

*Fiscal Equalization as a Coordination Device**

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Abstract

Taxing capital in open economies suffers from a rather wasteful tax competition. According to Konrad & Schjelderup (1999) harmonizing capital income taxes within a subgroup of countries is beneficial to all countries. Although economists and politicians advocate a coordinated tax policy within a federation or a federal system like the EU they favor national tax sovereignty over a harmonization of tax rates. This paper shows why a direct coordination on tax rates (harmonization) is dominated by implementing an indirect mechanism which redistributes tax revenues within a federation (fiscal equalization).

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1 Motivation

Taxing capital in open economies suffers from consequences of globalization. As long as independent governments are engaged in wasteful tax competition, they ignore the positive effect they have on their competitor's budget when making up the decision on tax rates. Hence, tax rates follow a race to the bottom and tend to be too low in equilibrium from an efficiency point of view¹ and globalization and its free capital movement can be seen as a challenge to create a fiscal system such that the resulting inefficiencies can be overcome. According to Konrad & Schjelderup (1999) harmonizing capital income tax rates within a subgroup of countries is beneficial to all countries if the Nash equilibrium is characterized by strategic complements. Although economists and politicians advocate a coordinated tax policy within a federation or a federal system like the EU they favor national tax sovereignty over a harmonization of tax rates. In economic terms, a coordinated behavior can either be centralized (i.e. a harmonized tax policy) or decentralized (keeping at least some tax sovereignty). These two opposing fiscal regimes are at the center of any constitutional design of a federation. The traditional economic theory of fiscal federalism, which goes back to Musgrave (1959) and Olson (1969) as well as to Oates (1972) famous 'decentralization theorem' attributes governmental decisions to the institutional stage where internalization of a possible spillover can be tackled best.

While this traditional view focusses on an equivalence of tax revenues and public expenditures, it is the growing fiscal competition among governments, which asks for a centralized policy coordination. On the one hand it should avoid the negative consequences of an increasing international mobility of the tax bases by calming down the competition within a federation, but on the other hand it should strengthen the competitiveness of the federation against its competitors outside. However, the latter aim is not as ruinous as becoming a 'tax heaven', which may be a successful strategy for smaller countries only. A policy coordination aims at forming a 'larger' decision unit, the federation, and thus creates a less elastic tax base, which, in turn, results in a less aggressive tax policy and relatively high tax rates. Hence, a federation's tax policy is somehow in line with the interest of the countries outside the federation.

A coordination on tax policies may either be induced by directly harmonizing tax rates or through an indirect mechanism like fiscal equalization within a federation. While for the former this consequence is obvious, the latter depends on an effect, which goes back to a reduction in the intensity of tax competition when tax revenues of different countries or regions within a country are linked through

¹For a survey on the negative consequences of tax competition for mobile tax bases on the reduced supply of (local) public goods see Wilson & Wildasin (2004).

a redistribution mechanism. According to Keen (1998) fiscal equalization has two substantial roles: redistribution of tax receipts and internalizing fiscal externalities within a federation.² In what follows we qualify the traditional view and show that fiscal equalization strengthens the federation against its competitors outside and improves the tax revenues relative to those under pure tax competition. Thus, revenue sharing does not tame the Leviathan, it tames the erosion of public receipts.

As there are at least two alternative designs of tax coordination, the federation may either be more centralized (with tax harmonization) or relatively decentralized (with fiscal equalization and tax sovereignty). Which of these alternatives serves best as a fiscal constitution in a federation? This question will be answered in what follows.

The present paper is organized as follows: the next section presents the economic framework of the tax competition model, which is subsequently used to analyze the impact different coordination strategies have on the tax receipts inside and outside the federation. The comparison of tax harmonization with fiscal equalization for a given federation proposes an optimal design of fiscal competencies. However, as discussed in section 4, the incentive to join a federation decisively depends on this specific design. In section 5 we will summarize our findings and draw some conclusions.

2 The economic framework

Consider a world with N identical countries. Each government imposes a source-based corporate income tax (CIT), which affects the country's aggregate tax base through two channels. First, interjurisdictional tax differences will lead to an outflow of the tax base to low tax countries. More exactly, firms can choose between distributing more economic activity towards other countries or benefiting from existing tax loopholes by profit shifting. The latter option underlines the lacking possibility of a country to unambiguously identify the source of a multinational company's profits. Second, taxation causes distortions of economic decisions, which yield in a shrinking tax base.

To keep the analysis simple, we abstract from modelling each enterprise's in-

²As revenue sharing yields a mechanism which reduces tax competition it is often accused as an implicit cartel among competing governments, cf. Brennan & Buchanan (1980, 180-84). Or more recently, Bucovetsky & Smart (2006) show that within a federation an equalization grant can implement an efficient policy choice by lower tier jurisdictions; see also Boadway & Flatters (1982). The cartelization hypothesis seems to be rather obvious in case of a Leviathanian government. Köthenbürger (2005, 449) implicitly qualifies this view by his statement that transfers might be an appropriate constitutional provision against fiscal expropriation in case of a welfare oriented government.

vestment decision explicitly, but concentrate on a country's aggregate tax base in a reduced linear form:

$$\pi_i = [1 - \alpha(t_i - \bar{t}_{-i}) - \beta t_i]. \quad (1)$$

Country i 's effective tax rate t_i as well as the average tax rate \bar{t}_{-i} in the complementary world are decisive for the aggregate tax base.³ The constant parameters α and β measure the two impacts on the tax bases mentioned before. The choice where to invest depends on tax differentials and is captured by the parameter $\alpha > 0$. Additionally, we pay attention to the distortionary effect through the parameter $\beta > 0$. Furthermore, we assume $\alpha < \beta$ and $\beta > 0$,⁵. The former assumption reflects that tax distortions have a stronger impact on the tax base than interjurisdictional tax differentials and the latter restriction guarantees equilibrium tax rates below 100%. The economic intuition behind is that β measures how taxes effect user cost of capital and thereby the attractiveness of an investment. The impact on the aggregate tax base of whether an investment will be done or not is stronger than that of locational choice due to capital mobility. The economic consequences of both assumptions seem to be in line with empirical evidence.

Governments are assumed to behave as Leviathans that are only interested in maximizing tax revenues. The tax receipts of government i are given by

$$R_i = \pi_i t_i. \quad (2)$$

As the revenues from taxation are to finance public expenditures, R_i can also be seen as a shorthand for welfare.⁴ Thus, capital mobility and the independent choice of each jurisdiction yields a race to the bottom in tax rates. To measure the welfare losses from this tax competition we compare the equilibrium outcome with the second best as a benchmark.

The second best as a fully cooperative solution internalizes all fiscal externalities and maximizes the world's aggregate tax revenues. The efficient tax rate $t^* = (2\beta)^{-1}$ does depend on the distortionary effect of taxation β alone while capital mobility α is only a matter of tax competition. It becomes decisive when governments behave non-cooperatively and act given the decisions of their $(N - 1)$ competitors. Hence, under unrestricted tax competition symmetry leads to identical equilibrium tax rates

³The average tax rate in the complementary world is defined as $\bar{t}_{-i} = \sum_{j \neq i} t_j / (N - 1)$ and does not include the tax rate of country i itself.

⁴The Leviathanian and the benevolent government serve as two opposing benchmarks. While tax competition tames the former, it is harmful for the latter. Although both are rather contrasting, Edwards & Keen (1996) have shown that for governments which are represented by a combination between pure selfishness and benevolence the positive effect of taxation (the negative of tax competition) dominates in equilibrium.

$t^c = (2\beta + \alpha)^{-1}$. Here taxes decrease when capital becomes more mobile (i.e. with increasing α). Comparing these two benchmarks, we observe a first result, which is common knowledge. If governments compete for mobile tax bases, equilibrium tax rates tend to be too low, i.e. $t^c < t^*$, which is true for $\alpha > 0$. It is capital mobility, which drives a wedge between the second best and an uncoordinated tax policy.

3 Federation's optimal tax policy

It is a widespread view that due to the increasing mobility of tax bases, countries are more and more engaged in ruinous tax competition, which finally ends up in a race to the bottom. As countries are only interested in their own payoff, they do not take into account the positive effect an increase of their tax rates would have on the competitors' revenues. Consequently, each country has an incentive to undercut its competitors' tax rates as public goods and services can thus be financed partially at the expense of the other countries. As a consequence of the eroding tax revenues subgroups of countries, like the members of the EU, are in search of a cooperative solution to reduce this harmful tax competition.

In what follows, we assume m countries to form a federation while $(N - m)$ represent the rest of the world. To the former we will relate as insiders (f) and to the latter as outsiders (o) respectively. In our paper we distinguish three different regimes. First, as a benchmark, the fully competitive case where no fiscal coordination is applied. Second, the centralized design with a fully harmonized tax policy, and third, a decentralized tax policy accompanied by a central (federation's) policy of fiscal equalization.

3.1 Full tax competition

As the fully competitive case serves as a benchmark, the best responses of a representative outsider or member of the federation are useful for an understanding of what's going on if the federation applies a common tax policy:

$$t_c^f = \frac{1 + \alpha \frac{N-m}{N-1} t^o}{2\beta + \alpha \left[1 + \frac{N-m}{N-1}\right]} \quad (3)$$

$$t_c^o = \frac{1 + \alpha \frac{m}{N-1} t^f}{2\beta + \alpha \left[1 + \frac{m}{N-1}\right]}. \quad (4)$$

Without any fiscal coordination among the insiders, forming a federation does not mean much more than changing the institutional framework, at least in our

context. Each member of the federation as well as each outsider country applies an independent tax policy. As all countries are symmetric, we can solve the first-order conditions to determine the best responses of the group of insiders and outsiders. As among similar countries equilibrium tax rates are identical these two reaction functions are enough to cover the whole information of our tax competition model.

The reaction functions are characterized by strategic complementarity, which is usual for tax competition. Therefore, if a federation aims at a tax policy that tames tax competition within the federation, it has even a similar impact on the tax rates outside. Consequently, an active federation increases tax rates worldwide.

The design of a federation's fiscal constitution will change the best response $t^f(t^o)$ accordingly while the outsiders' reaction $t^o(t^f)$ remains unchanged. Thus, in what follows, we first look at the change in eq. (3) and the respective new equilibrium.

3.2 Tax rate harmonization (centralization)

In our paper we concentrate on the question to what extent fiscal equalization is an adequate instrument to protect a federation against international tax competition and its negative effects. However, for comparison and a better insight in our results we let first the federation members coordinate directly on a common tax rate as in Konrad & Schjelderup (1999). If the federation harmonizes taxes, the chosen tax rate maximizes the federation's aggregate tax revenues. For this reason all fiscal externalities arising within the federation will be internalized.

While the outsider behave as before, the federation maximizes the tax revenues of a representative member given the (identical) tax rates t^o in the rest of the world

$$R^f = \left[1 - \alpha \frac{N-m}{N-1} (t^f - t^o) - \beta t^f \right] t^f. \quad (5)$$

The first-order condition to (5) yields a best response under the federation's tax harmonization

$$t_h^f = \frac{1 + \alpha \frac{N-m}{N-1} t^o}{2\beta + 2\alpha \frac{N-m}{N-1}}. \quad (6)$$

As the federation's response internalizes all fiscal externalities within the federation, the best response exhibits higher tax rates as in the fully competitive case, i.e. $t_c^f < t_h^f$ as a federation consists of at least two members ($m \geq 2$). Consequently, it follows from strategic complementarity that taxes within and outside the federation increase through harmonization. However, the harmonized tax rate exceeds that in the competitive world outside the federation as the slope of the best responses are smaller than one: $t^* > t_h^f > t_h^o > t^c$. Although harmonization tames some neg-

ative consequences of tax competition, there remain fiscal externalities among all outsiders and between insiders and outsiders. Thus, equilibrium tax rates fall short of those in the second best t^* .

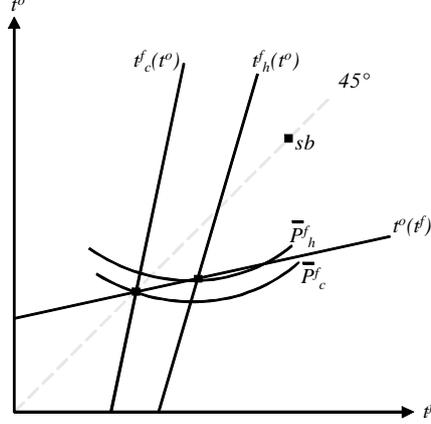


Figure 1: Tax harmonization

Proposition 1 *Centralized tax harmonization.*

Relative to the fully competitive case both, insiders and outsiders are better off if the federation applies a centralized harmonization strategy of its tax policy (i.e. tax rates).

The proof is obvious as the consequences of a harmonized tax policy are shown in figure 1.⁵ This result corresponds to that in Konrad & Schjelderup (1999). Although nobody is hurt by such a policy coordination, we do not observe a tax harmonization within the EU at all. If we want to explain this phenomenon either tax sovereignty must be an end in itself for the EU member states or there exists a common tax policy, which is even better for the federation than tax harmonization. If we look at the figure, it is obvious that there is at least some scope for such an improvement as the iso-payoff line \bar{P}_h^f intersects the outsiders' best response. Ideally, the federation would favor to become a Stackelberg leader against the rest of the world. However, this cannot be obtained by harmonization in general.

⁵Note that, as harmonization internalizes at least some fiscal externalities, the reaction function t_h^f lies to the right of t_c^f . Furthermore, as the federation becomes stronger, the strategic complementarity is intensified and thus under harmonization the best response t_h^f becomes flatter than without fiscal coordination. Obviously, the federation's iso-payoff curve \bar{P}_h^f has a zero slope at the harmonization equilibrium. As figure 1 is drawn from the perspective of the federation, the iso-payoff curve under pure tax competition \bar{P}_c^f in equilibrium obeys a negative slope.

As long as the tax policy within and outside the federation is chosen simultaneously, the Stackelberg point is not an equilibrium. A mechanism is still missing that enables the federation to commit to a policy that decentralizes the Stackelberg equilibrium whereas the decision on tax rates remains a simultaneous choice.

3.3 Fiscal equalization (decentralization)

Now the members of the federation discuss to implement a fiscal equalization scheme while they want to leave the (decentralized) tax sovereignty unchanged. Nevertheless, they want to implement a mechanism that provides an incentive to soften tax competition in order to internalize fiscal externalities within the federation. In what follows, we analyze whether fiscal equalization may serve as such a mechanism.

If fiscal equalization is applied, an insider receives or pays a transfer $\mu \cdot \phi_i \gtrless 0$, in which $\mu \in [0, 1]$ marks the extent of fiscal equalization while ϕ_i measures an insider's deviation from a specific federation-wide average. Depending on whether that deviation is positive or negative (i.e. whether the performance of the country in terms of the applied equalization scheme is above or below the federation's average), insider i will be a net payer or net recipient.

In the following subsections, we will specify different types of equalization schemes, which are in practice and discussed in the economic literature. A main characteristic of these schemes is their balanced budget, i.e. fiscal equalization purely redistributes tax revenues within a federation $\sum \phi_i = 0$.

Due to fiscal coordination within the federation, an insider i 's payoff consists of its tax revenue and its net payment to the equalization fund⁶

$$P_i^f = R_i^f + \mu \cdot \phi_i . \quad (7)$$

Countries outside the federation still do not coordinate their fiscal policies at all and their best response (4) remains unchanged.

As we will analyze the impact fiscal equalization has on the equilibrium tax rates, it is obvious to determine the best-response function of the representative insider to the tax policy of the outsider countries

$$t_\mu^f = \frac{1 + \alpha \frac{N-m}{N-1} t^o + \mu \phi_i'}{2\beta + \alpha \left[1 + \frac{N-m}{N-1} \right]} . \quad (8)$$

Here, the interjurisdictional tax differentials play a decisive role. Fiscal equalization drives a wedge between tax rates within and outside the federation, as the additional

⁶Obviously, for $\mu = 0$ there is no equalization intended. If, however, $\mu = 1$ we have fully equalization. Independent of a country's choice on its own tax rate it achieves a net payment of the federation's average tax revenue.

term $\mu\phi'_i$ in eq. (8) provides an incentive to set taxes at different levels ($t^f \neq t^o$).⁷ However, the type of fiscal equalization determines the extent and direction of this incentive.

To show the impact of fiscal equalization, we implicitly differentiate (4) and (8). As μ characterizes the extent of country's revenue sharing, the following equation isolates ϕ'_i as the driving force behind the shift in tax rates:

$$\begin{pmatrix} \frac{dt^o}{d\mu} \\ \frac{dt^f}{d\mu} \end{pmatrix} = \begin{pmatrix} \frac{\alpha \frac{m}{N-1}}{2\beta + \alpha \left[1 + \frac{m}{N-1}\right]} \\ 1 \end{pmatrix} \cdot \frac{\phi'_i}{Det}. \quad (9)$$

The sign of ϕ'_i determines whether revenue sharing reinforces or reduces the intensity of tax competition among the countries.⁸

Proposition 2 *The impact of fiscal equalization on taxation.*

If transfers are positively correlated with countries' own tax rate, i.e. $\phi'_i > 0$, fiscal equalization implies increasing tax rates inside as well as outside the federation. Moreover, tax rates within the federation exceed those of the outsiders:

$$\frac{dt^f}{d\mu} > \frac{dt^o}{d\mu} > 0 \quad \Rightarrow \quad t^f > t^o > t^c \text{ for all } \mu > 0. \quad (10)$$

The proof directly follows from (9). In case of $\phi'_i > 0$, fiscal equalization shifts the best response of an insider outwards. As tax rates are strategic complements and the reaction functions have a slope less than one, the taxes outside a federation must fall short of those inside.

Revenue sharing among the members of the federation depends on the equalization scheme ϕ . Typical schemes are either related to a country's tax base or its tax receipts. In what follows we stick to both cases separately.

3.3.1 Tax base equalization

A first scheme of fiscal equalization depends on a comparison of a country's tax base relative to the federation's average tax base. We refer to this as *tax base* equalization indicated by an index 'B'. An insider i will receive a positive transfer if its CIT tax base is below average. Transfers account for differences in a country's tax base

⁷Needless to say that $\phi'_i \neq 0$ is a necessary prerequisite for the above argument. Then, only if $\mu = 0$ (i.e. no fiscal equalization at all) the best responses of an insider coincides with that in the competitive case (4).

⁸ Det stands for the determinant of the second-order terms which stem from the system of first-order conditions (4) and (8): $Det = \left[P_{t_i t_i}^f P_{t_j t_j}^o - P_{t_i t_j}^f P_{t_i t_j}^o \right] \cdot \left(2\beta + \alpha \left[1 + \frac{m}{N-1} \right] \right)^{-1}$. As the Nash equilibrium of the tax competition game is unique Det is always positive, cf. Tirole (1988, 324).

relative to the federation's average tax base weighted by the federation's average tax burden \bar{t}^f . Thus insider i 's transfer is given by

$$\mu \cdot \phi_i^B = \mu \cdot \left[\bar{\pi}^f - \pi_i^f \right] \cdot \bar{t}^f. \quad (11)$$

According to Proposition 2 it is the relation between fiscal transfers and a country's own tax rate, which decisively determines the impact an equalization scheme has on the intensity of international tax competition.

The response of the transfer ϕ_i^B to a change in tax rate t_i^f is marked by a trade-off. Due to an increase of country i 's tax rate both the country's own and the federation's average tax base decrease. While a loss in country i 's tax base raises the expected transfer, a lower average tax base within the federation has an opposite impact. Nevertheless, the sign of $\frac{\partial \phi_i^B}{\partial t_i^f}$ is unambiguously positive as country i 's fiscal policy always has a stronger impact on its own tax base than on the federation's average:

$$\frac{\partial \phi_i^B}{\partial t_i^f} = t^f \cdot \left[\alpha \frac{N}{N-1} + \beta \right] \frac{m-1}{m} > 0. \quad (12)$$

Summarizing, a tax base equalization provides an incentive for higher taxes in order to gain from additional transfers and it yields an average tax level above that without coordination.

Substituting (12) in the first-order condition for an insider's optimal tax rate, we can identify the equilibrium relation between t_B^f and t_B^o from (4) and (8)

$$\frac{t_B^f - t_B^o}{t_B^f} = \mu \frac{m-1}{m} \cdot x_B > 0, \text{ where } x_B := \frac{\alpha \frac{N}{N-1} + \beta}{2\beta + \alpha \left(1 + \frac{N-1}{N} \right)} > 0. \quad (13)$$

Corollary 3 *Tax base equalization.*

As transfers according to a tax base equalization provide an incentive to increase tax rates, equilibrium tax rates satisfy the following relation $t_B^f > t_B^o > t^c$. Furthermore, the relative deviation of the tax rates from each other $\frac{t_B^f - t_B^o}{t_B^f}$ is increasing in α , μ and m , while it decreases with β .

The proof is obvious and follows directly from (13). The economic intuition behind the comparative statics is that with an increasing capital mobility α tax competition and thus the wedge between insiders and outsiders becomes stronger. If the number of members within the federation m increases, fiscal equalization more and more internalizes the federation's fiscal externalities, which consequently raises the wedge again. It is only the distortionary effect of taxation β , which works in opposite direction as with β all tax bases become more elastic. In that case, the

resulting average tax level worldwide is relatively low, and therefore, in terms of percentage, the tax differential between the federation and the rest of the world is also relatively low.

3.3.2 Tax revenue equalization

If the federation implements *tax revenue* equalization, insider i 's tax revenue must fall below-average to receive a positive transfer. Labelling the revenue equalization scheme with index ' R ', insider i 's transfer reads

$$\mu \cdot \phi_i^R = \mu \cdot \left[\bar{R}^f - R_i^f \right]. \quad (14)$$

The sign of $\frac{\partial \phi_i^R}{\partial t_i^f}$ is *a priori* undetermined. Both the country's and the federation's average tax receipts can either increase or decrease if country i raises taxes. However, it can be shown by using the derivative of (14) and inserting eq. (8) that in equilibrium

$$\frac{\partial \phi_i^R}{\partial t_i^f} = \frac{t^f \alpha}{N-1} \cdot \frac{\frac{m-1}{m}}{1 - \mu \frac{m-1}{m}}. \quad (15)$$

As we assume $\mu \in [0, 1]$, the equilibrium impact of an increase in country i 's tax rate is unambiguously positive. Inside the federation taxes are only set above those under full tax competition t^c if each member state expects that an increase in its tax rate has a stronger negative impact on its own tax revenues than on the federation's average. Again, the federation's fiscal equalization serves as an incentive for rising taxes.

From (15) in combination with the first-order conditions (4) and (8), the relation between insiders' and outsiders' equilibrium tax rates becomes

$$\frac{t_R^f - t_R^o}{t_R^f} = \frac{\mu \frac{m-1}{m}}{1 - \mu \frac{m-1}{m}} \cdot x_R \quad , \quad x_R := \frac{\frac{\alpha}{N-1}}{2\beta + \alpha \left(1 + \frac{N-1}{N}\right)}. \quad (16)$$

Corollary 4 *Tax revenue equalization.*

As higher tax rates imply higher transfers for $\mu \in (0, 1]$, equilibrium tax rates are as follows: $t_R^f > t_R^o > t^c$. Furthermore, the relative deviation of the tax rates from each other $\frac{t_R^f - t_R^o}{t_R^f}$ is again increasing in α , μ and m , while it decreases with β .

3.4 Optimal degree of equalization

The previous subsections have shown that fiscal equalization can be used to slow down tax competition. Thus, a federation may use revenue sharing to improve upon the race to the bottom in a pure tax competition game. To show that at least some

positive degree of fiscal equalization is always desirable from an insider's perspective, we look for the slope of P^f with respect to the extent of fiscal equalization at $\mu = 0$:

$$\frac{\partial P^f}{\partial \mu} \Big|_{\mu=0} = \underbrace{\left[1 - \left[2\beta + \alpha \left(1 + \frac{N-m}{N-1} \right) \right] t^f + \alpha \frac{N-m}{N-1} t^o \right]}_{= 0 \text{ (FOC (8))}} \frac{dt^f}{d\mu} + \underbrace{\alpha t^f \frac{d\bar{t}_{-i}}{d\mu}}_{> 0} > 0. \quad (17)$$

The impact of a tiny fiscal equalization is unambiguously positive and thus at least some redistribution of tax revenues within the federation pays for all member states.

Consequently, the federation should apply an optimal degree of revenue sharing μ^* . Fiscal equalization can then be used as a coordination device and serves as a commitment of the federation such that its members become *de facto* a Stackelberg leader against the rest of the world. Through fiscal equalization the federation can improve its tax revenues upon those under full tax competition and even upon those under tax harmonization.

Independent of the type of equalization, the optimal degree of equalization has to satisfy

$$\frac{\partial P^f}{\partial \mu} = [1 - 2\beta t^f] \frac{dt^f}{d\mu} - \underbrace{\left[\alpha (t^f - \bar{t}_{-i}) \frac{dt^f}{d\mu} + \alpha t^f \left(\frac{dt^f}{d\mu} - \frac{d\bar{t}_{-i}}{d\mu} \right) \right]}_{> 0 \text{ (if } m < N)} = 0, \quad (18)$$

which gives us the next result.

Proposition 5 *Imperfect internalization through fiscal equalization.*

As long as not all countries are members of the federation (i.e. $m < N$), fiscal equalization does not yield a perfect internalization of all fiscal externalities ($t^f < t^$).*

Proof. *The result can directly be seen from (18) as the first term on the RHS must be positive. Then it follows from $\frac{dt^f}{d\mu} > 0$ that $t^f < (2\beta)^{-1} = t^*$. ■*

Revenue sharing among the members of a federation internalizes the fiscal externalities within the federation. However, those externalities with the rest of the world remain unconsidered, and thus the equilibrium tax rates fall short of the efficient level, i.e. $t^c < t^o < t^f < t^*$.

By inserting insider's best response (8) in the first-order condition (18), we can solve for the payoff maximizing degree of fiscal equalization

$$\mu^* = \frac{\alpha t^f}{\phi'_i} \cdot \frac{\frac{d\bar{t}_{-i}}{d\mu}}{\frac{dt^f}{d\mu}}. \quad (19)$$

This formula implicitly yields a next result.⁹

Proposition 6 *Unconstrained fiscal equalization.*

An optimal fiscal equalization can always be achieved if we do not restrict the degree of equalization to $\mu \leq 1$. This result is independent of the type of revenue sharing (i.e. tax base or tax revenue equalization). Furthermore, the extent of fiscal equalization is smaller under tax base than tax revenue equalization, $\mu_B^* < 1 < \mu_R^* < \frac{m}{m-1}$.

Proof. If we insert ϕ_i' from (12) for tax base equalization and from (15) for the tax revenue scheme in eq. (19), the optimum formula can be rearranged to

$$\mu_B^* = \frac{\alpha}{\alpha \frac{N}{N-1} + \beta} \cdot \frac{m}{m-1} \cdot \frac{\frac{d\bar{t}_{-i}}{d\mu}}{\frac{dt^f}{d\mu}} < 1 \quad \text{and} \quad \mu_R^* = \frac{m}{m-1} \cdot \frac{(N-1) \cdot \frac{d\bar{t}_{-i}/d\mu}{dt^f/d\mu}}{1+(N-1) \cdot \frac{d\bar{t}_{-i}/d\mu}{dt^f/d\mu}} > 1, \quad (20)$$

respectively. The relation $\mu_B^* < \mu_R^*$ directly follows from a comparison of both terms as presented in (20). ■

As tax base equalization provides a stronger incentive to increase the tax rates inside and outside the federation, it needs a more moderate equalization factor μ_B^* relative to μ_R^* . However, in the latter case we need an excessive redistribution.¹⁰ Nevertheless, in both cases the federation as a Stackelberg leader implements identical tax rates through different types of revenue-sharing schemes.¹¹

If we consider the natural restriction on fiscal equalization, i.e. $\mu \leq 1$, we obtain a corner solution for revenue equalization $\mu_R^* = 1$. As shown in figure 2, it is only the tax base equalization, which decentralizes the Stackelberg equilibrium while a tax revenue based redistribution does fail this aim.

Proposition 7 *Restricted fiscal equalization.*

A centralized harmonization policy does not yield a higher payoff than under fiscal equalization accompanied by tax sovereignty. Furthermore, under tax base equalization the federation becomes a Stackelberg leader against the rest of the world, while for tax revenue equalization we obtain a corner solution with $\mu_R^* = 1$, which falls short of the Stackelberg point and yields the same payoff as under harmonization.

Proof. As in case of tax revenue equalization each insider's payoff is a weighted average of its own and the federation's average tax revenues, inserting the corner

⁹We first concentrate on interior optima and do not test for possible corner solutions, i.e. $\mu^* = 1$.

¹⁰For $\mu_R^* > 1$ each member of the federation has a net payoff which consists of the average tax revenue plus some further fiscal incentive: $P^f = \bar{R}^f + (\mu - 1) \cdot [\bar{R}^f - R_i^f]$. However, in practice, the equalization extent μ is restricted to fall short of 100%.

¹¹By using eq. (20) and eq. (4) in insider i 's best response to the tax rate outside the federation (8), we find that the federation's equilibrium tax rate is independent from the type of equalization scheme ϕ .

solution $\mu_R^* = 1$ yields a payoff equivalent to the federation's average, which in turn is identical to the payoff under tax harmonization. Furthermore, it is obvious that a Stackelberg equilibrium as with tax base equalization (i.e. $\mu_B^* < 1$) yields a better result than a harmonization policy. ■

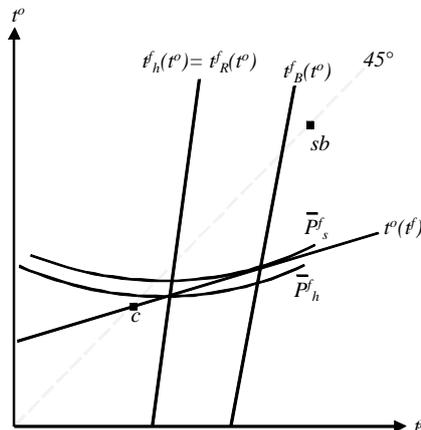


Figure 2: Optimum fiscal equalization

It remains to show, how the countries outside the federation are affected by the fiscal policy of the federation:

$$\frac{\partial P^o}{\partial \mu} \stackrel{\text{eq. (4)}}{=} t^o \alpha \frac{d\bar{t}_{-j}}{d\mu} > 0 . \quad (21)$$

From the outsider's point of view fiscal equalization is a very attractive policy as it yields a tax increase inside and outside the federation. However, the countries in the rest of the world become a relative 'tax holiday' such that the tax revenues P^o increase as both, the tax base π^o and the tax rate t^o rise. Consequently, forming a federation, which applies a redistribution of tax revenues is not at the expense of other countries. Fiscal equalization yields a tacit collusion of insiders and outsiders as both types of countries gain from such a policy.

3.5 An alternative formula for revenue equalization

In the previous section revenue equalization did not fully attain the Stackelberg solution. In that case the incentive to increase tax rates was not strong enough. This can easily be seen if we decompose ϕ_i . As country i 's revenue is part of the federation's average, its tax rate t_i^f influences ϕ_i twice, however, in opposite directions.

Thus, the net impact of i 's taxes on fiscal transfers is

$$\frac{\partial \phi_i^R}{\partial t_i^f} = \underbrace{\frac{\partial \bar{R}^f}{\partial R_i^f} \frac{\partial R_i^f}{\partial t_i^f}}_{\text{negative}} + \underbrace{\frac{\partial \bar{R}^f}{\partial \bar{R}_{-i}^f} \frac{\partial \bar{R}_{-i}^f}{\partial t_i^f}}_{\text{positive}} - \underbrace{\frac{\partial R_i^f}{\partial t_i^f}}_{\text{negative}}. \quad (22)$$

While the last two terms on the RHS show a strong incentive to raise taxes above the fully competitive level¹², it is the first term who works in opposite direction as a reduction in country i 's tax revenues lowers the federation's average tax revenues as well.

Considering the above argument, we slightly modify the transfer formula thereby avoiding corner solutions for μ . To strengthen the incentive to raise taxes, we now stick to a formula where a member state of the federation compares its own revenue with the average in the rest of the federation

$$\mu \cdot \phi_i^{R-} = \mu \cdot [\bar{R}_{-i}^f - R_i^f]. \quad (23)$$

Clearly, the federation's average tax revenue now unambiguously rises with an increasing tax rate of country i as it is not affected by the decline in the country's own revenue anymore. Applying (23), we obtain a slightly modified optimal degree of fiscal equalization, which now falls short of 100%:

$$\mu_{R-}^* = \frac{(N-1) \frac{d\bar{t}_{-i}/d\mu}{dt^f/d\mu}}{1 + (N-1) \frac{d\bar{t}_{-i}/d\mu}{dt^f/d\mu}} < 1. \quad (24)$$

Thus, the modified formula for revenue equalization can be used to implement the Stackelberg equilibrium.

Needless to say, that the same impact, which hampered the effectiveness of tax revenue equalization occurs in tax base equalization, as well. Nevertheless, a modification of that formula is not necessary as it already serves as an adequate instrument to reach the Stackelberg equilibrium.

4 Incentives to join a federation

If we search for a federation's favored tax policy, it is the less centralized policy, which yields the best results. A commitment to a unitary harmonization of CIT tax rates is too inflexible against the countries outside the federation as the remaining

¹²As we know that the overall incentive to raise taxes is positive, we concentrate on those cases where $\frac{\partial R_i^f}{\partial t_i^f} < 0$.

tax competition requires a simultaneous choice and not a two stage process (the federation fixes its taxes in advance of the outsiders' decision). Thus, all members of the federation favor a decentralized tax policy which is accompanied by an optimal fiscal redistribution over central harmonization. It is this equilibrium, which we observe within the EU. Although, sovereignty may be an end in itself – at least for some EU members – it has an additional advantage if it is accompanied by fiscal redistribution. Due to higher tax receipts each member of the federation will always prefer fiscal equalization to directly harmonized tax rates.

As an outsider is better off with an increasing tax rate of the federation, it seems to be obvious that a federation with a centralized tax harmonization tends to attract more members than a federation with a fiscal equalization scheme. Thus, it remains to show which federal policy provides the stronger incentive to join a federation.

If we focus on the formation of a single federation, the analyses are similar to those for self-enforcing International Environmental Agreements.¹³ A stable equilibrium with m^* members within the federation and $N - m^*$ outsiders is characterized by the following conditions:

$$P^f(m^*) \geq P^o(m^* - 1), \text{ i.e. no member leaves the federation}$$

$$P^o(m^*) \geq P^f(m^* + 1), \text{ i.e. no additional outsider joins the federation.}$$

Both conditions must be satisfied either for centrally harmonized taxation or decentralized taxation accompanied by fiscal equalization. However, as insiders' and outsiders' payoff depend on the federation's tax coordination, so does the participation.

Nevertheless, in both cases of fiscal coordination centrifugal and centripetal forces are active simultaneously. Thus, neither a grand federation nor a complete failure of creating a federation are equilibria of the participation game.

Proposition 8 *A stable membership of the federation must be of medium size.*

- i) The failure of any cooperation ($m = 1$) is unstable.*
- ii) If we assume $N \geq 4$, at least one country stays outside the federation independent of the type of tax coordination, i.e. $m = N$ is unstable.*

Proof. *i) Obviously, an insider of a two-country federation is better off than an outsider under perfect tax competition, i.e. $P^f(m = 2) > P^o(m = 1)$. ii) To show that there always exists at least a single outsider, we look at $m = N - 1$. According to figure 3 the outsider prefers to leave the grand coalition $m = N$ if the iso-payoff*

¹³This part of the literature goes back to Barrett (1994). A more complicated one, which allows for forming more than one parallel coalition is analyzed in Burbidge et al. (1997).

line through the second best (sb) is to the left of the harmonization equilibrium (h) and the Stackelberg point (S). It is sufficient to check the harmonization case for $m = N - 1$ and to prove whether the iso-payoff line has two points of intersection with the best response $t_h^f(t^o)|_{m=N-1}$. Formally, we have to solve the following two equations (i.e. the iso-payoff line \bar{P}_{sb} and the reaction function) :

$$\bar{P}_{sb} = (1 - \beta t^*)t^* = \frac{1}{4\beta} = t^o [1 - \alpha(t^o - t^f) - \beta t^o] \quad (25)$$

$$t_h^f(t^o)|_{m=N-1} = \frac{1 + \frac{\alpha}{N-1}t^o}{2\left(\beta + \frac{\alpha}{N-1}\right)}.$$

These two curves have two points of intersection if the square root in what follows is real and does not vanish:

$$t^o = \frac{2\left(\beta + \frac{\alpha}{N-1}\right) + \alpha}{2\left[\alpha\left(2\beta + \frac{\alpha}{N-1}\right) + 2\beta\left(\beta + \frac{\alpha}{N-1}\right)\right]} \quad (26)$$

$$\pm \sqrt{\frac{\left[2\left(\beta + \frac{\alpha}{N-1}\right) + \alpha\right]^2}{4\left[\alpha\left(2\beta + \frac{\alpha}{N-1}\right) + 2\beta\left(\beta + \frac{\alpha}{N-1}\right)\right]^2} - \frac{2\left(\beta + \frac{\alpha}{N-1}\right)}{4\beta\left[\alpha\left(2\beta + \frac{\alpha}{N-1}\right) + 2\beta\left(\beta + \frac{\alpha}{N-1}\right)\right]}}$$

A sufficient condition for this prerequisite is $N \geq 4$. ■

The result that for a sufficiently large world the grand coalition becomes unstable directly corresponds to the outcome in Burbidge et al. (1997) for a federal tax policy similar to harmonization.

If we have a closer look at figure 3, it is obvious that the incentives to join or leave a federation are different for the two types of policy coordination. This can be summarized in a conjecture. The stronger the incentive to defect from coordination the smaller will be a stable federation.

Conjecture 7 *Impact of (de-)centralization on federation's size.*

The incentive not to join a federation is higher with fiscal equalization (decentralized tax policy) and thus a federation, which harmonizes tax rates (centralized tax policy) has at least as much members as that with fiscal equalization.

A hint for this conjecture is that the Stackelberg equilibrium (s) lies always to the right of (h).

As the equilibrium tax rates increase with the size of the federation, we have two countervailing effects. A bigger federation with relatively low tax rates versus a smaller coalition with relatively high taxes. Thus, for the equilibrium payoff we obtain an ambiguous result.

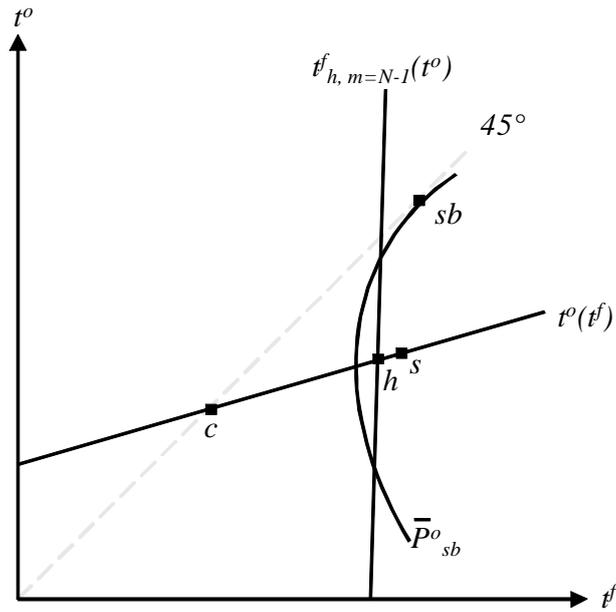


Figure 3: Participation for a single outsider

5 Conclusion

Revenue sharing within a federation is often introduced as a matter of fiscal equalization. Such redistribution between regions or countries can be seen as a kind of risk sharing where fiscal transfers are like a net premium in case of insurance against exogenous shocks. However, in the present paper there is no uncertainty and thus the above motive does not work. Nevertheless, fiscal redistribution fulfills a specific aim. Through an internalization of fiscal externalities all countries within and even outside the federation become better off. As this kind of revenue sharing strengthens the federation against its competitors, the institutional design is chosen in order to improve upon the wasteful consequences of tax competition.

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