sharing. In this case the receipts of the regional taxes should not be shared with other states. To deal with this issue the optimal income tax rate of a state is derived in this section.

Therefore the decision problem of a state is to maximize the indirect utility of its representative consumer subject to the regional public budget constraint through the choice of the optimal regional income tax rate, i.e.

$$\begin{aligned} \max_{G,\tau} \nu(G; \tau, p, w, Y) \\ \text{s.t.: } qG + Tr = Z(T), \quad \text{where } T = \tau wL, \end{aligned}$$

and the indirect utility function is again defined in equation (2).

Because $\partial w^n/\partial\tau = -w$ and $\partial Y/\partial\tau = -wE$ the derivative of the Lagrangean with respect to τ is

$$\frac{\partial \mathcal{L}(\cdot)}{\partial\tau} = -\frac{\partial\nu(\cdot)}{\partial w^n}w - \frac{\partial\nu(\cdot)}{\partial Y}wE + \lambda \frac{\partial Z(\cdot)}{\partial T} \left(wL - \tau w^2 \frac{\partial L}{\partial w^n} \right) = 0.$$

Using Roy's identity $\partial\nu/\partial w^n = -\alpha F$ and $\partial\nu/\partial Y = \alpha$ this may be transformed into

$$\alpha(E - F) = \lambda \frac{\partial Z(\cdot)}{\partial T} \left(L - \tau w \frac{\partial L}{\partial w^n} \right)$$

i.e.

$$\left[1 - \frac{\alpha}{\lambda(\partial Z(\cdot)/\partial T)} \right] L = \tau w \frac{\partial L}{\partial w^n} .$$

Expansion gives

$$\left[1 - \frac{\alpha}{\lambda(\partial Z(\cdot)/\partial T)} - \tau w \frac{\partial L}{\partial Y} \right] L = \tau w \left(\frac{\partial L}{\partial w^n} - L \frac{\partial L}{\partial Y} \right) .$$

Applying the Slutsky equation

$$\frac{\partial L}{\partial w^n} = s_{LL} + L \frac{\partial L}{\partial Y} ,$$

where s_{LL} is the substitution term, the above expression may be rewritten as:

$$(10) \quad \left[1 - \frac{\alpha}{\lambda(\partial Z(\cdot)/\partial T)} - \tau w \frac{\partial L}{\partial Y} \right] \frac{L}{w^n} = \frac{\tau}{1 - \tau} s_{LL} .$$

Let us now define the social marginal utility of private income γ as

$$\gamma = \alpha + \lambda \frac{\partial Z(\cdot)}{\partial T} \tau w \frac{\partial L}{\partial Y}$$

i.e. the marginal utility of private income α plus the marginal utility of the increase of public revenue that is induced by higher private income. Hence, substituting into (10) gives

$$\left[1 - \frac{\gamma}{\lambda(\partial Z(\cdot)/\partial T)} \right] \frac{L}{w^n} = \frac{\tau}{1 - \tau} s_{LL} .$$

From the definition of the net wage elasticity of compensated labour supply

$$\epsilon = \frac{w^n}{L} s_{LL}$$

it follows that

$$(11) \quad \frac{\tau^*}{1 - \tau^*} = \frac{1}{\epsilon} \left[1 - \frac{\gamma}{\lambda(\partial Z(\cdot)/\partial T)} \right] .$$

The lower the compensated wage elasticity of labour supply and the lower the relation between the social marginal utility of private income and the marginal utility of an additional income tax unit, the higher is the optimal income tax rate. An additional unit of

the receipts of income taxes causes a loss of γ and a gain of $\lambda(\partial Z(\cdot)/\partial T)$ in the marginal utility. If the latter is greater than γ , a higher tax rate increases the gain in marginal utility. The equation (11) shows that the optimal tax rate depends on the tax sharing and equalization system. If the receipts of the regional tax are not subjected to the national tax sharing or equalization system, the optimal tax rate is

$$\frac{\tilde{\tau}^*}{1 - \tilde{\tau}^*} = \frac{1}{\epsilon} \left[\frac{\lambda - \tilde{\gamma}}{\lambda} \right],$$

where

$$\tilde{\gamma} = \alpha + \lambda\tau w \frac{\partial L}{\partial Y}.$$

If all variables except $\tilde{\tau}$ and $\tilde{\gamma}$ are the same in both cases, then $\tilde{\gamma} > \gamma$ if $\partial Z(\cdot)/\partial T < 1$.

The optimal tax rate without tax sharing is greater than the optimal tax rate with tax sharing. Hence the incentives to strengthen the regional tax effort increase if the receipts of the regional tax are not included in the tax sharing or equalization system. Generally speaking the incentives are the higher the higher the value of $\partial Z(\cdot)/\partial T$, i.e. the higher the part of the receipts of the regional tax which stays in the tax state imposing the tax.

In the German case the incentives to strengthen tax efforts of the states will be low if the regional taxes are subjected to the existing tax sharing and equalization system, since $\partial Z(\cdot)/\partial T$ is between 0.0 and 0.37. Therefore the results support the recommendation of the Wissenschaftlicher Beirat (1992) not to include the regional income taxes into the national tax sharing and equalization system.

3. CGE-Analysis for Germany

The distortions or disincentives discussed above are derived in a partial model. It can be shown that in a general equilibrium model similar distortions result even if a detailed tax system and interregional trade are included (see Hirte 1996a).

The foregoing considerations do not take into account the welfare aspects of the tax reform discussed. So far the optimality conditions of the different systems have been presented. But it is well known from the literature on second best, that the derived welfare effects of tax reforms can be misleading if only these conditions are examined. To investigate these problems further, a computable general equilibrium analysis (CGE) can

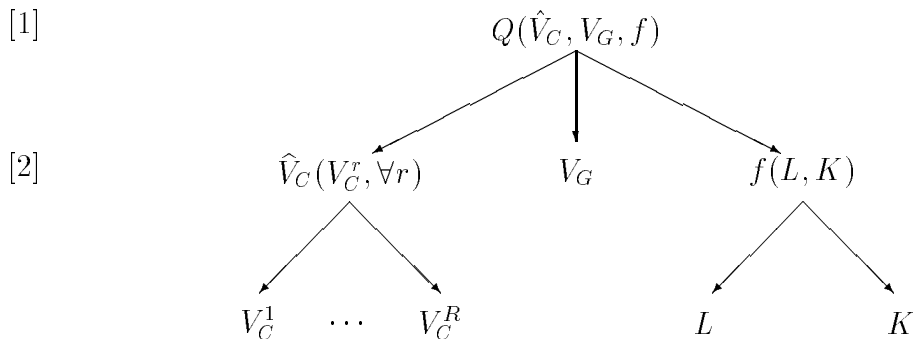


Figure 1: Technology

help to provide further insights into the signs of the welfare effects of the introduction of regional income taxes in Germany.

3.1 Model and Database

The CGE Model is of the Shoven Whalley type (see Shoven and Whalley 1972) and its interregional structure is similar to Jones and Whalley (1988) and Fehr, Rosenberg and Wiegard (1993). It is fully described in Hirte (1996a), as is the database and the solution algorithm.

The model is an eleven region model, where the regions are the ten western states of Germany and an aggregated eastern state (the new states). In every region there are two production sectors, one producing the regional public good and the other a private good used as a consumer good as well as an intermediate good.

The decisions about factor demands of the firms which maximize profits are divided into two parts. The overall production functions $Q(\cdot)$ are of the Leontief type, i.e. linear-limitational functions with constant coefficients for the value-added production functions $f(L, K)$, the input of the regional public good V_G , and the private intermediate production functions \hat{V}_C . Hence one branch of the decision problem is the optimal choice of the demand for the primary factors, i.e. labour and capital input (L and K). The method used is a value added production function of the CES type. The second branch is the determination of the demand for the private intermediate goods, based on a CES production function, where the inputs are all private goods V_C^r which are produced in state r , where $r \in 1, \dots, R$ (see figure 1).

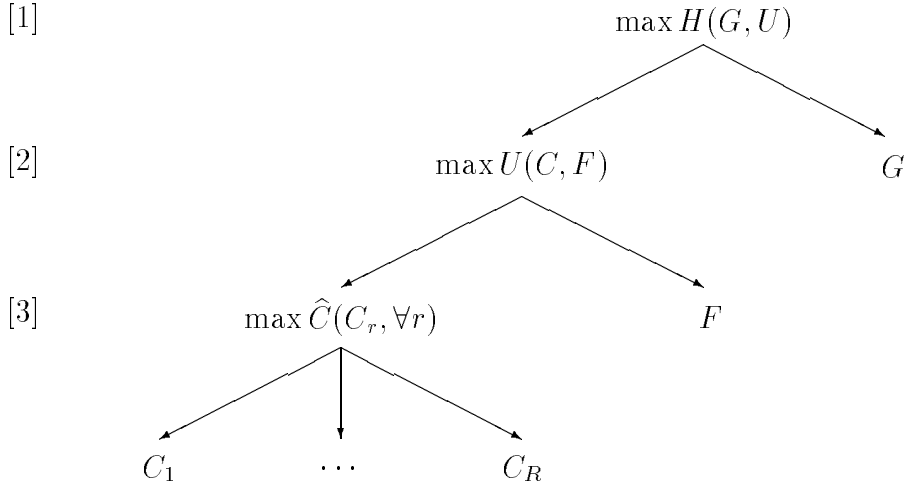


Figure 2: Utility tree

Capital is supplied inelastically by the regional households and is perfectly mobile between states. Labour that is supplied elastically is only intersectorally mobile but is immobile between regions, i.e. there is no interregional labour migration. The latter assumption rules out tax or expenditure competition by means of immigration, like "voting-by-feet" (Tiebout 1956 or for other aspects of migration, e.g. Boadway and Flatters 1982).

The individuals of each state are represented by a representative consumer who maximizes utility. His utility function is organized as an utility tree with utility functions of the CES type $H(G, U)$, $U(\hat{C}, F)$ and $\hat{C}(C_r, \forall r)$ (see figure 2). On the first decision level the consumer fixes his demand for the regional public good G and the private composite commodity U . This also determines the transfers. On the second level the private household maximizes subutility $U(\hat{C}, F)$ by fixing the demand for consumption of the composite consumer good \hat{C} and leisure F . On the third level the decision is between the varieties of the consumer goods distinguished by their place of production C_r , i.e. the Armington definition is employed (Armington 1969).

In each state the government supplies that quantity of the regional public good and transfers which is preferred by the representative consumer of the state. The federal government levies taxes on consumption, capital and labour incomes, production, and capital inputs. The receipts of the taxes are distributed among the national and state governments by means of an equalization and tax sharing system that is identical to the existing German system.

The database is computed for the year 1982 and is based on the input-output tables of

Hessen, Nordrhein-Westfalen and Baden-Württemberg and the former Federal Republic of Germany. The input-output coefficients of the other states are "guesstimated" by assuming identical technology and demand structure of the German states corrected by some other data. The interregional flows of goods are estimated by applying a gravitation model (e.g. Carlberg 1979). The parameters of the functions, for instance the labour supply and the substitution elasticities, etc., are taken from the literature (e.g. Stern et. al. 1976 or Weber 1996).

3.2 Some preliminary remarks on the simulations

In the next sections the welfare effects of the reform proposal of the Wissenschaftlicher Beirat (1992) are presented. The Wissenschaftlicher Beirat recommends a reform of the tax sharing and equalization system as well as the introduction of regional labour income tax supplements in Germany. The Beirat proposes to simplify the equalization tariff and to abolish all equalization components in the VAT sharing system.⁹ The receipts of these regional taxes should not be subjected to revenue sharing. The latter is also definitely favored by the theoretical results derived above.

In order to evaluate the influence of fiscal autonomy the results of the simulation of the introduction of fiscal autonomy are compared with the results of the introduction of the reform schemes without fiscal autonomy, i.e. without regional taxes. Additionally, some sensitivity simulations are carried out to investigate the reliability of the results.

The welfare effects of the states are measured by means of the Hicksian Equivalent Variation (EV). The national or overall welfare is computed by adding all regional EV.¹⁰

As the sum of the interregional transfers is zero the overall welfare effects are the result of national tax exports and substitution effects only. The welfare effects of the states consist of income and substitution effects. Therefore the EV is decomposed into both components.

The income effects are equal to the changes in net transfers (ΔTr) consisting of changes in the equalization and tax sharing grants (ΔZ), in other grants-in-aid to the state, in national transfers to the regional consumer, and in tax exports¹¹. The latter is computed by means of effective tax rates (see Hirte 1996a for more details),

The substitution effects are computed by some additional simulations, where the ΔTr are transferred back to the states, i.e. the states are compensated. The resulting Equivalent

Variations (EV_S) are approximations of the substitution effects. These approximations are sometimes not very good since the retransferring of ΔTr causes new income effects, e.g. changes in the tax sharing and equalization payments. Also there is no other efficient way to guess the substitution effects.

Another measure employed is the terms of trade (ToT), which are defined as the net-barter terms of trade and computed as Laspeyres indices. The changes in the ToT are mainly caused by interregional substitution effects and changes in the interregional net transfers. They represent the direction and the amount of the welfare effects induced by these interregional effects.

3.3 Results: fiscal reform without fiscal autonomy

The first simulations compute the effects of the introduction of the reform schemes of the Wissenschaftlicher Beirat (1992) without fiscal autonomy. The latter means that the states are not able to change lump-sum transfers or levy regional taxes. Table 1 shows the resulting welfare effects.

National welfare shown in million DM in the last row of column 2 is unchanged. The EV of the states are shown in column 2 in million DM and in column 3 in percent of regional public revenue, which encompasses revenue from tax sharing and fiscal equalization as well as other federal grants to the state. The figures show that the eastern states (ES), Baden-Württemberg (BW), and Hessen (HE) are better off whereas all other states are worse off.

The fourth column gives the changes in net transfers, which in all cases have identical signs and almost the same amount as the EV. Obviously, the change of net transfers dominates the sign and magnitude of the welfare effects.

The fifth column shows the substitution effects. In the case considered the approximation of the substitution effects is not bad. This is seen clearly by adding up column 4 and 5 and comparing it with column 3.

The substitution effects are low compared with the income effects and in a few cases of opposite sign to the overall EV. In most cases they are also opposite to the changes in the terms of trade, which are dominated by changes in net transfer. Because there are no changes in tax rates, the substitution effects are only caused by changes in prices.

1	2	3	4	5	6	7
State	EV	Δ Tr	EV _S	Δ ToT	Δ Z	
	mill	in %	in %	% of	% of	% of
	DM	of REV ^a	REV	REV	ToT	REV
SH ^b	-253	-3.8	-2.6	-1.2	-0.1	-2.8
HH ^c	-31	-0.5	-1.4	1.1	-0.2	-0.1
HB ^d	-171	-6.9	-6.3	0.2	-0.2	-5.6
NS ^e	-653	-3.5	-2.7	-0.6	0.0	-2.6
NW ^f	-42	-0.1	-0.2	0.1	-0.1	0.3
HE ^g	110	0.7	0.1	0.6	-0.1	1.1
RP ^h	-143	-1.5	-1.1	-0.3	0.1	-0.9
SA ⁱ	-223	-8.1	-6.5	-0.8	0.1	-6.6
BW ^j	484	1.9	1.5	0.4	0.0	2.1
BY ^k	-211	-0.7	-0.7	0.0	0.0	-0.2
ES ^l	1132	3.0	3.3	-0.1	1.1	3.8
Σ	0					

Table 1: Welfare effects without fiscal autonomy

^a Regional public revenue, i.e. grants from tax sharing and fiscal equalization as well as other federal grants to the state, ^b Schleswig-Holstein, ^c Hamburg, ^d Bremen, ^e Niedersachsen, ^f Nordrhein-Westfalen, ^g Hessen, ^h Rheinland-Pfalz, ⁱ Saarland, ^j Baden-Württemberg, ^k Bavaria, ^l Eastern States

The reason for these changes in prices are lower or higher transfers to the relatively poor states resulting in higher price differences. If these differences are increasing the existing distortions caused by distinct regional tax rates increase and the substitution effects also increase.

Another not surprising result is the congruence of the changes in revenue sharing and equalization grants (ΔZ) with the changes in net transfers.

3.4 Results: fiscal reform with regional income tax supplements

3.4.1 Tax supplements with previous tax cut

The Wissenschaftlicher Beirat (1992) suggests national and regional income tax supplements with a previous cut in the national tax rates. The simulation starts with a 4.5% reduction in the marginal tax rate¹². National and regional governments are allowed to add a supplement to the marginal tax rate. The receipts of the supplement are not subjected to tax sharing or fiscal equalization. At the same time, the prevailing tax sharing and equalization scheme is replaced by a new scheme proposed by the Wissenschaftlicher

Beirat (1992) (see above). In addition it is assumed that the policy reform is realized under differential incidence, i.e. the shift in taxes is revenue neutral.¹³

The reduction in the national income tax rates¹⁴ diminishes the receipts per capita of the relatively rich states more than the receipts per capita of the relatively poor states. Hence the equalization payments of the rich states decrease whereas the value-added tax sharing grants increase. Therefore the relatively rich states, in spite of the reduction in the grants due to income tax sharing, can cut their regional income tax rates. Lower equalization payments and tax rates made the relatively rich states better off. On contrary the relatively poor states are worse off.

The findings confirm these considerations (see table 2). All states with positive ΔZ (column 7) reduce their marginal income tax rates. These changes are displayed in column 9. For example, the income tax rate of the inhabitants of Schleswig-Holstein (SH) increases by 1 point.

1	2	3	4	5	6	7	8	9
State	EV		ΔTr	EV_S	ToT	ΔZ	Δm_G^a	$\Delta \tau^b$
	mill	in %	in %	in %	in %	in %	in%	in %
	DM	of REV	of REV	of REV	of ToT	of REV	of m	
SH	-214	-3.2	-2.2	-0.7	0.0	-2.2	-0.14	1.02
HH	65	1.0	1.4	0.0	-0.3	2.2	-0.06	-0.30
HB	-158	-6.3	-3.5	-2.3	-0.1	-4.5	-0.12	2.04
NS	-596	-3.2	-2.0	-0.8	0.1	-2.1	-0.14	1.05
NW	468	1.0	0.6	0.6	-0.1	1.7	0.32	-0.42
HE	308	2.0	1.5	0.6	-0.1	2.6	-0.01	-0.50
RP	-74	-0.8	-0.9	0.0	0.1	-0.1	-0.10	0.30
SA	-219	-7.9	-5.0	-3.0	0.4	-6.3	-0.49	3.27
BW	911	3.6	2.2	1.4	-0.1	3.8	0.40	-1.05
BY	71	0.2	0.2	0.3	0.0	0.9	0.14	-0.14
ES	-849	-2.2	-1.1	-1.3	1.1	-2.0	0.11	2.24
Σ	-286							

Table 2: Welfare effects with income tax supplements (with previous tax cuts).

^aChange of the refinancing multiplier

^bChange of the total tax rate (regional plus national income tax rate) as a percentage of the original income tax rate.

However the main focus should be on the overall welfare effects of the tax reform, which are, surprisingly, unambiguously negative (-286 millions DM). Moreover, if one compares these results with the results of the simulation without fiscal autonomy (table 1), one

can see that the highest welfare losses are computed in the case of regional income tax supplements. This is also a surprising outcome. To explain this outcome, one has to look into two distinct effects:

1. Higher income tax rates diminish the real net wage rate (w^n/p) leading to lower labour supply and higher wage rates. Finally the prices of goods increase. Vice versa, lower marginal income tax rates induce lower prices of goods. Since some states increase and some decrease their marginal tax rates, the price differences increase and the ToT change. The resulting higher price differences strengthen the substitution effects that are primarily caused by the different tax rates. These interregional substitution effects are welfare reducing.
2. A rise of the real net wage rate caused by decreasing income tax rates widens the wedge between the relative prices of goods, i.e. the marginal rate of transformation (MRT) and the MRS of leisure and the consumer goods as well as of leisure and the public good. The induced distortions lead to an increase in the intraregional substitution effects that is welfare reducing. Vice versa, a state that lowers its income tax rate improves its welfare due to reduced intraregional substitution effects.

Since six states raise the income tax rate and since the increase of the tax rate is on average higher than the tax rate cuts of the other states, the intraregional substitution effects increase. If these and the interregional substitution effects offset the gains induced by the higher degree of fiscal autonomy, the overall welfare will be dominated by the substitution effects and will be reduced.

The last column of table 2 displays the change of the refinancing rate of public expenditure (Δm_G)¹⁵, which is in all cases lower than one per cent. These low values are supposed to have only slight influences on the state welfare. Therefore it is not surprising that there is no clear connection between the signs of EV and Δm_G . This shows that the effects of the refinancing rate of public expenditure are not important in the German case.

3.4.2 Sensitivity analysis: Constant labour supply

Table 3 displays the results of the sensitivity analysis with labour supplied inelastically. The national welfare is positive and the welfare gains of the states are greater and the

losses lower except for the eastern states (ES). Changes in the income tax rates do not induce a change of labour supply since labour is now supplied inelastically. In addition, rises of the tax rates are lower than in the case of variable labour supply whereas cuts of the tax rates are greater. Also the differences in the tax rates are reduced compared to the case of variable labour supply. That leads to lower price differences. Therefore the substitution effects are lower than in the case of variable labour supply. This is shown by the figures in column 5 of table 2 and table 3. As a result the welfare effects caused by the growing degree of fiscal autonomy dominate the overall welfare effects.

1	2	3	4	5	6	7	8	9
State	EV		Δ Tr	EV_S	ToT	ΔZ	Δm_G	$\Delta \tau$
	mill	in %	in %	in %	in %	in %	in %	in %
	DM	of REV	of REV	of REV	of ToT	of REV	of m	
SH	-196	-2.9	-2.1	-0.7	0.1	-2.2	-0.14	0.87
HH	119	1.9	0.9	0.8	-0.2	2.2	-0.06	-0.39
HB	-140	-5.6	-4.8	-0.6	-0.1	-4.9	-0.12	1.69
NS	-524	-2.8	-2.2	-0.5	0.0	-2.2	-0.14	0.88
NW	605	1.3	1.0	0.3	-0.1	1.7	0.32	-0.48
HE	351	2.3	1.6	0.6	-0.1	2.7	-0.01	-0.56
RP	-56	-0.6	-0.4	-0.1	0.1	0.0	-0.10	0.20
SA	-216	-7.8	-6.3	-1.1	0.2	-6.9	-0.49	2.82
BW	963	3.7	2.9	0.7	0.0	4.0	0.40	-1.07
BY	151	0.5	0.4	0.1	0.0	1.0	0.14	-0.21
ES	-1036	-2.7	-1.8	-0.7	0.8	-2.0	0.11	1.72
Σ	21							

Table 3: Effects of regional income taxes (previous tax cut) with exogeneous labour supply

3.4.3 State income taxes with no previous tax cut

If there is no previous cut of the national tax rate, regional and national tax supplements, provided they are revenue neutral, will result in relatively small differences in the tax rate between the western states (column 8 of table 4 compared with column 8 of table 2). Hence the price differences between the western states and the interregional substitution effects of the western states decrease. At the same time all marginal income tax rates of the consumers of the western states increase compared with the case of a previous tax cut. This causes new intraregional substitution effects leading to lower EV_S in all western states.

The only exception are the new states (ES). Since their tax payments are below average, a reduction of the national tax rate leads to relatively low tax revenue and therefore to higher equalization grants. As a result their income tax rate supplement can be reduced substantially and intraregional substitution effects also decline substantially, as the EV_S of ES shows.

Nevertheless the overall welfare increases by about 631 millions of DM compared with a loss of about 286 millions DM in the case of a previous tax cut. These findings suggest that the great decline in the substitution effects of the eastern states (ES) dominates all other negative impacts, as for instance higher tax rates in the western states. Some other sensitivity computations underline this result.

If the states levy lump sum taxes instead of income tax rate supplements, the overall welfare gain becomes 22 millions DM, as another simulation has shown. These gains are hardly higher than in the case without fiscal autonomy (table 1), but a good deal lower than the gains in the case of (constrained) fiscal autonomy with regional income tax rate supplements but without a previous tax cut (table 4). Therefore regional tax rate supplements can lead to higher welfare gains compared with lump sum taxes. This outcome depends on the chosen institutional arrangements, which is a typical second best phenomenon.

1	2	3	4	5	6	7	8
State	EV		Δ Tr	EV_S	ToT	ΔZ	$\Delta\tau$
	mill	in %	in %	in %	in%	in %	in %
	DM	of REV	of REV	of REV	of ToT	of REV	
SH	-210	-3.2	-2.4	-0.8	0.1	-2.8	0.96
HH	-10	-0.2	-0.2	-0.2	-0.2	-0.1	0.03
HB	-156	-6.3	-3.8	-2.4	0.0	-5.2	1.98
NS	-523	-2.8	-2.1	-0.8	0.1	-2.5	0.92
NW	69	0.2	-0.1	0.1	-0.1	0.3	-0.29
HE	143	0.9	0.6	0.1	-0.1	1.1	-0.31
RP	-99	-1.1	-0.9	-0.4	0.2	-0.9	0.31
SA	-197	-7.1	-4.2	-2.9	0.4	-6.1	2.88
BW	549	2.2	1.2	0.6	0.0	2.0	-0.78
BY	-98	-0.3	-0.4	-0.1	0.0	-0.2	-0.04
ES	1162	3.1	1.3	2.0	0.4	3.4	-3.85
Σ	631						

Table 4: Welfare effects with income tax supplements (no previous tax cut)

4. Conclusions and political implications

The theoretical considerations show that there are some distortions caused by the degree of fiscal autonomy via the shadow price of rationing and by the tax sharing and fiscal equalization system via its influence on the refinancing rate of public expenditure. Until now the latter has not been taken into account in the field of fiscal federalism. In addition, such a fiscal system lowers the optimal regional tax rates if public expenditure is partly refinanced or if the receipts of the regional taxes are subjected to tax sharing. These are two other new aspects in discussing optimal tax rates or interregional tax competition. Besides it is a plausible explanation of the low degree of prosecution of tax evasion in some German states, since this low degree is approximately a substitute for a cut of tax rates. This is the case if the states collect the common taxes and if the receipts of the taxes effects the revenue sharing grants, which is the case in Germany.

In the CGE analysis these various effects are used to discuss the resulting welfare effects. It has been shown that a higher degree of fiscal autonomy is not in any case welfare improving. This depends on the actual institutional arrangements of the tax reform proposed. For example a previous cut of the national income tax rates is welfare reducing with respect to the overall (national) welfare whereas the same reform without a previous cut of the tax rate can be welfare increasing. Therefore the proposal of the Wissenschaftlicher Beirat (1992) should not be introduced without some modifications. The second result is the insignificance of the refinancing rate of public expenditure in the German case. Nevertheless, the tax sharing and equalization system influences the welfare effects due to income effects and changes in prices which cause secondary substitution effects.

However these results should not be stressed too much on account of the neglect of migration. But in the German case of relatively low interregional migration rates, except in the years of reunification, the model employed should be a useful simplification and the results presented should be a useful approximation to the sign of the actual welfare effects.

Notes

¹ This is strange, because Musgrave (1961) and Bös (1978) have shown that the revenue sharing system can effect the regional tax effort, i.e. there is a link between regional taxes and the revenue system.

² Since the partial analysis shows the essential points of the tax reform considered, it is preferred to a general equilibrium analysis. A general equilibrium analysis of the same economy but for

another purpose can be found in Hirte (1996b).

³ The Advisory Committee of the Federal Ministry of Finance.

⁴ Actually, a tax sharing or fiscal equalization system causes many interregional interdependencies. For instance a change in regional tax rates or expenditure changes the amount of regional tax receipts as well as the tax receipts of all other states by tax export or revenue sharing grants. This can induce reactions of other governments with ensuing changes in tax revenue, etc.

⁵ This approach is a generalization of the theory of grants-in-aid (e.g. Oates 1977) because a tax sharing and equalization system and refinancing of public expenditure are taken into account.

⁶ Rationing as a constraint is the formal concept used to analyze similar problems developed by Neary and Robert (1980).

⁷ The indirect utility function is defined as 'indirect' with regard to the private consumption, i.e. composite commodity and leisure, but $\nu(\cdot)$ is a 'direct' utility function with respect to the regional public good. This concept of a linked direct and indirect utility function is useful for investigating linked decisions on optimal tax rates and private consumption (e.g. Atkinson and Stiglitz 1980 p. 496, or Auerbach 1985 p. 113).

⁸ The German revenue sharing system consists of a tax sharing and the equalization system. The former regulates the distribution of the receipts of the income, value-added, corporate and capital taxes. Most taxes are distributed according to the relation of the population or the receipts of the taxes of the states. The only exception is the VAT sharing system since it has some equalizing components. In the fiscal equalization system transfers between the states ensure almost equal distribution of the per capita financial capacity of the states.

⁹ The proposed changes of the existing revenue sharing system are not presented in detail (see Hirte 1996a), since our main interest is in the welfare effects of different levels of fiscal autonomy.

¹⁰ The use of the aggregate EV to measure Pareto changes is controversial (see e.g. the Boadway Paradox, Boadway 1974). But some sensitivity simulations show that in all cases a positive (negative) EV is equivalent to a Pareto improvement (deterioration).

¹¹ In this way interregional tax competition appears (e.g. Sandler and Shelton 1972 or Gerking and Mutti 1982).

¹² The Wissenschaftlicher Beirat employs in its computations a 5% decline, but does not recommend any specific value.

¹³ It should be emphasized that the resulting tax rates are only revenue balancing tax rates and not the optimal tax rates. But they give an indication of the direction of the change from the prevailing tax rate to the optimal tax rate.

¹⁴ Actually the changes take place by means of the marginal tax rates. To simplify matters the distinction between marginal and average tax rates are not stressed below.

¹⁵ m_G is a multiplier employed to compute the social price of the public good out of the price q . It encompasses the refinancing rate and is defined as $(1 - \partial Z(\cdot)/\partial qG)$. The refinancing of transfers is omitted to ensure the weak separability necessary to allow the use of the utility tree. If the private household does not take into account the refinancing of transfers, the public good will be relatively cheaper. This leads to higher demand of the public good – a result similar to the so called 'flypaper' effect (see King 1984 p. 102–113).

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References

- Armington, P.S (1969) A theory of demand for products distinguished by place of production. *International Monetary Fund Staff Papers* 16: 156–167
- Atkinson, A.B, Stiglitz, J.E. (1985) *Lectures on public economics*. McGraw-Hill, New York, Maidenhead
- Auerbach, A.J. (1985) The theory of excess burden and optimal taxation, pp. 61–127. In: Auerbach A.J., Feldstein M. (eds.) *Handbook of public economics*, Vol I. North-Holland, Amsterdam
- Brennan, G., Buchanan J.M. (1980) *The power to tax: analytical foundations of a fiscal constitution*. Cambridge University Press, Cambridge
- Breton, A. (1987) Towards a Theory of Competitive Federalism, *European Journal of Political Economy* (special issue) 3: 263–329
- Boadway, R. (1974) The welfare functions of cost-benefit analysis. *Econ J* 84: 926–939
- Boadway, R., Flatters, F.R. (1982) efficiency and equalization payments in a federal system of government: a synthesis and extension of recent result. *Canadian Journal of Economics* 15: 613–633
- Bös, D. (1978) Zur Theorie des Finanzausgleichs, pp. 412–427. In: Dreissig, W. (ed) *Probleme des Finanzausgleichs I*. Duncker & Humblot, Berlin
- Carlberg, M. (1979) Ein interregionales, multisektorales Wachstumsmodell - dargestellt für die Bundesrepublik Deutschland. Vandenhoeck & Rupprecht, Göttingen
- Dye, T.R. (1990) *American federalism, competition among governments*. Lexington Press, Lexington, MA
- Gerking, S.D., Mutti, J.H. (1982) Possibilities for the exportation of production taxes: a general equilibrium analysis. *Journal of Public Economics* 16: 233–252
- Fehr, H., Rosenberg, Ch., Wiegard, W. (1993) Value added taxation in the EC after 1992: some applied general equilibrium calculations. *European Economic Review* 37: 1483–1506
- Hirte, G. (1996a) *Effizienzwirkungen von Finanzausgleichssystemen: Eine Empirische Allgemeine Gleichgewichtsanalyse für die Bundesrepublik Deutschland*. Peter Lang Verlag, Frankfurt a.M.: Finanzwissenschaftliche Schriften
- Hirte, G. (1996b) *Efficiency Aspects of Revenue Sharing Systems*. Diskussionsbeiträge der Wirtschaftswissenschaftlichen Fakultät Ingolstadt
- Jones, R., Whalley, J. (1988) Regional effects of taxes in canada: an applied general equilibrium approach. *Journal of Public Economics* 37: 1–28
- Kenyon, D.A., Kincaid, J. (eds) (1991) *competition among states and local governments: efficiency and equity in american federalism*. Urban Institute Press, Washington D.C.
- King, D.N. (1984) *Fiscal tiers: the economics of mult-level government*. Butler & Tanner Ltd, London
- McGuire, T.J. (1991) Federal Aid to states and localities and the appropriate competition framework, pp. 153–166. In: Kenyon D., Kincaid J. (eds.) *competition among states and local governments: efficiency and equity in american federalism*. Urban Institute Press, Washington D.C.
- Musgrave, R.A. (1961) Approaches to a Fiscal Theory of Political Federalism, pp. 97–122. In: NBER (ed.) *Public finance: needs, sources, and utilization*. Princeton University Press, Princeton
- Neary, J.P., Roberts, K.W.S. (1980) The theory of household behaviour under rationing. *European Economic Review* 13: 25–42
- Oates, W.E. (1977) *The political economy of fiscal federalism*. Lexington Press, Lexington, MA

- Oates, W.E., Schwab, R.M. (1991) The allocative and distributive implications of local fiscal competition, pp. 153–166. In: Kenyon D, Kincaid J. (eds.) competition among states and local governments: efficiency and equity in american federalism. Urban Institute Press, Washington D.C.
- Sandler, T.M., Shelton, R.B. (1972) fiscal federalism, spillovers and the export of taxes. *Kyklos* 25: 736–753
- Shoven, J.B., Whalley, J. (1972) A general equilibrium calculation of the effects of differential taxation of income from capital in the USA. *Journal of Public Economics* 1: 281–321
- Stern, R.M., Francis, J., Schuhmacher, B. (1976) Price elasticities in international trade: an annotated bibliography. MacMillan, London
- Tiebout, C.M. (1956) A pure theory of local expenditures. *Journal of Political Economy* 64: 416–424
- Varian, H.R. (1992) *Microeconomic analysis*. 3rd edition, W.W. Norton & Company, New York, London
- Weber, R. (1996) *Das Arbeitsangebot verheirateter Männer*. Peter Lang-Verlag, Frankfurt a. M.
- Wissenschaftlicher Beirat beim Bundesminister der Finanzen (1992) *Gutachten zum Länderfinanzausgleich in der Bundesrepublik Deutschland*. Schriftenreihe des Bundesminister der Finanzen 47, Bonn