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Equalisation and Fiscal Competition

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Abstract

The paper's aim is to link two different issues: equalization and fiscal competition. In the model there are two regions: the first one has rich citizens and the other one has poor citizens. Regional representatives in a federal Council must decide on the introduction of an equalization transfer based on fiscal capacity. Regions choose tax rates on a consumption good and the citizens choose where to buy the consumption good. We show that the existence of the transfer stimulates regions to choose higher tax rates. The economic insight for this result is that the existence of a mobile tax base generates a negative fiscal externality on each regional planner. We show that the equalization transfer presents a wider range of agreement opportunities between regional representatives to correct the inefficient levels of tax rates than a compensation transfer does. This is because efficiency gains are equalized with the introduction of an equalization transfer

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0. Introduction

Fiscal decentralization is normally justified by two factors. Firstly, local taxes reflect citizens' preferences much more than central taxes. Secondly, the management of local public expenditure would be more efficient than it would be if taxes were centralized.

However, in a Federation the geographical subset, where regional Government taxes, can not coincide with the subset where the tax-base of the residents of each region is distributed. In this case with free mobility of persons, goods and capital each region fixes its tax rate without taking into account the benefits in revenue and/or social welfare to the other regions (Mintz and Tulkens 1986; Wilson, 1991; Wildasin, 1988, 1991). That generates fiscal externalities. The extent and direction of these externalities depends on the interaction of two effects: public consumption effect and private consumption effect. The first effect is due to the region raising its tax-rate, which, if its tax-base is mobile, will benefit the other regions in revenue terms: in this way the region will fix a too-low tax-rate from a federal point of view. The second effect comes out only if the region is exporting the taxed good. In this case the region does not take into account that the good is also consumed by the citizens of the other regions and will fix a too-high tax-rate from a federal point of view.

In the EC fiscal competition is a concrete issue if we think of taxes like VAT or excises on fuel and alcohol. With taxation not co-ordinated the risk of cross-border shopping becomes real. In the 80's we experienced cases of cross-border shopping: Denmark-Germany and Ireland-United Kingdom (Fitzgerald et alii 1988, 1995). In '84 Ireland was forced to lower taxes on whiskey and TV because of the huge cross-border shopping of its residents in Northern Ireland. Cross-border shopping is also recently becoming a problem for the United Kingdom with Europe for products like wine and beer which are taxed vmuch more in UK than in the continental states (Crawford, Tanner, 1995).

According to the above mentioned empirical studies, that fiscal competition stimulates regions to lower equilibrium tax-rates, has a theoretical explanation: regions in their objective function give high weight to the collected revenue and the public consumption effect prevails.

Normally States or regions make some co-operative agreements to define tax-bases or tax-rates or to share taxes with the federal government. In this latter case the way that the federal revenue is given back can be crucial to the extent of fiscal externalities or the fairness level in the public good provision among different regions.

In this paper we analyse whether a transfer whose task is to equalize differences in the provision of local public goods can modify inefficiencies stemming from fiscal competition. This situation is to be considered with

these transfers reducing the higher revenue that regions get by attracting tax-base and by compensating other regions, which are losing tax-base. It is the case when the equalization transfer can transfer back a quota of the migrated tax-base.

Empirical literature (Bird and Slack, 1990; Bird, 1993) on equalization transfer does not take into account the influence in the introduction of equalization transfers on the fiscal decisions of the regions. In our work we try to study these effects in a framework with asymmetric per-capita tax-bases and with revenue maximiser regions.

We study the determinants of unanimous agreements on the introduction of an equalization system by the regions. In a context, where a federating process is starting up, as in the European Community or Italy, this issue is crucial. Can the equalization system come out of an agreement among the members of the Federal State?

We deal with this problem in a model with two regions where demand levels of the residents in the two regions are different. So per-capita tax-bases are asymmetric. The model is an extension of the Kanbur and Keen (1993) one. In the Kanbur and Keen (1993) model asymmetry was due to difference in sizes. In the model total tax-bases, but not per-capita ones, are asymmetric. The peculiarity of our model is the difference in per-capita tax-bases, which is of course very relevant in the evaluation of the effects of an equalization system. In the model the regions maximise revenue by choosing tax rates and a federal Council decides whether to introduce or not an equalization system.

We can think of an institutional framework like the one of the European Community where the Commission could propose the structure of the equalization system, but after the Council should approve it. We explore the possibility linked to the difference in per-capita tax-base that the choice of the federal Council brings a Pareto improvement in the level of the federal collected revenue. We show how an equalization transfer has greater possibilities to be introduced with the consensus of both regions than a compensation transfer does, given that both transfers introduce some kind of inefficiency in the revenue collection.

The paper is organised as follows. In the first section we describe the model . In the second section we explain and comment on the solution of the model. We explore the possible equilibria with equalization. In the third section we consider the possibility that the federal Council chooses a compensation transfer and we compare the two transfers.

1. Description of the model

There are two regions, 1 and 2. In each region there are $\bar{n}$ consumers uniformly distributed.

There are two firms, one in each region, with identical constant return to scale technology, which uses labour as input. Each firm produces the same homogeneous consumption good y. Production prices in this case are fixed.

We make the hypothesis that the demand of the consumption good, y_1, of each resident in region 1 is lower than the demand, y_2 , of each resident in

region 2. These are goods for which it is difficult to find substitutes so if people are used to consume a certain quantity they will not change their demand much even if prices change. We take account of this characteristic of the good by making the simplifying assumption that demands are rigid with respect to the prices. The reservation prices of the consumers of the two regions are such that the new tax-rate equilibrium, after the introduction of the transfer, will not induce a change in demand with respect to the no-equalization case. From now on we will refer to region 1 as the poor region and region 2 as the rich region.

In each region there is a leviathan government which maximises its revenue by choosing tax on the consumption good y. This assumption on the objective function will cause a public consumption effect which will stimulate too-low Nash equilibrium tax-rates with respect to the federal optimal solution (Mintz, Tulkens, 1986).

A Council composed of the representatives of the regions decides on the introduction of an equalization transfer based on difference between per-capita tax-bases. The decisions of the Council are taken at unanimity. This is the same rule of the EC Council when it has to approve fiscal acts. So the Council accepts to introduce the equalization transfer if it is Pareto-improving.

The model consists of a three stage complete information game. We solve it by backwards induction.

At the first stage, the Council, composed of the representatives of the two regions, decides on the introduction of an equalization transfer.

The introduction of the equalization transfer is likely to stimulate moral hazard problems in both regions. The transfer assures the poor region that it will receive a revenue quota from the other region, which can stimulate the poor region to decrease its effort in the control and development of its tax-base. The rich region will also have less incentive to control its tax-base because a quota of its revenue will go to the other region. Another example can be that when the states have to inform a federal organism with data about their tax-base. The states have incentives to provide biased information to get (give) the highest (lowest) amount of revenue. This can behaviour can induce the states to expect a loss in revenue after the introduction of the transfer.

We do not model the asymmetric information problem (Bordignon et alii, 1996), but we take account of the consequences on the collected revenues of the behaviour of the regional governments. We make the assumption that the introduction of an equalization transfer stimulates a loss in revenue which is a linear positive function of the equalization level α. The higher the level of the transfer is, the higher the disincentive to control the tax-base or the higher the risk to lose revenue because the other states are providing false information.

At the second stage, regional governments maximise revenue by choosing tax rates.

At the third stage each consumer decides where to buy the good knowing that crossing the border implies a cost δ per unit of distance from the border.

2. The model

The model is solved by backwards induction. At the third stage we determine tax-base flow from one region to another. At the second stage regions choose tax-rates by maximising tax-bases. At the first stage, once we have the equilibrium tax-rates we can calculate equilibrium revenues. The representatives of the regions choose whether to introduce or not the transfer by comparing the revenue functions they would have with the transfer with those without the transfer.

2.1 The third stage

Take region 2. Two conditions must be satisfied for the consumer of region 2 to cross the border and buy the good in region 1. The first one is that the surplus the consumer obtains by buying the same quantity she is ready to buy in her region is higher than the surplus the same consumer would get in her region:

Insert fig. 1

$$(1) \qquad r_2 y_2 - s_1 y_2 - \delta d > r_2 y_2 - s_2 y_2 \qquad \Leftrightarrow \qquad \frac{s_2 - s_1}{\delta} y_2 > d$$

The second condition asks for non-negative surplus:

(2) $r_2 y_2 - s_1 y_2 - \delta d > 0$.

r_1, r_2 reservation price net of production cost, in region 1 and 2, at which the consumer is indifferent between buying y_m or $y_m - 1$ units of the good where $m=1,2$;

δ transport cost per unit of distance to the border;

d distance from the border of the consumer indifferent as to whether he is to buy in region 1 or in region 2. As consumers are uniformly distributed d indicates also the consumers' quota going from region 2 to region 1.

s_1 and s_2 are per-unit tax of the two regions on the good y.

2.2 Second stage

The total demand function of good y of each region for a given tax-rate of the other region is:

$$
B_1 = \begin{cases} \bar{n}\left(y_1 + \dfrac{s_2 - s_1}{\delta} y_2\right) & \text{se } s_2 \geq s_1 \qquad \text{(3a)} \\[3mm] \bar{n}\left(1 - \dfrac{s_1 - s_2}{\delta}\right) y_1 & \text{se } s_2 \leq s_1 \qquad \text{(3b)} \end{cases}
$$

$$B_2 = \begin{cases} \overline{n}\left(y_2 + \dfrac{s_1 - s_2}{\delta}\, y_1 \right) & \text{se } s_1 \geq s_2 \quad (4a) \\[2em] \overline{n}\left(1 - \dfrac{s_2 - s_1}{\delta} \right) y_2 & \text{se } s_1 \leq s_2 \quad (4b) \end{cases}$$

Total consumption demands are very similar to the ones of the Kanbur and Keen model. If in our model we substitute the demand value with the size value of the regions (in the Kanbur and Keen model regions differ for their size) and vice versa for the size we fall into the Kanbur and Keen case. Total regional tax-bases are still the same, but per-capita regional tax-bases differ from our model: they are the same in both regions in the Kanbur and Keen model.

2.2.1 An equalization transfer

The solution of the following equation:

$$\alpha\, \frac{B_2}{\overline{n}} + tr_2 = \alpha\, \frac{B_1 + B_2}{2\overline{n}}$$

gives:

$$tr_2 = \alpha\, \frac{1}{2}\left(\frac{B_1}{\overline{n}} - \frac{B_2}{\overline{n}} \right)$$

where:

B_1 tax-base of region 1

B_2 tax-base of region 2

$\overline{n}$ residents in each region

α equalization rate

tr_2 is the transfer that region 2 will receive or give to equalize a quota α of per-capita tax-bases.

Symmetrically one can obtain tr_1. The total equalization transfer from one region to the other is:[1]

$$(5) \qquad TR_p = \pm\alpha \; \frac{1}{2}\left(\frac{B_1}{n} - \frac{B_2}{n}\right)$$

If we substitute in (5) (3a) and (4b), or (3b) and (4a) we get the expression for the transfer from one region to the other which equalizes per-capita revenue at the equalization rate α:

$$(6) \qquad TR_p = \begin{cases} \pm\alpha\overline{n}\left[\dfrac{1}{2}\left(y_1 - y_2\right) + \dfrac{s_2 - s_1}{\delta}\, y_2\right] & s_1 \le s_2 \quad \text{(a)} \\[3ex] \pm\alpha\overline{n}\left[\dfrac{1}{2}\left(y_1 - y_2\right) + \dfrac{s_2 - s_1}{\delta}\, y_1\right] & s_1 \ge s_2 \quad \text{(b)} \end{cases}$$

Take the case $s_1 \le s_2$. The transfer is composed of two terms. The first one, $\pm\alpha\overline{n}\,\dfrac{1}{2}\left(y_1 - y_2\right)$, is the revenue per-capita equalization at a rate α in the case of closed frontiers.

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[1]There is a similar transfer in Canada: the RTS (see Bird, 1990). It is of course more complicated because of the existence of more than two regions and the equalization rate is normally a weighted average of the average tax rates of all the regions.

With open frontiers and $s_1 < s_2$, there is a consumers' quota going from region 2 to region 1. This phenomenon makes the rich region have a lower tax-base than it would have in the autarkic case. The reverse is true for the poor region. In fact in (6a) we have the term $\pm \alpha \bar{n} \dfrac{s_2 - s_1}{\delta} y_2$, which is positive for the rich region and negative for the poor one. This term is the transfer to the rich region of a α-quota of the tax-base migrated to the poor region.

In the Kanbur and Keen model the only reason for the difference in the equilibrium tax-bases is cross-border shopping. In their model, where per-capita tax-bases are the same, the equalization transfer is:

$$TR_p = \begin{cases} \pm \alpha \ \dfrac{s_2 - s_1}{\delta} n_2 & s_1 \leq s_2 \\[2em] \pm \alpha \ \dfrac{s_2 - s_1}{\delta} n_1 & s_1 \geq s_2 \end{cases}$$

where:

n_1 consumers of region 1

n_2 consumers of region 2

It is of course proper to think of different per-capita tax-bases if we do not want to lose the redistributive impact of a transfer, which equalizes per-capita tax-bases.

2.2.2 Best reply functions and the equilibrium

The introduction of an equalizing can cause a loss in revenue. We discussed the reasons of this loss in section 1. We express the loss as a linear function of the equalization rate:

$\kappa\alpha$.

The higher κ is, the higher the loss for each level of α is. Thus κ measures the level of inefficiency due to the existence of the transfer.

(7)

$$R_{1p} = \begin{cases} s_1\overline{n}\left(y_1 + \dfrac{s_2 - s_1}{\delta} y_2 \right) + \alpha\overline{n}\left[\dfrac{1}{2}(y_2 - y_1) - \dfrac{s_2 - s_1}{\delta} y_2 \right] - \kappa\alpha & s_2 \geq s_1 \\[4ex] s_1\overline{n}\left(y_1 + \dfrac{s_2 - s_1}{\delta} y_1 \right) + \alpha\overline{n}\left[\dfrac{1}{2}(y_2 - y_1) - \dfrac{s_2 - s_1}{\delta} y_1 \right] - \kappa\alpha & s_2 \leq s_1 \end{cases}$$

(8)

$$R_{2p} = \begin{cases} s_2\overline{n}\left(y_2 - \dfrac{s_2 - s_1}{\delta} y_2 \right) + \alpha\overline{n}\left[\dfrac{1}{2}(y_1 - y_2) + \dfrac{s_2 - s_1}{\delta} y_2 \right] - \kappa\alpha & s_2 \geq s_1 \\[4ex] s_2\overline{n}\left(y_2 - \dfrac{s_2 - s_1}{\delta} y_1 \right) + \alpha\overline{n}\left[\dfrac{1}{2}(y_1 - y_2) + \dfrac{s_2 - s_1}{\delta} y_1 \right] - \kappa\alpha & s_2 \leq s_1 \end{cases}$$

region 1 maximises (7) with respect to s_1 and region 2 maximises (8) with respect to s_2. The best reply functions are (see appendix A2 and fig.2):

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$$(9) \qquad s_1 = \begin{cases} \dfrac{1}{2}\left(\delta + s_2 + \alpha\right) & s_2 \leq \delta\sqrt{\lambda} + \alpha \\[4mm] \dfrac{1}{2}\left(\delta\lambda + s_2 + \alpha\right) & s_2 \geq \delta\sqrt{\lambda} + \alpha \end{cases}$$

$$(10) \; s_2 = \begin{cases} \dfrac{1}{2}\left(\delta + s_1 + \alpha\right) & s_1 \leq \delta + \alpha \\[4mm] s_1 & \delta + \alpha \leq s_1 \leq \dfrac{\delta}{\lambda} + \alpha \\[4mm] \dfrac{1}{2}\left(\dfrac{\delta}{\lambda} + s_1 + \alpha\right) & s_1 \geq \dfrac{\delta}{\lambda} + \alpha \end{cases}$$

where: $\lambda = \dfrac{y_1}{y_2} \leq 1$

Insert fig.2

In (9) we see how region 1, that has a lower per-capita tax-base, chooses a tax-rate higher than the one of region 2 for very low s_2 levels. Region 2's tax-rate is so low that it is not worth it for region 1 to lower its tax-rate in order not to allow its residents to migrate. If region 2's tax-rate rises, region 1 raises its tax-rate of one half. Its tax-rate will stay in the regime $s_1 > s_2$ until some s_1 level. This level is lower the higher the difference in per-capita tax-bases is and the lower transport cost is. At this s_1 level a marginal rise in s_2 will cause region 1 to undercut s_1, reversing the cross-border

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shopping direction. The higher the per-capita tax-base difference between the two regions, the lower region 2's tax-base with respect to region 1's tax-base and of course the lower the s_1 level at which region 2 undercuts.

In (10) where we consider the best reply function of region 2, the region raises its tax-rate, when the other region will raise its too, without ever undercutting. Difference in per-capita tax-base never makes a jump in the best reply function worth it.

If we combine (9) and (10) we can state the following proposition:

Proposition 1: If $\lambda \leq 1$ and $\min[r_1, r_2] \geq \delta + \alpha$ then a unique Nash equilibrium exists in pure strategies:

$$s_1^* = \delta\left(\frac{1}{3} + \frac{2}{3}\lambda\right) + \alpha$$

$$s_2^* = \delta\left(\frac{2}{3} + \frac{1}{3}\lambda\right) + \alpha$$

Proof: see appendix A2.

The poor region chooses a lower tax-rate than the one the rich region chooses. $s_1 = s_2$ cannot in fact be an equilibrium because region 1's tax-base elasticity is lower than region 2's. Suppose that s_2 is the equilibrium tax-rate of region 2 then $s_1 = s_2$ cannot be a Nash equilibrium. In this case in fact a change of s_2 gives 0 marginal rise in revenue, but, as in $s_1 = s_2$ region 2's tax-base is lower than region 1's tax-base ($\bar{n}y_1 < \bar{n}y_2$), if region 1 decreases its

tax-rate the tax-base migrating to region 1 is higher than the migration of tax-base from 1 to 2, given 2's tax-rate. Indeed decrease of s_1 leads to a rise in the revenue of region 1. This is the reason why Nash equilibrium tax-rates are such that $s_1 < s_2$. This result is due to Kanbur and Keen (1993). In their model the asymmetry in population size of the two regions determines the difference in the elasticity of the total tax-bases we have illustrated. Even if we have an asymmetry in the level of per-capita consumption, as in our case, the total tax-bases are the same as the ones of the Kanbur and Keen model if we exchange per-capita consumption with size. That explains why our model replicates the Kanbur and Keen result. What is important is the asymmetry in the total tax-bases.

2.3 The equalization effect on the fiscal externality

What is new in the model is the introduction of an equalization transfer stimulates higher tax rates. The regional planner raises its tax-rate because the equalization transfer is composed of a part implying a limitation of the effect of mobility. A quota of the mobile tax-base will "come back". The regional planner will take this part into account in choosing tax-rates.

To better understand what happens let us examine the first order conditions of the federal government whose welfare function is:

$$W = R_1(s_1, s_2) + R_2(s_1, s_2)$$

and evaluate them at the Nash equilibrium:

$$(11)\frac{\partial W}{\partial s_1} = \frac{\partial R_2(s_1^*, s_2^*)}{\partial s_1} = \frac{y_2 s_2^*}{\delta} \geq 0$$

$$(12)\frac{\partial W}{\partial s_2} = \frac{\partial R_1(s_1^*, s_2^*)}{\partial s_2} = \frac{y_2 s_1^*}{\delta} \geq 0$$

Each region does not take into account that a raise in its tax rate, given the tax rate of the other, will benefit the other region, so tax rates are lower than the efficient ones are. (11) and (12) are exactly the analytical expressions of the fiscal externalities.

The first order conditions related to the Nash equilibrium are the following ($s_1^* \leq s_2^*$):

$$(13)\frac{\partial R_1}{\partial s_1} = \left(y_1 + \frac{s_1 - s_2}{\delta} y_2 \right) - s_1 \frac{y_2}{\delta} + \alpha \frac{y_2}{\delta} = 0$$

$$(14)\frac{\partial R_2}{\partial s_2} = \left(y_2 - \frac{s_2 - s_1}{\delta} y_2 \right) - s_2 \frac{y_2}{\delta} + \alpha \frac{y_2}{\delta} = 0$$

In (13) the fiscal externality effect on the decision of Region 1 is given by $-s_1 \frac{y_2}{\delta}$, which in equilibriun is exactly the value, with opposit sign, we have found in (11). The equalizing transfer effect is given by $\alpha \frac{y_2}{\delta}$. This effect can reduce or eliminate the fiscal externality effect. Each region in this case takes account that a raise in its tax-rate, given the tax-rate of the other

region, will benefit the other region, because it will get this benefit through the equalizing mechanism.

2.4 Some descriptive evidence

It is interesting to compare two federal countries like Canada and Australia with two different distribution of taxing power.

If we look in the *Statistics on tax revenues* (OECD, 1996) at the item *taxes on production and sales* (which essentially includes sales taxes, VAT taxes and excises taxes) we can observe the following:

Percentage collected at State/Provincial level

Canada   51

Australia   14

which tells us that Canada has a much more decentralized taxing power than Australia. According to the theory we would expect Australia to raise more revenue than Canada because Australia should have lower fiscal externalities, but if we look at the tax revenue of the federation, relative *to production and sales*, as percentage of total tax revenue of the federation, we get:

Canada   30

Australia   23

In this result *general taxes (sales and VAT taxes)* are determinant.

Even if in Canada taxes on production and sales are much more decentralised, Canada is able to raise a higher quota of total revenue than Australia does.

This can be due to agreements among provinces. But it is not easy to reach them: only recently Newfoundland, Nova Scotia and NewBrunswick reached an agreement on a harmonised sales tax (1997). The other provinces still autonomously decide their retail sales tax.

The low harmful impact of fiscal competition could be explained by the existence of a transparent equalizing system based on differences on tax-bases, like the Canadian system, which is very similar to the transfer we adopted in the model. In Canada the transfer is calculated for 33 types of taxes. (some of them are: sales taxes, taxes on tobacco, wine, beer, fuel).

2.5 First stage

At the first stage the federal Council decides whether to introduce or not the transfer at unanimity. So given the absence of an equalization transfer we want to explore the determinants of the possibility of introducing an equalization transfer which Pareto-improves the revenue of the Federation.

2.5.1 The equalization transfer

If we substitute in (7) and (8) equilibrium tax rates, we get:

$$(15) \qquad R_{1p} = y_2 \bar{n} \left[\delta \left(\frac{1}{3} + \frac{2}{3} \lambda \right)^2 + \frac{1}{2} \alpha (1+\lambda) \right] - \kappa \alpha$$

$$(16) \qquad R_{2p} = y_2 \bar{n} \left[\delta \left(\frac{2}{3} + \frac{1}{3} \lambda \right)^2 + \frac{1}{2} \alpha (1+\lambda) \right] - \kappa \alpha$$

If we subtract from (15) and (16) the revenue raised by the regions without

the equalizing transfer, we obtain $\alpha \left(\frac{y_1 + y_2}{2} - \kappa \right)$. Region 1 and 2 with the

introduction of the equalising system gain $\alpha \frac{y_1 + y_2}{2}$ and lose $\kappa \alpha$. Both

regions have the same efficiency gain because of equalization.

Both regions will not agree on the introduction of the equalization

transfer if $\kappa \geq \frac{y_1 + y_2}{2}$. In this case the inefficiency due to the introduction

of the transfer is not compensated by the efficiency gain, due to the effect that

the transfer have on the fiscal externalities.

3. The compensation transfer

In this section we assume that the Federal Council wants just to avoid

fiscal inefficiency due to mobility. The Council has to decide on the

introduction of a transfer, which compensates the loss in revenue of the

higher tax-rate region because of migration. We assume that also in this case

the introduction of the transfer causes a loss in revenue due to the reasons

outlined in section 1. So each region will lose revenue in the same way as before.

In our model such a compensation transfer is:

$$(17) \qquad TR_c = \begin{cases} \pm \beta \bar{n} \dfrac{s_2 - s_1}{\delta} y_2 & s_1 \leq s_2 \\[4mm] \pm \beta \bar{n} \dfrac{s_2 - s_1}{\delta} y_1 & s_1 \geq s_2 \end{cases}$$

$d = \dfrac{s_2 - s_1}{\delta} y_2$ is the demand quota going from region 1 to region 2.

Introducing (17) limits mobility effect on the tax-rate.

We want to explore the possibility that also the introduction of the compensation transfer can Pareto-improve the Federal revenue.

If we set $\alpha = \beta$, (17) is the second part of the equalization transfer (6). The compensation transfer is equivalent to the equalization transfer without the lump sum part.

As the equilibrium tax-rate is higher in the rich region than in the poor region, the compensation transfer is positive in the rich region and negative in the poor one.

3.1 The tax-rate incentive

One can ask if a compensation transfer causes the tax-rate to rise.

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The answer is yes. We noted (section 2.2.2) in the case of the equalization transfer that the term which determines the tax-rates to rise is

$\pm \alpha \bar{n} \dfrac{s_2 - s_1}{\delta} y_2$, which is the only term which appears in the compensating

transfer.

3.2 The choice on the introduction of the transfer

After having found second stage equilibrium tax-rates which are the same as in the equalization case if substituted in the revenue functions of the two regions we get:

$$(18) \qquad R_{1c} = y_2 \bar{n} \left[\delta \left(\frac{1}{3} + \frac{2}{3} \lambda \right)^2 + \lambda \beta \right] - \kappa \beta$$

$$(19) \qquad R_{2c} = y_2 \bar{n} \left[\delta \left(\frac{2}{3} + \frac{1}{3} \lambda \right)^2 + \beta \right] - \kappa \beta$$

The revenue function of 1, which must give back to region 2 a part of the collected revenue, raises with β less than in the equalization case if we set $\alpha = \beta$. In the compensation case there is not the positive term due to the difference in consumption demands between the two regions. Region 2's revenue rises more than in the equalization case for $\alpha = \beta$, because the lump-sum part of its equalization transfer is negative. With the compensation

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transfer the rich region takes the incentive effect on all its own tax-base. Before it transferred some of this effect to the other region.

If we subtract from (18) and (19) the revenue without the transfer we get that region 2 gains $\alpha y_2 n - \kappa \alpha$ and region 1 gains $\alpha y_1 n - \kappa \alpha$ from the introduction of the compensation transfer.

The reason of this difference in gain with the equalization case is that in the compensation case region 2 will not share the higher revenue it will get from the introduction of the compensation mechanism.

Region 1 in this case can be decisive in the introduction of the compensation transfer because it has a lower efficiency gain than region 2 has. This was not the case with the equalization system. Comparing the equalization levels with the compensation levels it is straightforward to state:

Proposition 2: When when $\kappa = \bar{\kappa}$ is so large that $\bar{\kappa} > y_1 n$ the compensation transfer cannot be implemented unanimously. Moreover it can be possible that an equalization transfer can still be implemented if $\kappa \in \left[\bar{\kappa}, \tilde{\kappa} \right]$ where

$$\tilde{\kappa} = \frac{y_1 + y_2}{2} n \, .$$

This is because a compensation transfer implies that the poor region who accepts to introduce the transfer will gain from low harmful tax-competition proportionally to its tax-base. With the equalization transfer the efficiency gain is equalized.

It is interesting to highlight that the higher the difference in tax-base, the larger the κ-range which allows the implementation of an equalizing transfer when the regions do not agree on a compensation transfer: $\tilde{\kappa} - \bar{\kappa} = \dfrac{y_2 - y_1}{2} n$.

4. Conclusions

In the paper we deal with a fiscal competition model with residents' mobility. Regions maximise their revenue by choosing tax-rates. Equilibrium tax-rates are lower than the efficient ones, because each region does not take into account that the other region can benefit in revenue terms from its decision (fiscal externality).

Introducing an equalizing transfer stimulates regions to raise tax-rates. In the model the only source of a change in revenue is tax-base mobility. Per-capita demands are in fact rigid. As consumers are uniformly distributed in each region the tax-base elasticity in the poor region is higher than it is in the rich region. The poor region's consumers have in fact a consumption demand lower than the rich region's consumers. The higher the rich region's tax-rate, the higher the difference in demands and the lower the transport cost. We show how the equalization transfer can be split in two components: one due to the difference in residents'tax-bases and a transfer, which gives back the migrated tax-base. This second component tries to offset the mobility effects: too-low tax-rates.

We analyse the determinants which drive the decision to introduce an equalization and compensation transfer.

A compensation transfer is equivalent to an equalization transfer without the redistributive component due to the difference in tax-bases. We show that it is possible to implement an equalization transfer when it is not possible to implement a compensation transfer. In both cases the introduction of the transfer induces a raise in tax-rates because of the compensation element. In the compensation case this efficiency gain is distributed proportionally to the residents' tax base, in the equalization case the efficiency gain is equalized along the two regions. The compensation transfer could not be implemented because it could not be convenient for the region with lower tax-base. It would not gain enough to offset the costs due to the implementation of the transfer. With the equalization transfer the efficiency gain of this region will raise.

This result allows to think that an equalization transfer can be used to raise the welfare (in our case the revenue) of both regions when a compensation transfer, which is typically used to avoid inefficiencies due to mobility, can not. It interesting to note that the Cockfield White paper and subsequent Commission proposals recommended with the decision to abolish internal fiscal frontier the introduction of a VAT clearing house mechanism (compensation system) based on a complex information flow among the States. Member states failed to agree on the VAT mechanism proposed by the Commision.

There is now a new proposal for the implementation of the VAT origin principle which was presented by the Commission in 1996. The Commission proposes a clearing mechanism based on estimates of aggregate trade flows among the member states. More than one member state opposed to the introduction of this kind of mechanism. They appear unpersuaded that estimated trade flows would be accurate enough to achieve a fair allocation of revenue. The States have an expected loss in revenue with the introduction of the clearing mechanism, which according to our model can be more relevant for states with a lower tax base. May be it could be possible for some member states with a lower tax base than others to more easily find an agreement on an equalizing transfer than on a compensation transfer, like the one proposed by the Commission. So an introduction of a general transfer system based on difference in revenue derived from VAT taxes could have an equalizing function, but could also bring a Pareto improvement.
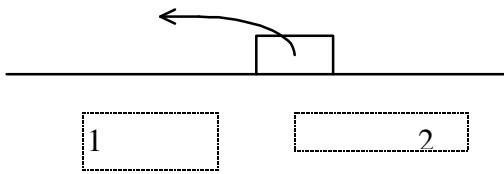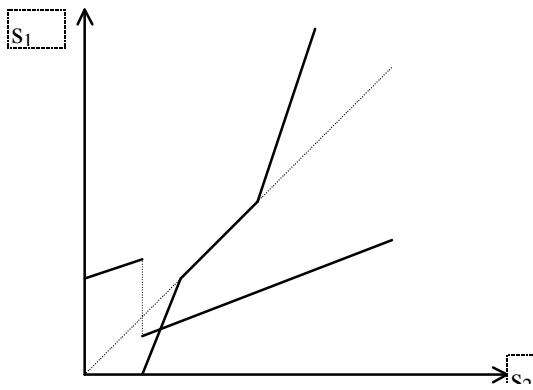
FIGURES

fig. 1

Fig. 2

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Appendix

A1 Procedure to find best reply functions

Region 1 revenue:

$T \geq t$

$$R_1 = N\left\{ t\left(x_A + \frac{T-t}{\delta} x_B \right) + \alpha\left[\frac{1}{2}[x_B - x_A] - \frac{T-t}{\delta} x_B \right] \right\} - \kappa\alpha \qquad (1A)$$

$T \leq t$

$$R_1 = N\left\{ t\left(x_A + \frac{T-t}{\delta} x_A \right) + \alpha\left[\frac{1}{2}[x_B - x_A] - \frac{T-t}{\delta} x_A \right] \right\} - \kappa\alpha \qquad (2A)$$

First order conditions:

$$\frac{\partial R_1}{\partial t} = 0 \implies s_1 = \frac{1}{2}(\delta\lambda + s_2 + \alpha)$$

(3A)

$$\frac{\partial R_2}{\partial t} = 0 \implies s_1 = \frac{1}{2}(\delta + s_2 + \alpha) \qquad (4A)$$

We proceed in three steps:

from (3A):

$$s_2 \geq s_1 \quad \Rightarrow \quad s_2 \geq (\delta\lambda + \alpha)$$

indeed :

$$(5) \qquad s_1 \begin{cases} \dfrac{1}{2}(\delta\lambda + s_2 + \alpha) & \text{if } s_2 \geq \delta\lambda + \alpha \\ s_2 & \text{se } s_2 \leq \delta\lambda + \alpha \end{cases}$$

From (7A):

$$s_2 \leq s_1 \quad \Rightarrow \quad s_2 \leq (\delta + \alpha)$$

indeed :

$$(6) \qquad s_1 \begin{cases} \dfrac{1}{2}(\delta + s_2 + \alpha) & \text{se } s_2 \leq \delta + \alpha \\ s_2 & \text{se } s_2 \geq \delta + \alpha \end{cases}$$

2nd step

We find revenue functions of region 1, given s_2 :

Substitute (5A) in (1A):

$$
R_1 = \begin{cases} N\dfrac{x_B}{2\delta}\left[\dfrac{\delta^2\lambda^2}{2}+\delta\lambda T+\alpha\delta+\dfrac{(T-\alpha)^2}{2}\right]-\kappa\alpha & T\geq\delta\lambda+\alpha \\[4mm] Nx_B\left[\lambda T+\dfrac{\alpha}{2}(1-\lambda)\right]-\kappa\alpha & T\leq\delta\lambda+\alpha \end{cases}
$$

substitute (6A) in (2A):

$$
R_1 = \begin{cases} N\dfrac{x_B}{2\delta}\left[\dfrac{\delta^2\lambda}{2}+\delta\lambda T+\alpha\delta+\dfrac{(T-\alpha)^2\lambda}{2}\right]-\kappa\alpha & T\leq\delta+\alpha \\[4mm] Nx_B\left[\lambda T+\dfrac{\alpha}{2}(1-\lambda)\right]-\kappa\alpha & T\geq\delta+\alpha \end{cases}
$$

3rd step

We determine the best reply function on all the s_2 range:

$$
s_2 \leq \min[\delta+\alpha,\ \delta\lambda+\alpha]
$$

$$
R_{1p}^{\#}-R_{1p}=(s_2-\alpha)^2\dfrac{\lambda}{2}-(s_2-\alpha)\delta\lambda+\dfrac{\delta^2\lambda}{2}\geq 0
$$

indeed in this sub-range:

$$
s_2 = \dfrac{1}{2}(\delta\lambda+s_2+\alpha);
$$

$$
s_2 \geq \max[\delta+\alpha,\ \delta\lambda+\alpha]
$$

$$R_{1p}^{\#} - R_{1p} = \frac{\left(s_2 - \alpha\right)^2}{2} - \left(s_2 - \alpha\right)\delta\lambda + \frac{\delta^2\lambda^2}{2} \geq 0$$

indeed in this sub-range:

$$s_1(s_2) = \frac{1}{2}\left(\delta\lambda + s_2 + \alpha\right);$$

$$s_2 \in \left[\delta + \alpha, \ \delta\lambda + \alpha\right]$$

if $\lambda \geq 1$ then $s_1 = s_2$,

if $\lambda \leq 1$

$$R_{1p}^{\#} - R_{1p} = (1-\lambda)\left[\delta^2\lambda - \left(s_2 - \alpha\right)^2\right] \geq 0 \qquad \forall s_2 \in \left[\alpha - \delta\sqrt{\lambda}, \ \delta\sqrt{\lambda} + \alpha\right]$$

So in this sub-range:

$$s_1 = \frac{1}{2}\left(\delta + s_2 + \alpha\right) \qquad \delta\lambda + \alpha \leq s_2 \leq \delta\sqrt{\lambda} + \alpha$$

$$s_1 = \frac{1}{2}\left(\delta\lambda + s_2 + \alpha\right) \qquad \delta\sqrt{\lambda} + \alpha \leq s_2 \leq \delta + \alpha$$

The best reply function of region 1 is:

$\lambda \leq 1$

$$s_1(s_2) = \begin{cases} \dfrac{1}{2}\left(\delta + s_2 + \alpha\right) & s_2 \le \delta\sqrt{\lambda} + \alpha \\[2ex] \dfrac{1}{2}\left(\delta\lambda + s_2 + \alpha\right) & s_2 \ge \delta\sqrt{\lambda} + \alpha \end{cases}$$

$\lambda \ge 1$

$$s_1(s_2) = \begin{cases} \dfrac{1}{2}\left(\delta + s_2 + \alpha\right) & s_2 \le \delta + \alpha \\[2ex] s_2 & \alpha + \delta \le s_2 \le \delta\lambda + \alpha \\[2ex] \dfrac{1}{2}\left(\delta\lambda + s_2 + \alpha\right) & s_2 \ge \delta\lambda + \alpha \end{cases}$$

A2. Proof of proposition 1

Take $\lambda \le 1$. Assume $s_1 > s_2$. Region 2 tax-rate will satisfy this condition if

$s_1 > \dfrac{\delta}{\lambda} + \alpha$. In this case:

$$s_2 = \frac{1}{2}\left(\frac{\delta}{\lambda} + s_1 + \alpha\right) \quad (7A)$$

and region 1 has the following best reply function:

$$s_1 = \frac{1}{2}\left(\delta + s_2 + \alpha\right) \quad (8A)$$

if we substitute (7A) into (8A):

$$s_1 = \frac{\delta}{\lambda}\left(\frac{1+2\lambda}{3}\right) + \alpha \leq \frac{\delta}{\lambda} + \alpha$$

indeed the equilibrium will not exist.

Take $s_1 < s_2$. If we combine best reply functions we have equilibrium tax-rates of proposition 1. From best reply functions we know that the equilibrium will exist if and only if:

$$s_2^* \geq \delta\sqrt{\lambda} + \alpha \qquad \text{(a)}$$

.

$$s_1^* \leq \delta + \alpha \qquad \text{(b)}$$

As:

$$\delta\left(\frac{2}{3} + \frac{1}{3}\lambda\right) + \alpha - \delta\sqrt{\lambda} - \alpha = \frac{\delta}{3}\left(1 - \sqrt{\lambda}\right)\left(2 - \sqrt{\lambda}\right) \geq 0$$

(a) is true.

As $\lambda \leq 1$ also (b) is true.

Moreover $s_1^* = s_2^*$ is the equilibrium if and only if $\lambda = 1$

QED