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Tax Evasion and Auditing in a Federal Economy

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Abstract

This paper analyzes the relation between tax auditing and fiscal equalization in the context of fiscal competition. We incorporate a model of tax evasion by firms into a standard tax competition framework where regional governments use their audit rates as a strategic instrument to engage in fiscal competition. We compare the region's choice of audit policies for three different cases: A scenario of unconfined competition without interregional transfers, a scenario with a *gross* revenue equalization (GRS) scheme and finally, a scenario with *net* revenue sharing (NRS), where not only the revenues from taxation but also the regions auditing costs are shared. Without regional transfers, fiscal competition leads to audit rates which are inefficiently low for revenue-maximizing governments. While in general GRS aggravates the inefficiency, NRS makes the decentralized choice of auditing policies more efficient.

Keywords: tax evasion, fiscal competition, fiscal equalization, auditing

JEL Code: H26, H71, H77

1. Introduction

Many contributions to the taxation literature take tax collection as given or costlessly executed, assuming that tax authorities have full information about individuals or firms' tax liabilities. Of course, this is not very realistic. In fact, we observe significant levels of tax evasion in almost all developed countries. According to estimations of Schneider and Enste (2000), the informal sector accounts for approximately 10 to 30 percent of total GDP in OECD countries and for more than 50 percent in some less developed countries. In order to fight evasion, tax authorities have to spend resources on auditing. From the perspective of revenue maximization, tax authorities should raise auditing up to the point where the marginal gains (less tax evasion, higher revenues from taxation and detected evasion) equal the marginal costs from an increase in tax collection efforts.[1] However, there is some evidence that tax authorities spend too little on tax enforcement.

In Belgium, there were repeatedly public discussions arguing that the Flemish region is too lax in its tax enforcement policy (Cremer and Gahvari, 2000). Recent evidence supports this claim (Crabbé, Janssen and Vandenbussche, 2004). For Germany, Lenk, Fuge and Schneider (1998) argue that some regions put too little effort into tax investigation.[2] Anecdotal evidence supports their view: In 1998, German tax authorities inspected hundreds of banks which were under suspicion to support income tax evasion by transferring non declared income of their customers to bank accounts abroad. Although the operation was highly successful in detecting tax evasion, authorities could only examine a small fraction of all cases in detail: Due to a low number of tax investigators, most evaders escaped without any sanctions and a considerable amount of revenue was lost. If we take this evidence as indicating too low auditing efforts, we have to ask for the reasons that lead to this inefficiency.

One possible reason is tax competition at the regional level. Even if regional governments can not impose their own taxes, there may be scope for fiscal competition if these governments are—at least partially—responsible for tax collection. This is the case for several federal countries, like Australia, Canada, Germany and the US.[3] In the presence of tax evasion, tax revenues are not determined exclusively by the statutory tax rate, but also by the enforcement policy. By choosing a certain auditing level, each region can determine its *effective* tax rate. Accordingly, the audit policy becomes an alternative strategic tool for tax competition and regions might compete via their effective rather than their statutory tax rate. As has been shown by Cremer and Gahvari (2000), countries will then end up with less than optimal audit rates, even if (statutory) tax rates are harmonized. This may be an important aspect in the context of a EU wide tax harmonization if tax collection remains in commission of the member states.

Another incentive for reducing auditing efforts may derive from fiscal equalization. As shown by Bordignon, Manasse and Tabellini (2001), tax collection incentives may be distorted if higher revenue reduces the amount of transfers received. Empirical support for this argument is provided by Knight and Li (1999) and Baretti, Huber and Lichtblau (2002). They find a negative impact of fiscal equalization on revenues collected by Chinese respectively German regions. For the German case, the latter authors argue that disincentives associated with fiscal equalization account for 15% lower tax revenues.

However, there is also scope for fiscal equalization to increase efficiency. As Köthenbürger (2002) demonstrates, interregional redistribution may induce regions to internalize the fiscal externalities associated to their policy. Hence, fiscal equalization could induce higher tax rates—respectively higher audit frequencies—as compared to the case of unrestricted fiscal competition. Taken these two opposing effects together, the net effect of fiscal equalization is ambiguous then and does crucially depend on the design of the equalization scheme.

As has been outlined above, the choice of audit rates may be affected by fiscal competition as well as by the design of the fiscal equalization scheme. While these aspects have been discussed separately in the literature, we combine them in a single framework. This allows us to study the joint incentives from interregional redistribution and competition for the decentralized choice of the audit policy.

We introduce a modified version of the standard model of tax evasion by the firm (e.g., Cremer and Gahvari, 1993) and incorporate it into a tax competition setting. In each region of a perfectly symmetric federal economy a representative firm uses a fixed factor and mobile capital to produce a consumption good. Firms have to pay a tax on capital and decide on how much of the taxes to evade. In making these decisions, each firm takes its evasion costs, the tax rate and the auditing probability into account. Local tax authorities choose their audit rates in order to maximize net revenues, trading off higher auditing costs with revenue increases. The statutory tax rate is determined at the federal level and taken as exogenously given by each region.

In this model, we compare the regions' choice of audit rates for three different cases. The first scenario describes a situation without any fiscal equalization where the choice of the audit rate is only affected by fiscal competition. We show that this will result in inefficiently low levels of auditing, which resembles the classical tax competition result (Zodrow and Mieszkowski, 1986) as well as the findings of Cremer and Gahvari (2000). In scenario two we introduce a system of gross revenue sharing (GRS). The GRS reflects the main properties of the German interstate transfer system (*Länderfinanzausgleich*) and introduces an explicit asymmetry: While tax revenues get shared, auditing costs are fully borne by each region.[4] Finally, scenario three describes an alternative fiscal equalization scheme, net revenue sharing (NRS), under which not only the revenues from taxation, but also the regions auditing costs get shared. For the case of symmetric regions, we show that a system of GRS in general leads to even lower spending on tax enforcement than in the case of unconfined competition. However, NRS would then increase audit rates in comparison to both, the benchmark case and the case of GRS.

The paper is organised as follows: Section 2 presents the basic model. Section 3 introduces a benchmark scenario where regions choose their audit policies in the absence of any fiscal equalization scheme. In Section 4, we analyze the decentralized choice under GRS and NRS. Before concluding with some policy implications we discuss our results in Section 5. All proofs appear in the Appendix.

2. Basic Model

Consider an economy with n regions, each inhabited by a single representative household. In a perfectly competitive industry firms produce one homogenous private good (numeraire). The production process in each region i uses perfectly mobile capital k_i and a fixed, immobile factor. The technology is represented by a standard neoclassical production function $f(k_i)$, where the fixed factor is suppressed. We assume a perfectly symmetric economy where all regions use the same technology and are endowed with the same amount of the fixed factor. Firms have to pay a unit tax on capital at a rate t. This *statutory* tax rate is equal for the whole economy. However, each firm can try to evade taxes by concealing a share e_i of the capital employed. To conceal inputs requires the use of resources by the firm. Following the literature, we assume that the costs of evasion are convex in e_i and linear in the tax base:[5] $g(e_i)k_i$ with $g' > 0$ and $g'' > 0$. With a probability p_i the evasion gets detected, and the firm has to pay the statutory taxes plus a fine that is proportional to the taxes evaded (Yitzhaki, 1974). For all regions, the penalty rate is $s - 1$, with $s > 1$. With probability $1 - p_i$ the firm gets away with the evasion and pays only taxes on the declared amount of capital. Expected profits π_i^e are defined as

$$\pi_i^e = f(k_i) - rk_i - g(e_i)k_i - p_i(tk_i + (s-1)e_itk_i) - (1-p)(1-e_i)tk_i,$$

where r is the factor price for capital. We can simplify this expression to

$$\pi_i^e = f(k_i) - \big(r + g(e_i) + t_i^e\big)k_i \tag{1}$$

with $t_i^e \equiv t(1 - e_i + e_i p_i s)$, the expected or *effective tax rate* in region i. Note that revenues from detected evasion (including penalties) are also included in the definition of the effective tax rate.

Taking the policy variables as given,[6] a risk neutral firm chooses k_i and e_i to maximize its expected profit. The firms optimal choice is then given by the following system of first order conditions

$$g'(e_i) = (1 - p_i s)t, \tag{2}$$

$$f'(k_i) = r + g(e_i) + t_i^e. \tag{3}$$

For the rest of the paper, we will assume that there is an interior solution with evasion in equilibrium (i.e., $p_i s < 1$). From (2) and (3) one can easily derive two basic results (see the Appendix). First, firms will conceal more if the statutory tax rate increases or the detection probability decreases — a standard result for models of firm tax evasion (Cremer and Gahvari, 1993). Second, an increase in the audit rate will raise (per unit) capital costs and hence decrease capital demand. This triggers an effect which is analogous to the impact of a tax increase on mobile capital in tax competition models.

Finally, we describe the capital market. In each region i a representative household is endowed with capital $\bar{k}_i$ and one unit of the immobile factor. The total capital supply to the economy $\bar{k}$ is fixed and market clearing requires

$$\sum_{i=1}^{n} \bar{k}_i = \bar{k} = \sum_{i=1}^{n} k_i. \tag{4}$$

Individuals invest their capital in a large number of firms distributed over the whole economy. By holding a fully diversified portfolio, they avoid the potential risks associated with tax evasion by firms. In the capital market equilibrium the arbitrage condition

$$f'(k_i) - g(e_i) - t_i^e = r \tag{5}$$

has to be fulfilled for all regions i.

3. Auditing Policy Without Fiscal Equalization

Let us now turn to the regional planners' policy choice. Throughout the whole paper we assume perfectly symmetric regions.[7] As a benchmark scenario we consider a federal economy without any interregional redistribution. Following the literature on tax evasion, the objective of the regional governments (or tax authorities) is revenue maximization.[8]

The tax and the penalty rate are (exogenously) determined at the federal level. Hence, the only policy variable controlled by the regional government is the audit rate, which determines the capital allocation and thereby the regions' revenues from taxes and penalties. Each region bears the full costs associated with auditing. Assuming that these costs are linear in the tax base (i.e. the level of firms' capital inputs), we define the total detection costs of a region as $c(p_i)k_i$, where $c(p_i)$ denotes the auditing costs per unit of capital (as a function of p_i), with $c' > 0$, $c'' > 0$ and $c(0) = 0$.[9,10] In the absence of an interregional redistribution mechanism the net revenue of region i is given by

$$k_i\big(t_i^e - c(p_i)\big), \tag{6}$$

with the effective tax rate t_i^e as defined above.[11] While the statutory tax rate in the economy is 'harmonized' and hence there is no scope for standard tax competition between regions,[12] the detection policy acts as a strategic substitute for the regional policymaker: By reducing its auditing rate, a region can lower the effective tax rate. This will reduce capital costs and attract mobile capital from other regions. Taking the capital market responses into account and considering the policy of the other regions as fixed, the first order condition becomes

$$k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i} = MC_i, \quad \text{with } MC_i \equiv c'(p_i)k_i + c(p_i)\frac{\partial k_i}{\partial p_i}. \tag{7}$$

(The term $\partial t_i^e/\partial p_i$ is derived in the Appendix. There we also show that t_i^e is concave in p_i.) Condition (7) implies a system of reaction functions which determine the Cournot-Nash equilibrium of the uncoordinated auditing choice.[13]

In the optimum, marginal benefits from auditing, depicted by the terms on the LHS of (7), have to be equal to MC_i which denotes the 'extended' marginal costs of auditing.[14] The marginal benefit on the LHS consists of two effects: The marginal increase in the effective tax rate (weighted with the tax base) and the marginal capital outflow which follows from an increase in p_i (weighted with the effective tax rate). These capital outflows clearly lower the marginal benefit of the region.

Let us now compare the decentralized choice to the centralized solution of the problem. Suppose that a central planner would choose a detection policy for each region in order to maximize the sum of all revenues,

$$\max_{p_1,\ldots,p_n} \sum_{i=1}^{n} k_i\big(t_i^e - c(p_i)\big).$$

The n first order conditions are given by

$$k_i\left(\frac{\partial t_i^e}{\partial p_i} - c'(p_i)\right) + \frac{\partial k_i}{\partial p_i}\big(t_i^e - c(p_i)\big) + \sum_{j\neq i} \frac{\partial k_j}{\partial p_i}\big(t_j^e - c(p_j)\big) = 0. \tag{8}$$

While the first two terms also appear in condition (7), the third term in (8) represents the revenue spillovers created by a region's detection policy.[15] For the case of symmetric regions, the planner will chose one unique auditing level $p_i = p_j \forall_{i,j}$ and hence $t_i^e = t_j^e \forall_{i,j}$. Since capital flows must be balanced, the second and third term in condition (8) cancel out and we get

$$\partial t_i^e/\partial p_i = c'(p_i). \tag{9}$$

Comparing (7) with (9) we can derive

Proposition 1. *In the absence of fiscal equalization, the uncoordinated choice of auditing policies in an open economy with mobile capital will lead to audit rates which are below the auditing level a central planner would choose.*

The intuition for this result is straightforward: For an open region the capital outflows reduce the marginal benefit of an increase in detection efforts. However, the capital outflows from one region will enlarge the 'foreign' tax base and, ceteris paribus, raise net revenues in the rest of the economy. Since regional decision makers ignore these well known fiscal externalities, they set lower detection probabilities than a central planner. Hence, the uncoordinated policy choice leads to audit rates which are 'inefficiently low' from the perspective of total revenue maximization. This further means that firms will choose a level of evasion, which is 'inefficiently high'—again from a revenue maximizing perspective.

Proposition 1 describes our benchmark result. In the next section, we will compare this result with the regions' uncoordinated policy choice in the presence of different fiscal equalization schemes.

4. Auditing Policy with Fiscal Equalization

In this section we introduce fiscal equalization into the model. We analyse two different schemes of equalizing transfers: Gross revenue sharing (GRS) and net revenue sharing (NRS).

4.1. Gross Revenue Sharing

Consider the following simple redistribution mechanism: Each of the n regions contributes a share $0 < \alpha < 1$ of its gross revenues $t_i^e k_i$ to the redistribution system and receives a share $1/n$ of the total revenues distributed, $\alpha \sum t_j^e k_j$. This fiscal equalization scheme captures a central feature of the current German interstate transfer system (*Länderfinanzausgleich*): While revenues obtained under a given detection policy have to be shared with all other regions, the costs for maintaining a certain audit rate have to be fully borne by the region itself. The net revenue of a region is then given by

$$(1-\alpha)t_i^e k_i - c(p_i)k_i + \frac{\alpha}{n}\sum_{j=1}^{n} k_j t_j^e. \tag{10}$$

We assume $t_i^e \gg c(p_i)$ and redistribution is not 'too extreme', such that $(1-\alpha)t_i^e > c(p_i)$ holds in equilibrium. The first order condition for the uncoordinated choice of a revenue maximizing regional government is

$$(1-\alpha)\left(k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i}\right) + \frac{\alpha}{n}\left(\sum_{j=1}^{n} t_j^e \frac{\partial k_j}{\partial p_i} + k_i \frac{\partial t_i^e}{\partial p_i}\right) = MC_i \tag{11}$$

with MC_i as defined above. The first term on the LHS depicts the distortion introduced by the fiscal equalization scheme, whereas the second term shows that a part of the fiscal spillovers will be internalized via the redistribution mechanism. For a proper analysis, we have to distinguish between an economy with many *small* or few *large* open regions.

4.1.1. Small Open Regions In the case of many small regions ($n \to \infty$), the impact of a single region's detection policy on total tax revenues in the economy becomes negligible. Hence, the second term on the LHS of (11) vanishes and the first order condition becomes

$$(1-\alpha)\left(k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i}\right) = MC_i. \tag{11a}$$

If we compare (11a) with condition (7), the result in the scenario without any interregional redistribution, one can easily see that GRS distorts the region's choice of detection efforts:[16] While the marginal costs MC_i are unaffected, the redistribution system clearly reduces the marginal gains from an increase in the audit rate. This is the case, since fiscal equalization leads to an implicit taxation of a region's gross revenue. Hence, regions will unambiguously choose a lower audit frequency than in the absence of fiscal equalization.

Proposition 2. *Under a system of gross revenue sharing, a small open region maximizing its net revenue will choose a detection probability which is even lower than in the case without fiscal equalization.*

This result is equivalent to Proposition 3 in Köthenbürger (2002). As in his analysis, the inefficiency due to the distorted incentives adds to the inefficiency due to fiscal competition: Detection efforts will be reduced further below the 'efficient' level a central planner would set and the amount of taxes evaded will be higher than in our reference case without any interregional redistribution system. Moreover, it is straightforward to show that the audit rate will decrease as α increases.

4.1.2. Large Open Regions Since the decision maker of a large region takes into account the impact of the local detection policy on the total revenues distributed, we can rearrange condition (11) and get

$$\left(1-\alpha\left(1-\frac{1}{n}\right)\right)\left(k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i}\right) + \frac{\alpha}{n}\sum_{j\neq i} t_j^e \frac{\partial k_j}{\partial p_i} = MC_i. \tag{11b}$$

As in the case of small open regions, GRS introduces a distortion. However, since large regions consider the strategic effect of their policies—the impact of their audit rate on total revenues redistributed—the distortion becomes smaller: $1-\alpha+\alpha/n > 1-\alpha$. Stated differently, for large regions the implicit taxation of gross revenues drops below the rate α observed for small regions. Moreover, there is a further incentive embedded in the GRS: As reflected in the second term on the LHS of condition (11b), a part of the fiscal externalities[17] gets internalized. Again, this is due to the fact that large regions—in contrast to small ones—take into account the strategic effect of their policies.

If we compare this case with the benchmark scenario, the introduction of GRS shows an ambiguous effect on the choice of audit rates. While the implicit taxation of gross revenues tends to lower auditing efforts, the internalization of the spillovers will act in the other direction. Comparing condition (11b) and (7), we can find a threshold level such that, for

$n < \hat{n}$, with

$$\hat{n} = 1 + \frac{\sum_{j \neq i} t_j^e \frac{\partial k_j}{\partial p_i}}{k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i}}, \tag{12}$$

the second effect dominates. We sum up these results in

Proposition 3. *Suppose large open regions and revenue maximizing governments under gross revenue sharing. There exists a threshold* $1 < \hat{n} < \infty$, *such that for* $n < \hat{n}$ ($n > \hat{n}$) *the detection probabilities chosen under a system of gross revenue sharing are higher* (*lower*) *than in the case without fiscal equalization.*

While GRS has an unambiguously negative effect in the case of small regions (see Proposition 2), it could increase audit rates for large open regions.[18] This result is to some extent surprising. At first glance, a GRS scheme seems to lead to a clear inefficiency: The asymmetric treatment of auditing costs on the one hand, and tax revenues on the other, unambiguously distorts a region's choice of the auditing effort. However, in the presence of fiscal competition, the redistribution system has a further effect: It works as a corrective subsidy and induces large regions to internalize a part of the fiscal externalities. While the distortion from the implicit taxation tends to lower audit rates, the corrective subsidy works in the opposite direction. If there are $n < \hat{n}$ jurisdictions, the second effect dominates the first one and GRS makes the decentralized choice more 'efficient' (in terms of revenue maximization), compared to the benchmark scenario. The intuition for this result is clear-cut: If the number of regions diminishes, the implicit taxation of gross revenues becomes smaller and the degree of internalization gets higher—irrespective of α (see condition (11b)). Following this line of reasoning it is straightforward to show that an increase in α further amplifies the efficiency enhancing (reducing) effect of GRS, as long as the mechanism induces a region to raise (lower) its auditing effort for the case of $n < \hat{n}$ ($n > \hat{n}$). One can also show that an increase in n, the number of regions, would result in lower audit rates. This is the case, since more regions will always increase the distortion of the redistribution and decrease the degree of internalization.

4.2. Net Revenue Equalization

Let us now introduce an alternative system of interregional redistribution. Instead of *gross* revenue sharing, we consider a mechanism which is based on *net* revenue sharing. Each region contributes a share $0 < \alpha < 1$ of its net revenues—tax revenues net of auditing costs—and receives a share $1/n$ of the total revenues distributed, $\alpha \sum k_j(t_j^e - c(p_j))$. With this mechanism, the revenue of a region becomes

$$(1 - \alpha)k_i\big(t_i^e - c(p_i)\big) + \frac{\alpha}{n}\sum_{j=1}^{n} k_j\big(t_j^e - c(p_j)\big). \tag{13}$$

The first order condition is given by

$$(1-\alpha)\left(k_i\frac{\partial t_i^e}{\partial p_i}+t_i^e\frac{\partial k_i}{\partial p_i}-MC_i\right)$$
$$+\frac{\alpha}{n}\left(\sum_{j=1}^{n}\frac{\partial k_j}{\partial p_i}\big(t_j^e-c(p_j)\big)+k_i\left(\frac{\partial t_i^e}{\partial p_i}-c'(p_i)\right)\right)=0. \tag{14}$$

As before, we discuss this condition separately for the cases of small and large open regions.

4.2.1. Small Open Regions As under GRS the second term on the LHS of condition (14) vanishes for the case of many small regions. We can rewrite (14) as

$$k_i\frac{\partial t_i^e}{\partial p_i}+t_i^e\frac{\partial k_i}{\partial p_i}=MC_i, \tag{14a}$$

which is identical to condition (7) in the benchmark scenario. While GRS distorts the auditing policy of small regions (Proposition 2), the distortion disappears under NRS. We can state

Proposition 4. *Under a system of net revenue sharing a small open region maximizing its net revenue will choose the same audit rate as in the benchmark scenario without fiscal equalization.*

The intuition for this result is clear: In contrast to the scenario of GRS, there is no asymmetric treatment of revenues and auditing costs under NRS. Therefore, revenue maximizing regions would unambiguously choose a higher audit rate after a change from GRS to NRS. The only inefficiency remaining arises from the competition for the mobile tax base. As in the benchmark scenario, auditing efforts will be 'inefficiently' low and the evasion level of the firms will be 'inefficiently' high from the perspective of total revenue maximization.

An interesting point to note is that Proposition 4 holds true for any α. Since interregional redistribution does not introduce any distortion, there is no equity-efficiency trade off in the choice of α.[19]

4.2.2. Large Open Regions As before, the government of a large open region considers the impact of its auditing policy on the tax base in the rest of the economy. We can rearrange condition (14) and get

$$k_i\frac{\partial t_i^e}{\partial p_i}+t_i^e\frac{\partial k_i}{\partial p_i}+\beta\sum_{j\neq i}\frac{\partial k_j}{\partial p_i}\big(t_j^e-c(p_j)\big)=MC_i \quad \text{with } \beta\equiv\frac{\alpha}{n(1-\alpha)+\alpha}. \tag{14b}$$

As in the case of small open regions discussed above, NRS does not distort the decentralized choice of detection probabilities. The inefficiency due to the fiscal competition between regions still remains. However, since the decision maker of a large open region incorporates the strategic effect of the auditing policy, a fraction β of the fiscal externality gets internalized. Compared to our benchmark scenario, the NRS will lead to higher audit rates in the case of large regions. If we contrast the impact of NRS with that of GRS, the former system introduces no distortion but—in most cases—a higher corrective subsidy.[20]

Proposition 5. (i) *Under a system of net revenue sharing, a large open region maximizing its net revenue will set an audit rate which is higher than the rate chosen in the benchmark scenario without any fiscal equalization.* (ii) *Moreover, if* $n > \hat{n}$, *the audit rate is also higher than the rate chosen under gross revenue sharing.*

Proposition 5 is the main result of our analysis: For large open regions, a NRS scheme partly internalizes fiscal externalities without introducing any distortion. Given that the sufficient condition $n > \hat{n}$ holds, the decentralized choice of detection policies under NRS will result in higher auditing efforts as compared to both, the case without any equalization transfers and the case with a GRS. Incorporating auditing costs into the redistribution mechanism will only slightly reduce the amount redistributed (for a given α) but increase detection probabilities. Firms would evade less and tax revenues would be higher. Interestingly, for $n < \hat{n}$ a GRS mechanism could in principle induce higher audit rates than a NRS mechanism. This result stems from the fact, that NRS slightly reduces the redistributive volume and that for small n the distortion embedded in the GRS vanishes. However, in the Appendix we show that $n > \hat{n}$ is only a sufficient condition, and Proposition 5 (ii) will in general also hold for $n < \hat{n}$.

From (14b) one can further show, that an increase in the number of regions would lead to a lower degree of internalization and therefore to a decline in audit rates. In contrast, raising the level of redistribution α would result in a stronger internalization of externalities, without causing any distortion. Hence, as discussed above in the context of Proposition 4, there is no equity-efficiency trade-off.

5. Discussion

5.1. Asymmetric Information

In the last section we concluded that a switch from GRS to NRS will typically enhance tax collection efforts. However, our modeling approach neglects a severe disadvantage associated with NRS which renders this transfer mechanism relatively unattractive. Under NRS, regions have a clear incentive to overstate their auditing costs, if there is asymmetric information between different layers of the government.[21] Hence, as Bordignon, Manasse and Tabellini (2001) point out, information asymmetries introduce a new source of inefficiency for the choice of tax enforcement efforts. As long as there are no institutional rules which prevent regions from abusing their informational advantage, the feasibility of NRS is unclear.[22]

Nevertheless, if the (gross) revenue of a region is observable to the federal government, the central authority could use this information as a proxy for the underlying audit rate and the corresponding costs. This could imply an upper bound for the declared costs. While it is not clear, whether in this case a NRS would increase enforcement efforts compared to GRS, the former mechanism would clearly reduce the level of fiscal equalization.

5.2. Asymmetric Regions

In deriving our main results, we have restricted our analysis to a perfectly symmetric economy: Evasion as well as auditing technologies are the same for all regions, jurisdictions are of the same size and production technologies are identical. The equilibrium is therefore characterized by symmetric capital allocations and equal (net) revenues. Hence, there is no need for equalization transfers. While in such a scenario the analysis of interregional redistribution seems rather artificial, the incentives embedded in different revenue sharing mechanism are equally at work in a scenario of heterogeneous regions. In the case of different production technologies, however, asymmetric capital allocations would render the comparison of GRS and NRS less clear cut. Since these size-related effects are well studied in the literature[23] and work here in a very similar way,[24] incorporating them would only blur the results of the study without gaining further insights.

Of course, one could allow for further levels of heterogeneity, e.g. with respect to auditing and evasion costs. However, this may better fit into a simulation based rather than an analytical approach. Calibrating the model and comparing the results with existing empirical evidence—especially Baretti, Huber and Lichtblau (2002)—would be an interesting task for further research.

5.3. Central Government Policy[25]

Another limitation of our model is the exogenous choice of the tax policy. Following the institutional framework in Germany, we have assumed that there is a harmonized tax rate, chosen by the federal government. The central government might counterbalance low detection probabilities by raising the statutory tax rate. However, in our framework this policy is not necessarily feasible. A comparative static analysis for the different scenarios shows the ambiguous result

$$\frac{dp_i}{dt} \gtreqless 0.$$

Hence, an increase in the statutory tax rate might further reduce auditing efforts.

The other policy instrument available to the central government is the penalty rate. Since punishment is costless and enforces a lower level of evasion, a central planner could set $s \to \infty$ and there would be no evasion at all (see Kolm, 1973). However, strong penalties are probably not feasible: If a firm would go bankrupt because of a very severe punishment, the penalty may not be credible. Keeping this restriction in mind, assuming that s is fixed at some credible rate (with $p_i s < 1$) appears plausible.

6. Conclusion

In this paper, we have analyzed the decentralized choice of audit rates for the case of symmetric regions. As a benchmark result we show that fiscal competition will lead to detection probabilities which are inefficiently low from the perspective of revenue maximization. In such a framework, a fiscal equalization scheme has an efficiency enhancing potential, since interregional redistribution provides a mechanism to internalize fiscal externalities (see Köthenbürger, 2002). We first consider a system of GRS, which makes regions bear the full auditing costs while tax revenues get shared. This asymmetric treatment of costs and revenues introduces a further distortion, which tends to lower audit rates. As an alternative to GRS, we introduce a system of NRS. Under this mechanism both costs and revenues are shared and therefore NRS does not create any distortion. We show that NRS generally induces higher detection probabilities for large regions. Results for small regions are equal to those in the benchmark case of unconfined fiscal competition.

The policy implications of these results are straightforward. A federal government which, on the one hand, equalizes tax revenues between its regions but, on the other, imposes the costs of tax collection upon these regions, will face a higher degree of tax evasion. This may well be the case for Germany, since the current fiscal equalization system corresponds to a GRS scheme. Switching to NRS should lead to more auditing, less tax evasion and to higher net revenues, while redistribution, the primary objective of fiscal equalization, would hardly be affected. However, if there is asymmetric information between central and local governments regarding a regions auditing costs, a system of NRS may not be a feasible instrument since jurisdictions could easily overstate their enforcement costs.

An alternative which could induce the first best solution would be the centralized choice of tax enforcement policies—as practiced in centralized countries such as France and as recently proposed by the German Ministry of Finance. Nevertheless, following the literature on fiscal federalism (Oates, 1972), there may exist several disadvantages of a centralized policy our model does not account for. Hence, we can not argue in favor of a centralization. Furthermore, if we consider the scenario of tax harmonization within the EU, centralized tax collection appears infeasible. Similarly, the harmonization of enforcement policies would be a difficult (if not impossible) task, since—in contrast to taxation—there are hardly any transparent and contractible indicators for the level of tax enforcement. In this case, audit policies become alternative strategic tools for fiscal competition. To limit competitive forces, it is therefore important to study different mechanisms, which help to induce efficiency in decentralized tax collection. Clearly, further research is needed in order to design a mechanism which is also feasible in the context of information asymmetries.

Appendix

Comparative Statics (Section 2)

Using the implicit function theorem on (2) we get

$$\frac{\partial e_i}{\partial p_i} = -\frac{st}{g''} < 0, \tag{A.1}$$

$$\frac{\partial e_i}{\partial t} = \frac{1 - p_i s}{g''} > 0. \tag{A.2}$$

Applying the implicit function theorem on equation (3) and making use of (2) we get

$$\frac{\partial k_i}{\partial p_i} = \frac{ste_i + \partial r/\partial p_i}{f''} < 0. \tag{A.3}$$

Effective Tax Rate (Section 3)

The effective tax rate is given by $t_t^e \equiv t(1 - e_i + e_i P_i s)$. We can easily derive

$$\frac{\partial t_i^e}{\partial p_i} = t\left(\frac{st}{g''}(1 - p_i s) + e_i s\right) > 0 \tag{A.4}$$

where we made use of (A.1) and $p_i s < 1$. From (A.4) and substituting (A.1) we get

$$\frac{\partial^2 t_i^e}{\partial p_i^2} = -\frac{(st)^2}{g''}\left(2 - \frac{tg'''(1 - p_o)}{(g'')^2}\right) < 0, \tag{A.5}$$

assuming that the first order effect dominates.

Proof of Proposition 1

We can rewrite condition (7) as

$$\frac{\partial t_i^e}{\partial p_i} + \psi\big(t_i^e - c(p_i)\big) - c'(p_i) = 0 \tag{A.6}$$

with $\psi = \frac{1}{k_i}\frac{\partial k_i}{\partial p_i}$, and condition (9) as

$$\frac{\partial t_i^e}{\partial p_i} - c'(p_i) = 0. \tag{A.7}$$

We know from (A.3) that $\psi < 0$. Therefore the second term in (A.6) is negative and the LHS of (A.6) is smaller then the LHS of (A.7) for any p_i.

Proof of Proposition 2

In order to compare conditions (7), respectively (A.6), and (11a), we rearrange the latter and get

$$(1 - \alpha)\frac{\partial t_i^e}{\partial p_i} + \psi\big((1 - \alpha)t_i^e - c(p_i)\big) - c'(p_i) = 0. \tag{A.8}$$

Note that in general the equilibrium audit rates will differ between the compared scenarios. However, in a symmetric equilibrium between perfectly symmetric regions, different levels of p_i do *not* affect the capital allocation, since the capital supply in the economy is exogenous and audit rates will be the same in all regions. This implies that (for any p_i) ψ is the same for the different scenarios compared.

The comparison of (A.6) and (A.8) shows that for $\alpha > 0$ the LHS of (A.8) is smaller than the LHS of (A.6) for any p_i.

Proof of Proposition 3

Comparing (11b) with (7) we get the threshold defined in (12). Note that in the case of symmetric regions there must hold

$$\sum_{j \neq i} t_j^e \frac{\partial k_j}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i} = 0, \tag{A.9}$$

in any symmetric equilibrium. Applying (A.9) on (12) we get

$$\hat{n} \equiv \frac{k_i \frac{\partial t_i^e}{\partial p_i}}{k_i \frac{\partial t_i^e}{\partial p_i} + t_i^e \frac{\partial k_i}{\partial p_i}} \tag{A.10}$$

Since the denominator of $\hat{n}$ in (A.10) is positive it follows from (A.3) that $\hat{n} > 1$. For the limit $|t_i^e \frac{\partial k_i}{\partial p_i}| \to k_i \frac{\partial t_i^e}{\partial p_i}$ we get $\hat{n} \to \infty$.

Using (A.9) we can rewrite condition (11b) in the following way

$$\left(1 - \alpha\left(1 - \frac{1}{n}\right)\right)\frac{\partial t_i^e}{\partial p_i} + \psi\big((1-\alpha)t_i^e - c(p_i)\big) - c'(p_i) = 0. \tag{A.11}$$

One can easily show that for $n < \hat{n}$ ($n > \hat{n}$) the LHS of condition (A.11) is higher (lower) than the LHS in (A.6) for any p_i.

Proof of Proposition 4

Since the capital allocation is the same for the different scenarios under consideration (see the Proof of Proposition 2), condition (14a) and (7) are identical.

Proof of Proposition 5 (i)

Analogous to (A.9) there does also hold

$$\sum_{j \neq i} \frac{\partial k_j}{\partial p_i}\big(t_j^e - c(p_j)\big) + \frac{\partial k_i}{\partial p_i}\big(t_i^e - c(p_i)\big) = 0. \tag{A.12}$$

With (A.12) we can rearrange (14b) and get

$$\frac{\partial t_i^e}{\partial p_i} + \gamma\psi\big(t_i^e - c(p_i)\big) - c'(p_i) = 0, \tag{A.13}$$

with $\gamma \equiv \frac{1-\alpha}{1-\alpha+\alpha/n}$. Since $\psi < 0$ and $0 < \gamma < 1$ (for $\alpha > 0$), the LHS in (A.13) is larger than the LHS of (A.6) for any p_i.

Proof of Proposition 5 (ii)

The LHS of (A.13) is larger than the LHS of (A.11) for any p_i, if

$$\alpha\left(\left(1-\frac{1}{n}\right)k_i\frac{\partial t_i^e}{\partial p_i}+t_i^e\frac{\partial k_i}{\partial p_i}\right)+\frac{\alpha}{(1-\alpha)n}k_i\left(\frac{\partial t_i^e}{\partial p_i}-c'(p_i)\right)>0. \quad \text{(A.14)}$$

Since the first order conditions imply $\frac{\partial t_i^e}{\partial p_i} > c'(p_i)$, the second term in (A.14) is positive. Therefore, a sufficient condition for (A.14) to hold is

$$\left(1-\frac{1}{n}\right)k_i\frac{\partial t_i^e}{\partial p_i}+t_i^e\frac{\partial k_i}{\partial p_i}>0, \quad \text{(A.15)}$$

which is equivalent to $n > \hat{n}$.

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Notes

1. This is the point made in the early literature on tax evasion, see for example Kolm (1973). For the case of welfare maximizing governments Slemrod and Yitzhaki (1987) argue for a lower level of auditing.
2. See also a report by the *Arbeitnehmerkammer Bremen* (2001).
3. While in many countries—e.g. Austria, Belgium, China, Denmark, Spain and the UK—auditing is carried out by regional governments (in some cases together with the central state), only in few countries, like France, tax auditing is completely centralized. Compare Bordignon, Manasse and Tabellini (2001, p. 719) and Knight and Li (1999).
4. We pick up this example, since the mechanism is particularly illustrative for our analysis. Moreover, the findings from Baretti, Huber and Lichtblau (2002) allude to the quantitative relevance of the associated disincentives.
5. This assumption makes the firms' evasion decision independent of the amount of capital employed (compare equation (2)). Our main results derived below, do also hold for more general assumptions.
6. For an analysis of commitment problems, see Reinganum and Wilde (1986).
7. In an earlier version of this paper we show that the results derived in Section 3 do also hold for the case of asymmetric regions.
8. This can be justified either by a 'Leviathan' government or by a welfare maximizing government in the case of consumers which receive significantly higher marginal utilities from public than from private consumption (see e.g. Kanbur and Keen, 1993).
9. We suppose that this cost function is exogenously given in the short run and that it can not be influenced by the regional government.
10. One could consider a detection technology characterized by marginal auditing costs which are increasing or decreasing in the tax base. However, non-linearity would not affect our results in a qualitative way.

11. At first sight it is not clear why evasion should be possible in the presence of a planner who perfectly knows the size of the tax base. However, if there are many producers and the tax authority does not know the exact distribution of the capital among the firms, there is scope for tax evasion.
12. In this point we follow the institutional arrangements in Germany.
13. One can easily show that the regions' audit rates are strategic complements for all scenarios considered.
14. Of course, a revenue maximizing planner neglects any further costs associated from auditing (e.g. compliance costs).
15. Note that condition (8) corresponds to the case where one would provide each region with a corrective subsidy in order to internalize its fiscal externalities. This replicates the result of Wildasin (1989) for the case of fiscal competition in audit rates.
16. In general, the equilibrium audit rates will differ between the compared scenarios. However, in a symmetric equilibrium between symmetric regions this will *not* affect the capital allocation. This is the case, since total capital supply is exogenous and for a given scenario equilibrium audit rates will be the same in all regions. Hence, for any equilibrium there holds $k_i = \bar{k}/n$, which allows us to compare first order conditions across scenarios.
17. Note that the total spillover would be $\sum_{j \neq i} \frac{\partial k_j}{\partial p_i}(t_j^e - c(p_j))$.
18. Another issue we do not take up here, is the fact that large regions face a lower capital elasticity than small regions because of a different impact of their detection policies on the interest rate. Compare e.g., Bucovetsky (1991).
19. This property (as well as Proposition 4 per se), only holds true since in our model we have excluded any income effect from redistribution.
20. Although $\beta > \alpha/n$ the comparison with the case of GRS—condition (11b)—is not trivial, since the redistribution volume is smaller under NRS.
21. Regions could simply declare other administrative costs as expenditures on auditing.
22. To the best of our knowledge, the concept of NRS is so far only a theoretical one as it is not implemented in any country.
23. Compare e.g. Bucovetsky (1991).
24. Small regions with a lower level of capital employed tend to use 'more aggressive' strategies.
25. In an earlier version of this paper, we also discuss the case of welfare maximizing governments.

References

Arbeitnehmerkammer Bremen (2001). "Steuerliche Betriebsprüfung 1999 im Ländervergleich".

Baretti, C., B. Huber and K. Lichtblau. (2002). "A Tax on Tax Revenue: The Incentive Effects of Equalizing Transfers: Evidence from Germany," *International Tax and Public Finance* 9, 631–649.

Bordignon, M., P. Manasse and G. Tabellini. (2001). "Optimal Regional Redistribution Under Asymmetric Information," *American Economic Review* 91(3), 709–723.

Bucovestsky, S. (1991). "Asymmetric Tax Competition," *Journal of Urban Economic* 30, 167–181.

Crabbé, K., B. Janssen and H. Vandenbussche. (2004). "Is there regional tax competition? Firm level evidence for Belgium". CEPR Discussion Paper No. 4721.

Cremer, H. and F. Gahvari. (1993). "Tax evasion and optimal commodity taxation," *Journal of Public Economics* 50, 261–275.

Cremer, H. and F. Gahvari. (2000). "Tax Evasion, Fiscal Competition and Economic Integration," *European Economic Review* 44, 1633–1657.

Kanbur, R. and M. Keen. (1993). "Jeux sans frontières: Tax Competition and Tax Coordination When Countries Differ in Size," *American Economic Review* 83(4), 877–892.

Knight, J. and Li, S. (1999). "Fiscal Decentralization: Incentives, Redistribution and Reform in China," *Oxford Development Studies* 27, 5–32.

Köthenbürger, M. (2002). "Tax Competition and Fiscal Equalization," *International Tax and Public Finance* 9, 391–408.

Kolm, S. (1973). "A Note on Optimal Tax Evasion," *Journal of Public Economics* 2, 265–270.

Lenk, Th., H. Fuge and F. Schneider. (1998). "Zurück zu mehr Föderalismus: Ein Vorschlag zur Neugestaltung des Finanzausgleichs in der BRD unter besonderer Berücksichtigung der ökonomischen Theorie der Politik". Working Paper 9805, Department of Economics, Johannes Kepler University Linz.

Oates, W. (1972). *Fiscal federalism*. New York: Harcourt Brace Jovanovich.

Reinganum, J. and L. Wilde. (1986). "Equilibrium Verification and Reporting Policies in a Model of Tax Compliance", *International Economic Review* 27(3), 739–760.

Schneider, F. and D. Enste. (2000). "Shadow Economies: Size, Causes and Consequences," *Journal of Economic Literature* 38(1), 77–114.

Slemrod, J. and S. Yitzhaki. (1987). "The Optimal Size of a Tax Collection Agency," *Scandinavian Journal of Economics* 89(2), 183–192.

Wildasin, D. (1989). "Interjurisdictional Capital Mobility: Fiscal Externality and a Corrective Subsidy," *Journal of Urban Economics* 25, 193–212.

Yitzhaki, S. (1974). "A Note on Income Tax Evasion: A Theoretical Analysis," *Journal of Public Economics* 3, 201–202.

Zodrow, G. and Mieszkowski. (1986). "Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods," *Journal of Urban Economics* 19, 356–370.