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Fiscal Equalization, Tax Salience, and Tax Competition

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March 1, 2014

Abstract

This paper analyzes the efficiency consequences of local revenue policies if jurisdictions try to attenuate the pressures of inter-regional competition for mobile factors by substituting attention-grabbing tax instruments that spotlight an additional tax burden with rather inconspicuous ones. We show that the substitution of tax instruments with the view to reduce the *perceived* tax price may suppress the under-exploitation of tax bases that typically goes along with fiscal equalization.

JEL Classifications: H77, H22, H30

Key Words: Fiscal Equalization, Tax Salience, Tax Competition, Fiscal Federalism

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1 Introduction

This paper analyzes the efficiency consequences of tax competition and fiscal equalization in a federal state if some local tax instruments are more salience than others. As a common feature in complex and nontransparent tax systems some tax instruments attract the taxpayers' attention by a high extend while others remain rather unnoticed. In this connection jurisdictions that engage in inter-regional tax competition have incentives to attenuate the competitive pressures by substituting tax instruments that spotlight a tax increase with other ones that do not attract the attention of taxpayers. Hence, in comparison to the neoclassical model with fully optimizing agents the underlying tax competition game takes a slightly different form if tax salience matters. Local governments attract mobile factors from other regions by choosing an appropriate mix of tax instruments that reduces the tax price that is *perceived* by taxpayers.

In the paper we analyze a federal setting with jurisdictions that decide on two tax instruments in order to raise a tax on capital employment, namely the statutory tax rate as well as the intensity of tax enforcement measures. In a neoclassical full optimization model which assumes that taxpayers can observe the enforcement intensity and fully apprehend this piece of information the expected prices is equal to the expected value in line with the workhorse tax evasion model in line with Allingham and Sandmo (1972) and Cremer and Gahvari (2000). Differently to the standard model, we assume that the typical taxpayer learns signals that convey only a fragmentary picture concerning the concrete enforcement intensity. In particular, the taxpayer can only roughly estimate the current detection rate based on a retrospective background, a mouth-to-mouth exchange of experiences with other taxpayers, or proxy variables like the number of tax inspectors that are employed in the jurisdiction. Furthermore, apart from the problem of incomplete observability salience effects of tax instrument matter. In line with Chetty, Looney, and Kroft (2009) taxpayers pay more attention to the variation of tax instruments that are included in the publicly displayed statutory tax rate than to other factors like the intensity of tax enforcement that indirectly influence the effective tax price. This is why the model framework accommodates taxpayers' beliefs concerning the tax price that differs from the actual tax due in the neoclassical model. Accordingly, in this setting with incomplete tax compliance we define salience in terms of the observableness of the local tax inclusive

price for capital employment that may deviate from the statutory tax rate if the tax enforcement is fragmentary.

In the model jurisdictions try to dampen the pressures in the inter-regional competition for mobile factors by granting tax discount that stand in the limelight and attract taxpayers' attention. At the same time jurisdictions broaden the tax base by increasing the detection rate of tax audits without attracting high attention. Accordingly, with an appropriate assignment of revenue functions jurisdictions engage in broadening their tax bases in order to gain a margin for cuts of the statutory tax rates. In this connection, we address the question to which extent substitution effects that stems from tax salience may suppress the under-exploitation of tax bases that typically goes along with fiscal equalization, viz. the tax back effect of fiscal equalization can produce a moral hazard incentive problem if jurisdictions can influence the eligibility for transfers by reducing the frequency and intensity of tax audits and other related measures. Barette et al. (2002) for example depicts the case in the German federal system with decentralized tax enforcement and centralized tax autonomy.

Investigating the efficiency consequences of local revenue policies when decision makers in regional firms imperfectly optimize on tax policy variations we develop an approach that in line with Chetty (2009) relies on two major assumptions. Firstly, we assume that a tax on an inter-regional mobile capital only affects welfare by its impact on the inter-regional allocation of production factors. Secondly, the firms factor demand is consistent with the neoclassical full optimization model when prices are fully salient. Accordingly, we decompose the efficiency consequences of taxation in neoclassical model and the efficiency consequences that uniquely stem from tax salience effects. Correspondingly, we can show to which extent taxpayers' inattention to certain tax instruments may change results that are conventional wisdom in a neoclassical model framework.

A recent literature has pointed out that complex and nontransparent tax systems are an ideal breeding ground for imperfect optimizing behavior of economic agents. In this spirit Gabaix and Laibson (2006) point out that tax policies are shrouded attributes if the tax price is not displayed in posted prices. This is for example the case for sales taxes, hotel city taxes, vehicle excise fees as well as for social security taxes. Likewise Chetty, Looney, and Kroft (2009) who analyze commodity taxes in the US show that taxes that are included in the price which is displayed on price tag in a supermarket

have much larger impact on demand than other ones which must be add on by the taxpayer. Similar to our paper Bracco et al. (2013) investigate a federal setting where jurisdictions substitute salient taxes with less salient ones in order to take advantage in an inter-regional competition environment in a political economy model. In a similar model framework Alt and Dreyer Lassen (2003) look at governments choice between taxes or debt.

The outline of the paper is as follows. In section 2 we set up a basic model that displays the interplay between fiscal equalization and inter-regional tax competition in a federal state. As a benchmark we derive in section 3 the first best optimal revenue policy including the statutory tax rate, the tax enforcement policy as well as a schedule of inter-regional transfers. In section 4 we consider a federal state in which jurisdictions can decide on local enforcement intensities but do not have any means to impose an individual local tax. Section 5 display a setting where jurisdictions can decide on both tax enforcement as well as the statutory tax rate.

2 The Basic Model

We consider a federation composed of a federal government and a large number of jurisdictions, indexed by $i = \{1, 2, \dots, n\}$. Each jurisdiction is inhabited by m_i immobile household that in each case in-elastically supply $1/m_i$ working hours in a local labor market as well as an equal capital endowment $\frac{k}{m_i}$ in a federal capital market. Furthermore, each household that lives in region i owns an equal share of the firms that are located in region i . These firms employ *effective* labor and capital in order to produce a transformable good. Effective labour is defined by the product of working time and an efficiency parameter θ_i , $\theta_i \in \mathbf{R}$, that signifies region-specific human capital endowment. The production output *per effective labor unit* in jurisdiction i denoted by y_i writes:

$$y_i = f(k_i/\theta_i), \tag{1}$$

where k_i denotes the *per capita* capital employment and $f(\cdot)$ signifies the linear-homogenous production function with $f_k(\cdot) > 0$, $f_{kk}(\cdot) < 0$. We assume that the exogenously given stock of capital nk is perfectly mobile within the borders of the federation while labor supply is strictly localized in jurisdiction i . Jurisdictions are small proportional to

the size of the whole federation so that local policy measures do not influence the net return of capital r in the federal capital market.

In each jurisdiction a unit tax on capital employment τ_i is imposed. Firms evade a proportion σ_i of their tax due. The proportion σ_i is exogenously given and takes a value in $[0, 1]$.¹ Jurisdictions organizes independent tax offices that undertake tax audits in the respective region. The detection rate a_i may take different values in $[0, a_h]$ according to the modalities of the tax audits that are independently determined by jurisdictions. The upper bound a_h of detection rates with $0 < a_h \leq 1$ is a technological threshold. We assume that tax audits are costless for jurisdictions.² If tax evasion is detected during tax audits firms must pay an amount of $\sigma_i \phi k_i \tau_i$ with a penalty rate $\phi \geq 1$ to the respective jurisdiction. The tax price of capital employment expected by firms in region i is given by:

$$\rho_i = \mu(\sigma_i, a_i) \tau_i, \quad (2)$$

where the weight $\mu(\sigma_i, a_i)$ measures the expected broadness of the capital tax base, i.e. the proportion of the tax bases that is expected to be engrossed by the tax authority. This weight crucially depends on the magnitude of tax evasion σ_i and the detection rate of tax audits a_i . For example, firms that engage in tax evasion in a setting with patchy tax audits expect a narrow tax base or rather a tax price ρ_i below the statutory τ_i .

In a neoclassical full optimization model which assumes that taxpayers can observe the enforcement intensity a_i and fully apprehend this piece of information the expected broadness of the tax base $\mu(\sigma_i, a_i)$ measures $1 - \sigma_i + \sigma_i a_i \phi$. However, the typical taxpayer learns signals that convey only a fragmentary picture concerning the concrete enforcement intensity a_i . In particular, it can only roughly estimate the current detection rate based on a retrospective background, a mouth-to-mouth exchange of experiences with other taxpayers, or proxy variables like the number of tax inspectors that are employed in the jurisdiction. Furthermore, apart from the problem of incomplete observability

¹In the basic model no reference is made to the influence of the choice of tax instruments on tax compliance. We implicitly assume that tax compliance is determined by factors outside of the frame of the model. However, in section 6 we point out a more general model framework assuming that σ_i is a function of the tax instruments a_i and τ_i .

²We consider the case where audit costs are reimbursed by the federal government or by an inter-regional cost-sharing program. In section 6 we analyze a setting with local governments that reflect audit costs in their budgets.

saliency effects of tax instrument matter. Commonly, taxpayers are more attentive to the variation of the publicly displayed statutory tax rate than to other tax instruments like the intensity of tax enforcement that indirectly influence the effective tax price. This is why the model framework accommodates taxpayers' beliefs concerning the tax price that differs from the actual tax due $1 - \sigma_i + \sigma_i a_i \phi$.

Without setting any detailed structure on the taxpayers' cognition we consider a weight $\mu(\sigma_i, a_i)$ that is a smooth function of the enforcement intensity a_i and σ_i with $\mu_a(\sigma_i, a_i) \geq 0$, $\mu_\sigma(\sigma_i, a_i) \geq 0$ and $\mu_{aa} = \mu_{\sigma\sigma} = 0$. For the purpose of a better presentation and clarity in the below analysis the firms' actual expectations concerning the tax prices are related to the firms expectations in the hypothetical reference case with fully optimizing agents that can fully observe tax instruments τ_i and a_i . Accordingly, we measure the degree of firms' attention to the tax instrument a_i by the ratio between the marginal impact of a_i on ρ_i as it happens and as it would be in the hypothetical full optimization reference case:

$$\xi_a^i = \frac{\mu_a(\sigma_i, a_i)}{\sigma_i \phi}. \quad (3)$$

Analogously, the degree of firms' attention to the tax instrument τ_i is defined by the ratio between the marginal impact of τ_i on ρ_i as it happens and as it would be in full the optimization reference case:

$$\xi_\tau^i = \frac{\mu(\sigma_i, a_i)}{1 - \sigma_i + \sigma_i a_i \phi}. \quad (4)$$

In a perfect competition environment firms in region i chooses input factors that maximize expected profit π_i based on their expected tax price (2):

$$\max_{k_i} f(k_i/\theta_i) - (\mu(\sigma_i, a_i)\tau_i + r)k_i - w_i, \quad (5)$$

where w_i is the wage rate in jurisdiction i . The first order condition of the optimal input use writes:

$$f_k(k_i/\theta_i) = \mu(\sigma_i, a_i)\tau_i + r, \quad (6)$$

$$f(k_i/\theta_i) - k_i(\mu(\sigma_i, a_i)\tau_i + r) = w_i. \quad (7)$$

After tax audits have been effectuated tax offices sent tax assessment notes to firms. The balance between the actual tax due that is displayed in a particular assessment note and the tax accruals that are made by a firm before the tax audit has taken place is defined

by $q_i = \mu(\sigma_i, a_i)\tau_i k_i - (1 - \sigma_i + \sigma_i a_i \phi)\tau_i k_i$. Due to the fact that the production function is linear-homogenous and the firms' investment decision are based on the expected user cost of capital $\rho_i + r$ the profit after tax audits come to $\pi_i = q_i$. Using equation (6) we can derive firms' demand of input capital contingent on the expected tax price:

$$k_i(\rho_i, \theta_i) = \theta_i f_k^{-1}(\mu(\sigma_i, a_i)\tau_i + r). \quad (8)$$

The comparative static analysis of (8) yields the tax base elasticity:

$$\eta_i = \frac{\theta_i}{f_{kk}(k_i)} \frac{(1 - \sigma_i + \sigma_i a_i \phi)\tau_i}{k_i}. \quad (9)$$

Each jurisdiction i intends to maximize utility of the domestic household by an appropriate policy. Utility is characterized by the following quasi-linear function:

$$U_i(z_i, x_i) = V_i(z_i) + x_i, \quad (10)$$

where z_i is a local public good provided by jurisdictions and x_i is the private good supply. Households' total income, composed of labor income, share of profits, and capital income is entirely used for private good consumption:

$$x_i = w_i + q_i + rk. \quad (11)$$

Furthermore, the budget constraint of jurisdiction i is given by:

$$z_i = k_i(\rho_i, \theta_i)(1 - \sigma_i + \sigma_i a_i \phi)\tau_i + s_i, \quad (12)$$

where s_i is a transfer payment from an inter-jurisdictional equalizing program, that equalizes differences in jurisdictions' tax bases. We consider a simple redistribution scheme with a constant equalizing rate α that takes a value in $[0, 1]$:

$$s_i = \alpha \left(\sum_{j=1}^n \frac{k_j(\rho_j, \theta_j)}{n} - k_i(\rho_i, \theta_i) \right) \bar{\tau}, \quad (13)$$

where the transfer payment s_i to jurisdiction i depends on the difference between the specific size of the tax base in jurisdiction i and the average size of tax bases in the federation. The difference between the local tax base and the federal average tax base is weighed by the federal average value of statutory tax rates $\bar{\tau} = \frac{\sum_{i=1}^n k_j \tau_j}{\sum_{i=1}^n k_j}$ in order to

compute the transfer payments. Transfer payments can be neither directly pegged on the enforcement intensity a_i , nor on the capital employment k_i .

Jurisdictions are entrusted with the task to tackle tax evasion in the most effective way by accomplishing a detection rate a_h . However they have a latitude of discretion to freely choose a detection rate a_i in the range $[a_l, a_h]$ that deviates from an obligatory enforcement intensity a_h . Likewise jurisdictions can impose a local statutory tax rate τ_i on capital employment in their home-region. In a federation with combined federal and local taxes we may alternatively assume that jurisdictions encompass the statutory tax rate τ_i by imposing a surtax $\frac{\tau_i}{t} - 1$ ($\tau_i \in [\tau_l, \tau_h]$, $\tau_l > 0$) upon the tax revenue of a federal-wide tax on capital with rate t . Then, the statutory tax rate τ_i includes two components, namely the federal-wide capital tax t as well as a region-specific surtax $\frac{\tau_i}{t} - 1$.³

The timing of the game is sketched as follows:

- At *stage 0* nature draws fiscal power θ_i in each jurisdiction that cannot be observed by any agent in the game.
- At *stage 1* the statutory tax rate τ_i and the intensity of tax enforcement activities a_i are determined.
- At *stage 2* firms chose input factors based on the expected tax price ρ_i .
- At *stage 3* tax audits are executed.
- At *stage 4* local tax offices sent tax assessment notes to firms.
- At *stage 5* the inter-regional redistribution program is effectuated.

Jurisdiction i with type θ_i that enacts a policy (τ_i, a_h) earns the following tax revenue:

$$k_i(\mu_i(\sigma_i, a_h)\tau_i, \theta_i)(1 - \sigma_i + \sigma_i a_h \phi) = \theta_i f_k^{-1}\left(\mu_i(\sigma_i, a_h)\tau_i + r\right)(1 - \sigma_i + \sigma_i a_h \phi). \quad (14)$$

However, the same jurisdiction can produce a tax revenue that furnishes *prima facie* evidence for fiscal power $\tilde{\theta}_i$ by enacting a policy $(\tau_i, a_i(\tilde{\theta}_i, \theta_i, \tau_i))$:

$$k_i(\mu_i(\sigma_i, a_h)\tau_i, \tilde{\theta}_i)(1 - \sigma_i + \sigma_i a_h \phi) = \theta_i f_k^{-1}\left(\mu_i(\sigma_i, a_i(\tilde{\theta}_i, \theta_i, \tau_i))\tau_i + r\right)(1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i, \tau_i)\phi), \quad (15)$$

³If jurisdictions impose a surtax $\frac{\tau_i}{t} - 1$ on the revenue $t k_i$ of the federal tax $t k_i$ the over all tax revenue is given by $t k_i + (\frac{\tau_i}{t} - 1)t k_i = \tau_i k_i$

where the LHS of equation (15) expresses the tax revenue earned by a jurisdiction with type $\tilde{\theta}_i$ that enacts a policy combination (τ_i, a_h) and the RHS is the tax revenue earned by a jurisdiction with type θ_i that chooses a combination $(\tau_i, a_i(\tilde{\theta}_i, \theta_i, \tau_i)\phi)$.

Lemma 1 *The enforcement intensity $a_i(\tilde{\theta}_i, \theta_i, \tau_i)$ that mimics a fiscal power $\tilde{\theta}_i$ in a jurisdiction with fiscal power $\theta_i > \tilde{\theta}_i$, a statutory tax rate τ_i , a tax base elasticity $\eta_i > -1$, and $\xi_a^i \leq 1$ takes a value below a_h .*

Proof: *see Appendix*

3 The Reference Solution

As a benchmark we consider a social planner that determines in each jurisdiction the statutory tax rates τ_i , transfer payments s_i , and enforcement intensity a_i in order to maximize the federal welfare, i.e. the sum of local welfare:

$$\{(\tau_1, \dots, \tau_n), (s_1, \dots, s_n), (a_1, \dots, a_n)\} \in \arg \max \sum_{i=1}^n (V_i(z_i) + x_i)$$

s.t. (11) and (12)

$$\sum_{i=1}^n s_i = 0 \quad \forall i.$$

The first order condition w.r.t. the statutory tax τ_i writes:

$$k_i(1 - \sigma_i + \sigma_i a_i \phi) = V_i'(z_i)k_i(1 - \sigma_i + \sigma_i a_i \phi) + \sum_{j=1}^n V_j'(z_j)\tau_j(1 - \sigma_j + \sigma_j a_j \phi) \frac{\partial k_j}{\partial \tau_i} \quad \forall i. \quad (16)$$

The first order condition w.r.t. the enforcement intensities a_i writes:

$$k_i \sigma_i \phi \tau_i = V_i'(z_i)k_i \sigma_i \phi \tau_i + \sum_{j=1}^n V_j'(z_j)\tau_j(1 - \sigma_j + \sigma_j a_j \phi) \frac{\partial k_j}{\partial a_i} \quad \forall i. \quad (17)$$

The first order condition w.r.t. the transfer payments s_i writes:

$$V_i'(z_i) = V_j'(z_j) \quad \forall i, j. \quad (18)$$

The clearing conditions for the federal capital market are given by:

$$\sum_{j=1}^n \frac{\partial k_j}{\partial \tau_i} = 0, \quad \forall i, j \quad (19)$$

$$\sum_{j=1}^n \frac{\partial k_j}{\partial a_i} = 0, \quad \forall i, j. \quad (20)$$

Inserting equations equation (18), (19) and (20) into equations (16) and (17) yields:

$$V'_i(z_i) = 1 \quad \forall i. \quad (21)$$

By equation (18) differences of fiscal power across regions are fully equalized by the transfer scheme s_i , so that each jurisdiction provides the same amount of local public goods. Besides, equation (21) points out that the social planner implements a combination of a statutory tax rates and an enforcement intensity (τ_i, a_i) such that each firm in the federation is confronted with the same tax price ρ_i irrespective of the local fiscal power θ_i . Differences in the regional tax prices cause an efficiency enhancing relocation of capital that reduces overall returns to capital. The optimization problem exhibits a degree of freedom. The social planner can choose different combinations (τ_i, a_i) in order to produce a tax price ρ_i that fulfills condition (21). Taking into account that jurisdictions are entrusted to enact an enforcement intensity a_h the optimal statutory tax rate is unambiguously determined. For a given tax enforcement a_h the first order condition of the first best optimal statutory tax rate τ_i^* writes:

$$V'_i(k_i(\mu(\sigma_i, a_h)\tau_i^*)(1 - \sigma_i + \sigma_i a_h \phi)\tau_i^*) = 1. \quad \forall i \quad (22)$$

4 Centralized tax autonomy and decentralized tax enforcement

In the first place consider a federation with jurisdictions that can indirectly influence the tax price by manipulating the broadness of the tax base via the intensity of tax enforcement but do not have any tax autonomy. The federal government imposes a federal-wide tax on capital t that meets condition (22). Accordingly, the tax rate t is first best optimal provided that the enforcement intensity is equal to a_h . Jurisdictions furnish *prima facie* evidence for fiscal power $\tilde{\theta}_i$ that maximizes local welfare via the tax instrument a_i :

$$\begin{aligned} & \max_{\tilde{\theta}_i} V(z_i) + x_i \\ & \text{s.t. (11) to (13)} \end{aligned}$$

The first order condition writes:

$$V'_i(z_i)(1 - \alpha) \left(k_i \sigma_i \phi t + \frac{\partial k_i}{\partial a_i} (1 - \sigma_i + \sigma_i a_i \phi) t \right) \frac{da_i}{d\tilde{\theta}_i} = k_i \sigma_i \phi t \frac{da_i}{d\tilde{\theta}_i} \quad (23)$$

Rearranging the first order condition (23) yields:

$$V'_i(z_i) \leq \frac{1}{(1 - \alpha)(1 + \eta_i \xi_a^i)} = MCF_a^i, \quad (24)$$

where the RHS of (24) represents the marginal utility of local public good supply. The LHS is the marginal cost of funding by the use of a_i (hereafter denoted by MCF_a^i) that indicates the loss of private good consumption which accrues from the passed forward additional capital tax burden on labor proportional to the increment of local government revenues.

In the neoclassical full optimizing reference case without fiscal equalizing ($\xi_a^i = 1$, $\xi_\tau^i = 1$, $\alpha = 0$) expression (24) represents the equilibrium condition of a standard tax competition game in line with Zodrow and Mieszkowski (1986) and Wildasin (1989). Local welfare maximizing jurisdictions are concerned about the outflow of mobile capital to other regions within the federation as they do not consider the underlying positive fiscal spill over effects to other regions. Therefore, they choose enforcement intensities below the efficient level a_h as the perceived marginal costs MCF_a^i go beyond one. The first order condition (24) exhibits an interior solution (a_i, τ_i^*) , with $a_l \leq a_i < a_h$ if the lower bound of enforcement intensities a_l takes a sufficiently low value. Otherwise (24) shows a corner solution (a_l, τ_i^*) .⁴

The inter-regional redistribution program compensates for a decline of the tax base that stems from an inter-regional relocation of capital. It therefore internalizes inter-regional fiscal spill over effects up to the portion α . However, there is an additional source of inefficiency in a setting with fiscal equalization if jurisdictions can control the basis of assessment of the tax base equalizing program via its enforcement policy. Local governments anticipate that a proportion of α of the additional tax revenue that originates from the broadening of the local tax base through a more intense tax enforcement

⁴In accordance with Cremer and Gahvari (2000) the strategic variable in inter-regional competition setting is the broadness of the tax base that is controls by jurisdictions via the tax enforcement policy. In Zodrow and Mieszkowsky (1986) and Wildasin (1989) and other related models the strategic variable is the statutory tax rate. However, like in the aforementioned tax competition models the background of inter-regional competition in the setting is the mobile production factor capital.

pour out of the local government budget into the common pool of the federal redistribution program. Due to the marginal loss of eligibility for transfers that goes along with an intensification of tax enforcement the marginal cost of funding concerning a_i is augmented if $\alpha > 0$ and $0 > \eta_i \geq -1$ holds.⁵

Proposition 1 *In a federation with decentralized tax enforcement policy and harmonized tax rates, tax base equalization and tax revenue equalization have the same efficiency consequences.*

If enforcement policy has shrouded attributes and firms pay low attention to the intensity of tax enforcement and high attention to statutory tax rates ($\xi_\tau^i = 1$, $\xi_a^i < 1$), the demand of input capital becomes more inelastic to the local enforcement policy. This is why jurisdictions face less pressures to hamper the exodus of mobile capital by reducing a_i and perceive lower marginal costs of funding through a_i than in the neoclassical full optimization case. The lower the degree of attention ξ_a^i the more the inter-regional competition for a mobile tax bases is dampened. In the border line case $\xi_a^i = 0$ the capital demand is completely inelastic with respect to the enforcement policy a_i . Then the efficiency consequences of a more intense enforcement of the capital tax are equivalent to the imposition of a tax on inelastic labour supply or a residence tax.

Proposition 2 *In a federation with decentralized tax enforcement, harmonized tax rates, and partial fiscal equalization the equilibrium enforcement intensities are higher if firms pay less attention to a_i .*

Proof: see Appendix.

5 Decentralized tax autonomy and decentralized tax enforcement

Consider a federal constitution that assigns the responsibility of both tax instruments to local government level. Additionally, they choose the statutory tax rate in order to

⁵Köthenbürger (2002) analyzes the efficiency consequences of both tax base equalizing as well as tax revenue equalizing in a federal setting with jurisdictions that control the statutory tax rate τ_i while enforcement intensities are exogenously given. Accordingly, jurisdictions can influence the entitlement to benefit from the transfers in a tax base equalizing program but not the entitlement of a tax base equalizing program. In contrast in the setting displayed in this section of the paper jurisdictions that control a_i but not τ_i can undermine the tax base redistribution scheme.

maximize local welfare:

$$\begin{aligned} & \max_{\tilde{\theta}_i, \tau_i} V(z_i) + x_i \\ & \text{s.t. (11) to (13).} \end{aligned}$$

As in the previous section jurisdictions can furnish evidence for a specific type θ_i via the its tax enforcement policy. The respective first order condition of the welfare-maximizing enforcement policy a_i is equivalent to expression (23). Moreover, the first order condition of the statutory tax rate τ_i writes:

$$V'_i(z_i) \left(k_i(1 - \sigma_i + \sigma_i a_i \phi) + (1 - \alpha) \frac{\partial k_i}{\partial \tau_i} (1 - \sigma_i + \sigma_i a_i \phi) \tau_i \right) \leq k_i(1 - \sigma_i + \sigma_i a_i \phi). \quad (25)$$

Rearranging expression (25) yields:

$$V'_i(z_i) \leq \frac{1}{(1 + (1 - \alpha)\eta_i \xi_\tau^i)} = MCF_\tau^i, \quad (26)$$

where the RHS of the first order condition (26) depicts the marginal cost of funding by the use of τ_i , that is denoted by MCF_τ^i .

Assuming the neoclassical reference case without fiscal equalization, ($\xi_\tau^i = 1$, $\xi_a^i = 1$, $\alpha = 0$), there is neutrality in the use of the tax instruments τ_i and a_i . However, the two tax instruments affect the assessment basis of the inter-regional redistribution scheme in different ways. A variation of the tax enforcement intensity directly changes the entitlement to benefit from transfers. Due to the fact that the standardized tax rate $\bar{\tau}$ enters into the formula of the transfer scheme a marginal variation of τ_i does not alter the local governments' eligibility for transfer apart from a change of the broadness of the tax base caused by an inter-regional relocation of capital. Accordingly, in the neoclassical model with fiscal equalization the value of MCF_τ^i is lower than the value of MCF_a^i .

Proposition 3 *A neoclassical model framework with decentralized tax enforcement, decentralized tax autonomy, and fiscal equalization unfolds a corner solution that involves an enforcement intensity below a_h .*

Proof: We consider the special case $\xi_\tau^i = \xi_a^i = 1$ and add up the first order conditions (26) and (23). Then we can constitute the following inequality for a positive equalizing rate α :

$$\frac{1}{(1 + (1 - \alpha)\eta_i)} > \frac{1}{(1 - \alpha)(1 + \eta_i)}. \quad (27)$$

The RHS of expression (27) that signifies MCF_τ^i exceeds the MCF_a^i that is represented by RHS if the equalizing rate α takes a positive value.

If firms pay low attention to the tax instrument a_i and high attention to τ_i ($\xi_\tau^i > \xi_a^i$), it is relatively difficult for jurisdictions to attract mobile capital by provoking low detection rates a_i . On the other hand the lowering of the statutory tax rate τ_i attracts high attention by firms, so that the regional capital demand is responsive to a variation of the statutory tax rate. Consequently, in a setting with no fiscal equalization ($\alpha = 0$) the marginal costs MCF_a^i are lower than MCF_τ^i , so that jurisdictions choose a_h in equilibrium. However, in a setting with fiscal equalization the loss of eligibility for transfers involved by the use of a_i foils the competitive edge that stems from the firms' low degree of attention to a_i . Accordingly, it is of particular interest to discuss the conditions under which the latter effect outreach the first effect, so that jurisdictions have no incentives to deviate from the efficient enforcement intensity a_h .

Proposition 4 *It is not beneficial for jurisdiction i to narrow the tax base by cutting enforcement intensities below a_h if the equalizing rate do not exceed the following critical value:*

$$\alpha^c = \frac{\eta_i(\xi_a - \xi_{\tau_i})}{1 + \eta_i(\xi_a - \xi_{\tau_i})}. \quad (28)$$

Proof: Jurisdictions have a comparative advantage in using a_i as a funding instrument in an inter-regional competition environment if the following condition holds:

$$\frac{1}{(1 + (1 - \alpha)\eta_i\xi_{\tau_i})} \leq \frac{1}{(1 - \alpha)(1 + \eta_i\xi_a)}. \quad (29)$$

Expression (29) holds if α falls short of the critical equalizing rate α^c .

Equation (28) highlights that the scope for incentive-compatible federal redistribution, i.e. the upper bound of equalizing rates that ensure a corner solution a_h . Thereby, the scope for incentive-compatible federal redistribution crucially depends on tax salience effects.

Proposition 5 *In a federation with an elastic tax base the critical equalizing rate α^c is a decreasing function of the taxpayers' degree of attention to a_i .*

Proof: Differentiation of equation (30) w.r.t. ξ_a^i shows that the critical equalizing rate is a decreasing function of ξ_τ^i provided that $0 > \eta_i > -1$ holds:

$$\frac{\partial \alpha^c}{\partial \xi_a^i} = \frac{\eta_i}{(1 + \eta_i(\xi_a^i - \xi_\tau^i))^2} < 0. \quad (30)$$

The blue line in figure 1 illustrates the enforcement policy of jurisdiction i as a discontinuous function of α . There is a comparative advantage of using policy measure a_i if the equalizing rate falls short of the critical value α^c . On the one hand an increase of the relatively inconspicuous enforcement intensity a_i do not provoke an exodus of capital to a great extend, on the other the respective loss of eligibility for transfers carry little weight if α takes a relatively small value. Therefore the local welfare maximization problem exhibits a corner solution with an enforcement intensity a_h . In contrast, if the equalizing rate passes α^c the loss of eligibility for transfers that goes along with an increase of a_i plays a relatively important role. The salience effects in the inter-regional competition for mobile capital are comparatively unimportant if α is high. This is why jurisdiction i chooses an enforcement intensity strictly below a_h if $\alpha > \alpha^c$. In particular if α approaches one the marginal costs of funding by the use of a_i go to infinity so that there is a corner solution a_l .

Moreover, figure 1 shows that the tax rate policy is ambiguously influenced by the equalizing rate of the redistribution scheme. In the borderline case where α is equal to one the first order condition (28) coincides with the condition of the first best optimal tax policy (16). However, if α takes a value below one local tax policy deviates from the first best for two reasons. Firstly, jurisdictions do not take into account a proportion of $(1 - \alpha)$ of fiscal spill over effects and therefore tend to choose inefficiently low tax rates. The incomplete internalization of fiscal spill overs is indicated by the red line in figure 1. Secondly, jurisdictions with heterogeneous fiscal power try to compensate unbalanced tax base differences by adjusting local tax rates. The sign of the tax adjustment effect that is involved with a variation of a equalizing rate is however undetermined. In particular jurisdictions with low fiscal power tend to choose relatively high statutory tax rates in order to even out deficiencies in local public good supply. The opposite is true for jurisdictions with relatively high fiscal power. The differences in local tax rates distort however the allocation of capital in the federal capital market and violates the condition for a first best capital allocation that is given in (18).

Lemma 2 *Jurisdictions with relatively high fiscal power have more high-powered tax incentives than jurisdictions with low fiscal power.*

Proof: The marginal impact of a variation of the equalizing rate on the tax rate is given by:

$$\frac{d\tau_i}{d\alpha} = -\frac{F_{\alpha}^i(\tau_i, \alpha)}{F_{\tau}^i(\tau_i, \alpha)}, \quad (31)$$

where $F_{\tau}^i = \frac{\partial F^i}{\partial \tau}$ and $F_{\alpha}^i = \frac{\partial F^i}{\partial \alpha}$, with $F^i(\tau_i, \alpha) = V_i'(z_i) \left(k_i(1 - \sigma_i + \sigma_i a_i \phi) + (1 - \alpha) \frac{\partial k_i}{\partial \tau_i} (1 - \sigma_i + \sigma_i a_i \phi) \tau_i \right) - k_i(1 - \sigma_i + \sigma_i a_i \phi) = 0$. The denominator of equation (31) has a negative value due to the semi-definite negativity of the problem. The sign of numerator of equation (31) is ambiguous:

$$F_{\alpha}^i = V_i''(z_i) \frac{\partial z_i}{\partial \alpha} \left(k_i(1 - \sigma_i + \sigma_i a_i \phi) + (1 - \alpha) \frac{\partial k_i}{\partial \tau_i} (1 - \sigma_i + \sigma_i a_i \phi) \tau_i \right) - V_i'(z_i) \left(\frac{\partial k_i}{\partial \tau_i} (1 - \sigma_i + \sigma_i a_i \phi) \tau_i \right). \quad (32)$$

Equation (32) displays the marginal impact of the equalizing rate on local tax incentives. Firstly, an increase of the equalizing rate alters the after transfer revenues of local governments. More specifically, the revenues of jurisdictions that furnish evidence for an above (below) average fiscal power decline (increase) if α augments. This is why the first term on the RHS of equation (32) is negative for local government with a relatively low fiscal power and positive for jurisdictions with a relatively high fiscal power. Secondly, with an increase of the equalizing rate fiscal spill over effects are internalized by a higher extend. The spill over internalization effect that goes along with an increase of α depicted the latter term of the RHS of equation (32) is always positive. Accordingly, expression (32) takes a positive value for jurisdictions with a relatively low fiscal power and a negative value for jurisdictions with relatively high fiscal power.

Proposition 6 *The critical value α^c is relatively high (low) for jurisdictions with relatively high (low) fiscal power.*

Differentiation of equation (31) w.r.t. η_i shows that the critical equalizing rate is an increasing function of the elasticity of the tax base, provided that ξ_{τ}^i exceeds ξ_a^i :

$$\frac{\partial \alpha^c}{\partial \eta_i} = \frac{\xi_a^i - \xi_{\tau}^i}{(1 + \eta_i(\xi_a^i - \xi_{\tau}^i))^2} < 0. \quad (33)$$

Proposition 6 conveys that the scope for federal redistribution can be increased by a non-linear transfers scheme with an equalizing rate that is decreasing function of fiscal power θ_i .

6 Extension of the model

6.1 Governments are revenue maximizer

In this section we consider a Leviathan type government that has some discretionary power to act in its own interest. More specifically, we assume that each jurisdiction tries to maximize its disposable revenue.

Assumption 1 *Jurisdictions intend to maximize their disposable revenue after transfer payments are enacted.*

According to assumption 1 we consider the following revenue maximization problem:

$$\begin{aligned} \max_{\tilde{\theta}_i, \tau_i} \theta_i f_k^{-1} \left(\mu(\sigma_i, a_i(\tilde{\theta}_i, \theta_i)) \tau_i + r \right) (1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i) \phi) \tau_i + s_i(\tilde{\theta}_i). \quad (34) \\ \text{s.t. (13).} \end{aligned}$$

The first order conditions w.r.t. $\tilde{\theta}_i$ and τ_i of the revenue maximization problem of writes:

$$k_i \sigma_i \tau_i + \frac{\partial k_i}{\partial a_i} (1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i) \phi) \tau_i \leq 0 \quad (35)$$

$$k_i (1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i)) + (1 - \alpha) \frac{\partial k_i}{\partial a_i} (1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i) \phi) \tau_i \leq 0 \quad (36)$$

Rearranging equations (33) and (34) yields:

$$1 - \eta_i \xi_a^i \geq 0, \quad (37)$$

$$1 - (1 - \alpha_i) \eta_i \xi_\tau^i \geq 0. \quad (38)$$

By definition the revenue maximizing local governments do not factor the incidence of the capital tax on local labour income so that the RHS of equations (35) and (36) is equal to zero. In line with Stöwhase and Traxler (2005) the equalizing rate of the redistribution scheme α do not have an impact on the equilibrium enforcement policy if local governments are revenue maximizer. The rate of retention $1 - \alpha$ is canceled out of

expression (35) as a variation of a_i affects the entire assessment basis of transfer scheme. In contrast expression (36) shows that the transfer scheme is invariant to a variation of τ_i apart from combined capital relocation. Solving equations (35) and (36) simultaneously yields the critical equalizing rate:

$$\alpha^c = 1 - \frac{\xi_a^i}{\xi_\tau^i}$$

Proposition 7 *The scope for federal redistribution do not depend on the elasticity of the tax base if local governments are revenue maximizer.*

6.2 Tax audits are costly

We assume that positive tax audit costs enter into the local government budget constraints.

Assumption 2 *Tax audits entail positive costs ga_i , with $g > 0$, that are born by jurisdictions. The tax base equalizing scheme s_i do not foresee any sharing of audit costs across jurisdictions.*

Due to assumption 2 the local budget constraint in i alters as follows:

$$z_i = k_i(\mu(\sigma_i, a_i)\tau_i, \theta_i)(1 - \sigma_i + \sigma_i a_i \phi)\tau_i + s_i(\theta_i) - ga_i \quad (39)$$

Including the modified budget constraint (39) into the local welfare maximizing problem yields following first order condition w.r.t. the enforcement intensities:

$$V_i'(z_i) \leq \frac{1}{(1 - \alpha)(1 + \eta_i \xi_a^i) - \frac{g}{k_i \sigma_i \phi \tau_i}}. \quad (40)$$

The respective first order condition w.r.t. the statutory tax rate remains unchanged. Solving equations (40) and (28) simultaneously we can compute the respective critical equalizing rate α^c :

$$\alpha^c = \frac{\eta_i \left(\xi_a - \xi_{\tau_i} - \frac{g}{k_i \sigma_i \phi \tau_i} \right)}{1 + \eta_i (\xi_a - \xi_{\tau_i})}. \quad (41)$$

Proposition 8 *The critical equalizing rate is a decreasing function of marginal tax audit costs that jurisdictions have to bear after payment of inter-regional transfers.*

Proof: Differentiating (41) w.r.t. the marginal tax audit costs g shows that α^c is decreasing in g .

Equation (40) demonstrates that A typical principal agent problem can be overcome if local audit cost are not fully reimbursed by the federal government or an appropriate transfer scheme. Local government become residual claimant of their own cost reductions in the local tax administration. On the same time however, they have high powered incentives to produce a high tax enforcement intensity.

6.3 Tax evasion causes an additional deadweight loss in the federal economy

We consider a federation in which tax evasion causes an additional deadweight loss in the economy.

Assumption 3 *The overall federal welfare is characterized by the following function:*

$$\sum_{i=1}^n (V_i(z_i) + x_i) - \frac{\gamma}{2} \left(\sum_{i=1}^n \sigma_i (1 - a_i) t k_i \right)^2, \quad (42)$$

where the quadratic function $\frac{\gamma}{2} \left(\sum_{i=1}^n \sigma_i (1 - a_i) t k_i \right)^2$ signifies the deadweight loss that stems from tax evasion with a positive constant γ . An individual jurisdiction does not take into account the federal welfare loss and therefore maximizes local welfare as indicated in equation (2).

By assumption 3 jurisdictions face the same decision problem as in section 4.2. Accordingly, the additional welfare issues that arise from tax evasion do not play a role if the equalizing rate takes a value below α^c . If however for any political reason the equalizing rate α exceeds the critical value α^c such that the condition for a corner solution a_h is violated. If α is relatively high the the use of the tax instrument a_i is disadvantageous as the marginal loss of eligibility that goes along with an increase of a_i outreach its benefits in an inter-regional competition environment.

Proposition 9 *If the equalizing rate is higher than α^c for any political reason and if tax evasion causes an additional welfare loss it can be more appropriate to use a tax revenue equalizing scheme instead of a tax base equalizing scheme.*

Proof: We consider an inter-regional redistribution scheme that depends on the local tax revenue: equalizing program:

$$s_i = \alpha \left(\sum_{j=1}^n \frac{\tau_j k_j(\rho_j, \theta_j)}{n} - \tau_i k_i(\rho_i, \theta_i) \right). \quad (43)$$

Introducing expression (43) into the local welfare maximizing problem the first order condition w.r.t. θ_i and τ_i writes:

$$V'_i(z_i) \leq \frac{1}{(1-\alpha)(1+\eta_i\xi_a^i)}, \quad (44)$$

$$V'_i(z_i) \leq \frac{1}{(1-\alpha)(1+\eta_i\xi_\tau^i)}, \quad (45)$$

Solving (44) and (45) simultaneously yields the following condition that must be fulfilled in order to implement the corner solution a_h, τ_i :

$$\xi_a^i \leq \xi_\tau^i$$

7 Appendix

7.1 Reaction function of jurisdictions

Market-clearing requires that the exogenously given aggregate capital supply kn equals the aggregate capital demand $\sum_{i=1}^n k_i$.

Differentiation of the market clearing condition w.r.t. $h_i = \tau_i, a_i$ yields:

$$\frac{\partial r}{\partial h_i} = -\frac{k'_i(\rho_i) \frac{\partial \rho_i}{\partial h_i}}{\sum_{j=1}^n k'_j(\rho_j) \frac{\partial \rho_j}{\partial r}}. \quad (46)$$

Respectively, an increase of $h_i = \tau_i, a_i$ leads to an outflow of capital from region i to the remaining regions j different to i :

$$\frac{\partial k_i}{\partial h_i} = \frac{\theta_i}{f_{kk}(k_i)} \left(\frac{\partial \rho_i}{\partial h_i} + \frac{\partial \rho_i}{\partial r} \frac{\partial r}{\partial h_i} \right), \quad \frac{\partial k_j}{\partial h_i} = \frac{\theta_j}{f_{kk}(k_j)} \frac{\partial \rho_j}{\partial r} \frac{\partial r}{\partial h_i}. \quad (47)$$

For notational simplicity we assume that jurisdictions are price-takers with respect to the interest rate r due to a high number of n . Accordingly, equations (6) and (7) can be reformulated as follows:

$$\lim_{n \rightarrow \infty} \frac{\partial r}{\partial h_i} = 0, \quad \lim_{n \rightarrow \infty} \frac{\partial k_i}{\partial h_i} = \frac{\theta_i}{f_{kk}(k_i)} \frac{\partial \rho_i}{\partial h_i}, \quad \lim_{n \rightarrow \infty} \frac{\partial k_j}{\partial h_i} = 0. \quad (48)$$

7.2 Proof of lemma 1

We differentiate equation (21) w.r.t. $\tilde{\theta}_i$:

$$\left. \frac{da_i(\tilde{\theta}_i, \theta_i)}{d\tilde{\theta}_i} \right|_{\tilde{\theta}_i=\theta_i} = \frac{\frac{1}{\theta_i} k_i(\tau_i, \tilde{\theta}_i)(1 - \sigma_i + \sigma_i a_h \phi)}{k_i(\tau_i, \tilde{\theta}_i)(\sigma_i \phi) + \frac{\partial k_i}{\partial a_i}(1 - \sigma_i + \sigma_i a_i(\tilde{\theta}_i, \theta_i)\phi)} \quad (49)$$

$$\left. \frac{da_i(\tilde{\theta}_i, \theta_i)}{d\tilde{\theta}_i} \right|_{\tilde{\theta}_i=\theta_i} = \frac{1}{\theta_i} \frac{1}{\frac{\sigma_i \phi}{(1 - \sigma_i + \sigma_i a_i \phi)} + \eta_i \frac{\mu_a}{(1 - \sigma_i + \sigma_i a_i \phi)}} \quad (50)$$

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