Optimal income taxation with tax competition

Vilen Lipatov and Alfons Weichenrieder

Oxford University Centre for Business Taxation
Said Business School, Park End Street,
Oxford, Ox1 1HP

WP 12/07

Optimal income taxation with tax competition*

Vilen Lipatov† Alfons Weichenrieder‡

March 2012

Abstract

We introduce tax competition for mobile labor into an optimal-taxation model with two skill levels and analyze a symmetric subgame-perfect Nash equilibrium of the game between two governments and two taxpayer populations. Tax competition reduces the distortion from the informational asymmetry and increases employment of the less productive individuals. When countries are heterogeneous, this effect is more pronounced in the smaller country.

JEL Classification Codes: H21, F22

Keywords: optimal income tax, migration, unemployment, tax competition, Leviathan government

1 Introduction

Recent years have seen a surge of research on tax competition. This is of little surprise, as in our globalized world the borders are becoming increasingly open; people, goods, and resources increasingly mobile; and government

*We are grateful to the participants of the CESifo Area Conference on Public Sector Economics 2011, CESifo Conference "Taxation, Transfer and the Labour Market", Centre for Business Taxation Summer Symposium and IIPF Congress in Ann Arbor for their helpful comments.

†Goethe University Frankfurt, corresponding author: e-mail: Lipatov@em.uni-frankfurt.de, phone: (+49) 69 798-34777, address: Grüneburgplatz 1, 60323 Frankfurt am Main; Germany

‡Goethe University Frankfurt, Vienna University of Economics and Business, and CESifo

policies more interdependent. Nowadays, there is little doubt that a tax policy neglecting cross-border effects is no more than a (possibly convenient) abstraction.

A wide range of problems have been addressed within this blooming field, from tax-base erosion to redistribution and allocation of resources to coordination and harmonization proposals. Sinn (2003) provides an excellent overview of tax competition literature within a broader framework of systems competition. Capital tax competition has perhaps the longest tradition, as capital has early been recognized to be a mobile factor of production and, correspondingly, a most mobile tax base (for a seminal contribution, see Zodrow and Mieszkowski 1986). Income tax competition has also been analyzed, but mostly insofar as the mobile factors could affect it. Lately, mobility of individuals also has come into focus, especially in the context of European integration (e.g., Richter 2004).

Our paper contributes to this new strand of literature by merging tax competition for mobile labor with optimal-income-taxation approaches[1]. In a novel article, Simula and Trannoy (2010) analyze how migration possibilities affect the optimal taxation formula in a single country. Although our paper is also based on connecting optimal taxation with labor mobility, unlike Simula and Trannoy we focus on the effect of tax competition on the employment of low-skilled workers[2]. A paper that is closely related to our approach is Piaser (2007). It rather technically analyzes the anatomy of equilibria in a model similar to ours, but does not allow for Leviathan governments and does not discuss asymmetric countries and policy implications highlighted in our paper.

We augment a standard two-skill-level optimal-income-taxation model with the possibility of migration for high-skilled workers. In this framework governments compete for these workers and their taxes in a simple Hotelling setting.

The main result of our analysis is that opening the borders increases em-

[1] Huber (1999) studies the effect of capital tax competition on the optimal income tax when labor is immobile. Osmundsen et al. (2000) analyze optimal income tax with mobile labor, but the asymmetric information in their model is about location preferences rather than productivity. Osmundsen et al. (1998) study a similar problem for firms.

[2] Other recent contributions to the analysis of optimal income tax with tax competition include Morelli et al. (2010) who focus on the political economy implications of tax competition, and Bierbrauer et al. (2011) who confirm a "race to the bottom" under the assumption of perfect labor mobility.

ployment of the low-skill workers. Intuitively, competitive pressure lowers the tax on the mobile high-skill workers. This allows the government to reduce the distortion from taxing the low-skilled without violating the incentive compatibility constraint. As a result, their employment increases. This is a clear, testable prediction that is robust to the choice of various objectives of the government and the relative size of the countries.

We also show that the smaller country lowers its tax on the high-skilled by more than the larger country does. This is consistent with the general intuition that the smaller entity is more aggressive in competition, as it has less revenue to lose from its own population, but a larger competitor's tax base to gain from lowering the tax.

There is a clear contribution of our result to the policy discussion about the vices and virtues of tax competition: despite a negative effect on tax revenues, it also has a positive effect on the employment of low-skilled workers. This may be particularly important for the countries with low efficiency of the government sector, as tax competition tames Leviathan governments and improves the resource allocation.

The rest of the paper is structured as follows. Section 2 contains the basic Leviathan model; in section 3 alternative government objectives are discussed; in section 4 the model with asymmetric equilibrium is analyzed; limitations and extensions are discussed in the conclusion.

2 The Model

2.1 Closed economy

We use as a benchmark Stiglitz's (1982) version of the Mirrlees (1971) model of income taxation, but introduce a different objective of the government. In a closed economy, individuals of measure 1 have identical preferences that can be represented by a utility function $u(x, y)$, where $x \geq 0$ is consumption and $0 \leq y \leq 1$ is the time worked. u is a strictly concave, continuously differentiable function, strictly increasing in x and strictly decreasing in y.

There are two types of individuals in the economy: those with high productivity θ_H constitute measure γ, and those with low productivity θ_L have correspondingly measure $1-\gamma$; $\theta_H > \theta_L > 0$. An individual of type i provides $z_i = \theta_i y_i$ of labor while investing y_i of her time. We assume that for given (x, z), $\left(\frac{dx}{dz}\right)_{\bar{u}}$ must be decreasing in θ. (single-crossing property).

The government cannot observe θ, but it does observe income z and chooses income taxes $\{t_L, t_H\}|_{t_i \leq z_i}$ to maximize the tax revenue

$$R = \gamma t_H + (1-\gamma)\, t_L$$

subject to a *satisfaction constraint* $u_L, u_H \geq u_0$. This constraint makes it impossible for the living conditions of the poor to be set arbitrarily low and may be interpreted as a requirement of a modern welfare state.

In a separating equilibrium, the individual i then chooses (x_i, y_i) that maximizes $u(x, y)$ subject to $x_i \leq \theta_i y_i - t_i$, and corresponding incentive compatibility (IC) and satisfaction constraints. For simplicity we assume that the utility thresholds that ensure participation are equal to u_0.

It is well known that the budget constraints, the satisfaction constraint for the low type and the IC constraint either for the high type or for the low type, are binding in such problems (e.g., Stiglitz 1982). In the appendix we show that in our setting it is possible to rule out a binding IC constraint for the low productivity type.

The individual optimization will result in setting consumption and time for the low type at the levels satisfying

$$\begin{aligned} x_i &= \theta_i y_i - t_i, \\ \theta_i\,(1-t_i')\, u_x + u_y &= 0. \end{aligned}$$

The Leviathan will then leave the less productive with their reservation utility, setting t_L to satisfy

$$u\,(z_L - t_L, z_L/\theta_L) = u_0,$$

and t_H to satisfy

$$u\,(z_L - t_L, z_L/\theta_H) = u\,(z_H - t_H, y_H)$$

and the revenue maximization condition. The government will not find itself better off in a pooling equilibrium in our setting, as shown by Stiglitz (1982). Nothing guarantees, however, that the corner with $z_L = 0$ is not hit.

Writing down the maximization explicitly (and in line with the literature), we can define the marginal tax rate as

$$t_i' = 1 + \frac{u_y}{\theta_i u_x}.$$

We set up the Lagrangian $L = \gamma t_H + (1-\gamma) t_L + \mu (u(z_L - t_L, z_L/\theta_L) - u_0) + \lambda (u(z_H - t_H, z_H/\theta_H) - u(z_L - t_L, z_L/\theta_H))$ and denote for compactness $u^L := u(z_L - t_L, z_L/\theta_L)$; $u^H := (z_H - t_H, z_H/\theta_H)$; $u^{HL} := u(z_L - t_L, z_L/\theta_H)$. The corresponding FOCs are

$$t_L \;:\; 1 - \gamma - \mu u_x^L + \lambda u_x^{HL} = 0, \tag{1a}$$

$$z_L \;:\; \mu \left(u_x^L + u_y^L/\theta_L\right) - \lambda \left(u_x^{HL} + u_y^{HL}/\theta_H\right) = 0, \tag{1b}$$

$$t_H \;:\; \gamma - \lambda u_x^H = 0, \tag{1c}$$

$$z_H \;:\; \lambda \left(u_x^H + u_y^H/\theta_H\right) = 0. \tag{1d}$$

The last equation immediately produces a "no distortion at the top" result: $u_x^H + u_y^H/\theta_H = 0 \Longrightarrow t_H' = 0$. From quasiconcavity, $dx/dy = -u_y/u_x$ is an increasing function of y. Thus, as long as $x_L < x_H$, we have $-u_y^{HL}/u_x^{HL} < -u_y^H/u_x^H$. Correspondingly, $u_x^{HL} + u_y^{HL}/\theta_H > u_x^H + u_y^H/\theta_H = 0$, and from (1b) $u_x^L + u_y^L/\theta_L > 0$, so that $t_L' > 0$.

For future reference, denote the optimal tax rates in the autarky case by $\{t_L^a, t_H^a\}$.

The appendix shows that for a sufficiently high level of γ the low-skilled will find it optimal not to participate in the labor force ($z_L^a = 0$). In what follows we assume that γ is not too high for interior solution (Our basic result about the increased employment level of the "poor" from the tax competition for the high skilled will sustain in the corner solution).

2.2 Open economy

Suppose now we have two identical economies of the sort described above. Additionally, high-productivity individuals may migrate between countries in search of a better life. Low-productivity individuals are immobile. This is an extreme case of correlation between productivity and mobility decision, and we employ it for the sake of simplicity. Simula and Trannoy (2010) discuss why it seems reasonable to assume that higher-skilled workers are also more mobile. For example, skilled workers have better language skills and should have easier access to information on foreign countries.

Our high-productivity individuals differ in their propensity to migrate. Specifically, we assume that the initial population in each country is distributed on the interval $[0, 1]$ according to a continuously differentiable distribution function $F(a)$. Under this assumption we can use a Hotelling model for the analysis. Basically, our migration costs are similar in spirit to switching costs widely analyzed in the industrial organization literature (e.g., Farrell and Klemperer 2007). The utility of the high-productivity individual located at a is $u(x,y) - c(a)$, where c is a strictly increasing function with $c(0) = 0$. Thus, we assume that utility is additively separable with respect to migration costs.

One caveat related to this analysis is that upon migration the government can observe the type of individual and thus impose a perfect-information tax on her (or any other tax conditioned upon the fact of migration and hence potentially different than the tax on the rest of population). However, we can exclude such behavior by postulating that the government must treat migrants and nonmigrants equally (and this is indeed the case in many countries that have antidiscrimination laws) for the sake of horizontal equity.

The timing of the events is as follows. In the first stage, the governments simultaneously choose the tax schedules. In the second stage, the agents observe these tax schedules and decide which schedule to accept (equivalently, choose their labor-consumption pairs). The low type individuals are restricted to choose the tax menus from the country of their residence only; the high type individuals may also (at some cost) choose the tax menus offered by the other country.

Given a pair of taxes $\left(t_H^A, t_H^B\right)$ in two countries, if $t_H^A < t_H^B$, all the individuals from country B with $a < \hat{a} : u\left(z_H^A - t_H^A, z_H^A/\theta_H\right) - c(\hat{a}) = u\left(z_H^B - t_H^B, z_H^B/\theta_H\right)$ will migrate to country A; and analogously for country B. Correspondingly, now the Leviathan will want to maximize[3]

$$R^A = \gamma t_H^A \left(1 + \int_0^{\hat{a}} dF(a)\right) + (1-\gamma)\, t_L^A$$

subject to the satisfaction constraint

$$u(\theta_L y_L - t_L, y_L) = u_0,$$

the incentive compatibility constraint

$$u(\theta_H y_L - t_L, y_L) \leq u(\theta_H y_H - t_H, y_H),$$

which does not have to be binding any more, and individual rationality

$$\theta_i (1 - t_i')\, u_x + u_y = 0.$$

[3] To be concise, we do not explicitly consider the case with $t_H^A > t_H^B$. However, it is easy to see that our formulation remains valid in this complementary case, if we additionally define functions c and F on the interval $[-1, 0]$ by $c(-a) = -c(a)$ and $F(-a) = -F(a)$.

The solution to this program for given t_H^B will give us a best-response function for country A. Writing this up more explicitly, we have

$$\hat{a} = c^{-1}\left(u\left(z_H^A - t_H^A, z_H^A/\theta_H\right) - u\left(z_H^B - t_H^B, z_H^B/\theta_H\right)\right) \tag{2}$$

and the Lagrangian $L = \gamma t_H\left(1 + \int_0^{\hat{a}} dF(a)\right) + (1-\gamma)\, t_L + \mu\left(u\left(z_L - t_L, z_L/\theta_L\right) - u_0\right) + \lambda\left(u\left(z_H - t_H, z_H/\theta_H\right) - u\left(z_L - t_L, z_L/\theta_H\right)\right)$, where $\lambda \geq 0$ and superscript A is omitted for more parsimonious notation. The first order conditions are now

$$t_L \;:\; 1 - \gamma - \mu u_x^L + \lambda u_x^{HL} = 0, \tag{3a}$$

$$z_L \;:\; \mu\left(u_x^L + u_y^L/\theta_L\right) - \lambda\left(u_x^{HL} + u_y^{HL}/\theta_H\right) = 0, \tag{3b}$$

$$t_H \;:\; \gamma\left(1 + \int_0^{\hat{a}} dF(a) - t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H\right) - \lambda u_x^H = 0, \tag{3c}$$

$$z_H \;:\; \gamma t_H f(\hat{a})\, c^{-1\prime}(.)\left(u_x^H + u_y^H/\theta_H\right) + \lambda\left(u_x^H + u_y^H/\theta_H\right) = 0. \tag{3d}$$

First, we can see that the conditions of the less productive are not affected by the migration possibility of the high-skilled. Second, the "no distortion at the top" result is still preserved, regardless of whether the IC constraint is still binding. Indeed, as in the last expression $\gamma t_H f(\hat{a})\, c^{-1\prime}(.) + \lambda$ is strictly positive, it is necessary that at the optimum $u_x^H + u_y^H/\theta_H = 0$, that is, $t_H' = 0$. Third, the FOC with respect to t_H has now an additional term $\int_0^{\hat{a}} dF(a) - t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H$. If the IC constraint were not binding, the choice of the tax on high-productivity individuals would be a simple trade-off between increasing the tax base and reducing the tax rate to maximize revenue. Otherwise, relaxing the IC constraint is an additional benefit of decreased tax:

$$1 + \int_0^{\hat{a}} dF(a) = t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H + \frac{\lambda}{\gamma} u_x^H.$$

The shadow value of the constraint is changed from γ/u_x^H in autarky to $\gamma\left(1 + \int_0^{\hat{a}} dF(a)\right)/u_x^H - \gamma t_H f(\hat{a})\, c^{-1\prime}(.)$ in the open economy.

If competition is very intense, the IC constraint may become nonbinding; in such a case the condition (3b) simplifies to $\mu\left(u_x^L + u_y^L/\theta_L\right) = 0$, and we have no distortion at the bottom: $u_x^L + u_y^L/\theta_L = 0$, as the satisfaction constraint for the low-productivity individuals is binding[4]. This is a remarkable result: in our model tax competition is a way to tame Leviathan, and it might even restore first-best solution in some cases.

Example 1 *In the extreme case of no switching costs, Bertrand competition decreases the tax on the high productivity type to zero. There is no distortion for the low type; its IC constraint may be binding.*

Proof. *In Bertrand equilibrium both governments get the first best revenue from their low type residents. Clearly, a deviation to any other tax on the "poor" is not profitable. A deviation to a higher tax on the "rich" does not change the revenue, because all the "rich" emigrate. A deviation to a negative tax on the "rich" decreases the revenue.* ■

The best response of country A is defined by the equations (3a)–(3d) and (2). By the inverse function theorem, $c^{-1\prime}(.) = 1/c'(.)$. We now look at a symmetric (subgame-perfect) Nash equilibrium, defined by the pair of best responses $t_H^A\left(t_H^B\right)$ and $t_H^B\left(t_H^A\right)$ such that $t_H^A = t_H^B = t_H^o$. The condition (3c) can be rewritten as

$$t_H^o = \frac{c'(0)}{f(0)}\left(\frac{1}{u_x^H} - \frac{\lambda}{\gamma}\right), \tag{4}$$

and together with the conditions (3a)–(3d) it defines a symmetric Nash equilibrium in our model.

Notice that $c'(0)$ reflects intensity of competition: for $c'(0) = 0$ there is no heterogeneity with respect to migration decision, so there is effectively Bertrand competition; for $c'(0) \to \infty$ competition becomes ineffective, and we have the following lemma.

Lemma 1 *Consider autarky equilibrium tax rates* $\{t_L^a, t_H^a\}$*. For* $c'(0) \to \infty$*, the unique symmetric equilibrium in the tax competition game converges to* $t_L^o = t_L^a, t_H^o = t_H^a$*.*

Proof. Starting from autarky equilibrium values, from (1c) $\gamma - \lambda u_x^H = 0$. The condition (3c) as a best response to autarky equilibrium in another country can be rewritten as $-\gamma t_H u_x^H f(0)/c'(0) < 0$, so there is an incentive

[4] As competition intensifies further, IC constraint of the low type may become binding. In this case "no distortion at the bottom" is preserved, but "no distortion at the top" disappears and there may be overprovision of hours worked for the high skilled. Our results in Propositions 1-3 remain unaltered.

to cut the tax, but this incentive vanishes in the limit of an unbounded slope of the switching cost function. ■

Thus, the autarky equilibrium is a limiting case of open-economy equilibrium with no effective tax competition. Intuitively, Lemma 1 shows that t_H^a cannot be a part of equilibrium strategy in the open economy setup, because there is a profitable deviation to a lower tax on the rich.

Proposition 1 *Tax competition lowers the tax on the high-skilled, $t_H^o < t_H^a$.*

Proof. From Lemma 1, $t_H^o \neq t_H^a$. Under our assumptions, autarky tax is a unique revenue maximizer in autarky, so $R^a(t_H^a) > R^a(t_H^o)$[5]. Suppose $t_H^o > t_H^a$. The government deviating to t_H^a from above in open economy gets the same revenue as in autarky plus any revenue stemming from inflow of high types. Hence, the revenue at t_H^a in open economy is at least as high as the revenue at t_H^a in autarky, $R^o(t_H^a) \geq R^a(t_H^a)$. Since we look at a symmetric candidate equilibrium, the population in open economy is the same as in autarky, so with the same taxes the government gets the same revenues in autarky and in open economy, $R^o(t_H^o) = R^a(t_H^o)$. Collecting the relations discussed, we get $R^o(t_H^a) \geq R^a(t_H^a) > R^a(t_H^o) = R^o(t_H^o)$, so for any $t_H^o > t_H^a$ there exist a profitable deviation to t_H^a. Thus, the only possible candidate equilibrium is $t_H^o < t_H^a$. ■

Proposition 2 *Tax competition increases employment of the low-skilled: $z_L^o > z_L^a$.*

Proof. From Proposition 1 we know that $t_H^o < t_H^a$. If the IC constraint is binding, we show in appendix that $z_L^o > z_L^a$. If the IC constraint is not binding, from the condition of no distortion at the bottom, $z_L^o > z_L^a$. ■

The propositions assume existence of the equilibrium, which indeed holds if we assume that the conditions (3a)–(3d) and (2) define best responses. In this case, the intersection of the best responses is nonempty. To establish this, we have to study the best response on the interval $[0, t_H^a]$. By proposition 1 it is necessary and sufficient that the best response intersects the 45° line on this interval. There are no discontinuities in our problem, so the best-response function must be continuous. As we have shown, $BR(t_H^a) < t_H^a$. On

[5] By $R(t_H)$ we mean maximal revenue obtainable by setting the tax on high productivity type at t_H given some level of tax in the other country. Equivalently, $R(t_H)$ is the revenue obtained by fulfilling all first-order conditions except for (3c).

the other hand, $BR(0) \geq 0$, as a negative tax on the rich can not be revenue-maximizing. By continuity then there exists an intersection (or intersections) with the 45° line on the interval $[0, t_H^a]$, and hence an equilibrium exists. Moreover, this equilibrium (or equilibria) is symmetric, because the best responses are identical.

An interesting policy-relevant observation obtains immediately: tax competition contributes to the employment of low-skilled labor, which is obviously a virtue. While such an increase does not improve the lot of the low-skilled, tax competition benefits the high-skilled at the expense of Leviathan. Conversely, tax coordination (autarky in our model) would increase tax revenue, but would be inferior to tax competition in terms of the employment and utility of the high-skilled[6].

3 Alternative objectives of the government

3.1 Rawlsian government

Suppose now government is not interested in its own rents, but has Rawlsian preferences, that is, it wants to maximize the utility of the low-productivity individuals subject to some budget constraint. The corresponding Lagrangian is then

$L = u(z_L - t_L, z_L/\theta_L) + \lambda (u(z_H - t_H, z_H/\theta_H) - u(z_L - t_L, z_L/\theta_H))$
$+\mu \left(\gamma t_H \left(1 + \int_0^{\hat{a}} dF(a)\right) + (1-\gamma) t_L\right)$.

We immediately see that the structure of the problem does not change, so the structure of the solution to it stays the same. The difference is that whereas Leviathan takes all the rents away from the "poor", the Rawlsian government, to the contrary, maximizes them. The FOCs are now

$$t_L \quad : \quad \mu(1-\gamma) - u_x^L + \lambda u_x^{HL} = 0, \tag{5a}$$
$$z_L \quad : \quad u_x^L + u_y^L/\theta_L - \lambda \left(u_x^{HL} + u_y^{HL}/\theta_H\right) = 0, \tag{5b}$$
$$t_H \quad : \quad \mu\gamma \left(1 + \int_0^{\hat{a}} dF(a) - t_H f(\hat{a}) c^{-1\prime}(.) u_x^H\right) - \lambda u_x^H = 0, \tag{5c}$$
$$z_H \quad : \quad \mu\gamma t_H f(\hat{a}) c^{-1\prime}(.) \left(u_x^H + u_y^H/\theta_H\right) + \lambda \left(u_x^H + u_y^H/\theta_H\right) = 0. \tag{5d}$$

[6]It can be noted that tax competition is not necessarily welfare-improving in models of Leviathan governments. See Edwards and Keen (1996) for details.

To see that this set of FOCs is equivalent to (3a)–(3d), divide them through by μ and re-denote $\mu_1 = 1/\mu$, $\lambda_1 = \lambda/\mu$. Then Lemma 1 and the no-distortion results go through. The proof of Proposition 1 uses the same logic as before:

Proposition 1R Tax competition lowers the tax on the high-skilled, $t_H^o < t_H^a$.

Proof. From Lemma 1, $t_H^o \neq t_H^a$. Under our assumptions, autarky tax is a unique L-type utility maximizer in autarky, so $u_a^L(t_H^a) > u_a^L(t_H^o)$[7]. Suppose $t_H^o > t_H^a$. The government deviating to t_H^a from above in open economy gets the same revenue as in autarky plus any revenue stemming from inflow of high types. This allows to keep a balanced budget while lowering t_L and therefore increasing u^L. Hence, the L-type utility at t_H^a in open economy is at least as high as L-type utility at t_H^a in autarky, $u_o^L(t_H^a) \geq u_a^L(t_H^a)$. In the symmetric candidate equilibrium, the population in open economy is the same as in autarky, so with the same t_H the government has to charge the same t_L in autarky and in open economy in order to keep the balanced budget. Hence, also L-type utility remains the same, $u_o^L(t_H^o) = u_a^L(t_H^o)$. Collecting the relations discussed, we get $u_o^L(t_H^a) \geq u_a^L(t_H^a) > u_a^L(t_H^o) = u_o^L(t_H^o)$, so for any $t_H^o > t_H^a$.there exist a profitable deviation to t_H^a. Thus, the only possible candidate equilibrium is $t_H^o < t_H^a$. ■

Proposition 2 still holds as can be seen from its proof in the appendix.

Intuitively, it makes little difference whether the government wishes to tax the high-skilled to maximize its own rent or the utility of the poor. In both situations mobility of the high-skilled tends to ease the self-selection constraint that the government has to respect, allowing the poor to be less rationed on the labor market.

While in the Leviathan model tax competition has kept the utility of the poor constant, in the Rawlsian model their utility goes down and only the utility of the high-skilled goes up.

[7] By $u^L(t_H)$ we mean maximal utility of low productivity type obtainable by setting the tax on high productivity type at t_H given some level of tax in the other country. Equivalently, $u^L(t_H)$ is the low type utility level obtained by fulfilling all first-order conditions except for (5c).

3.2 Utilitarian government

Now consider the case that the governments want to maximize the sum of the utility of the individuals. A problem here is that it is not clear whether the utility of new immigrants should enter the government's objective[8]. Given that in reality obtaining citizenship is often a long and painful process, we assume that the government cares only about the established residents. Then the Lagrangian is
$L = \gamma u\left(z_H - t_H, z_H/\theta_H\right) + (1-\gamma)\, u\left(z_L - t_L, z_L/\theta_L\right)$
$+\lambda\left(u\left(z_H - t_H, z_H/\theta_H\right) - u\left(z_L - t_L, z_L/\theta_H\right)\right) + \mu\left(\gamma t_H\left(1 + \int_0^{\hat{a}} dF(a)\right) + (1-\gamma)\, t_L\right).$
The corresponding FOCs are

$$\begin{aligned}
t_L &: \mu(1-\gamma) - (1-\gamma)\, u_x^L + \lambda u_x^{HL} = 0, && \text{(6a)}\\
z_L &: (1-\gamma)\left(u_x^L + u_y^L/\theta_L\right) - \lambda\left(u_x^{HL} + u_y^{HL}/\theta_H\right) = 0, && \text{(6b)}\\
t_H &: \mu\gamma\left(1 + \int_0^{\hat{a}} dF(a) - t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H\right) - (\lambda+\gamma)\, u_x^H = 0, && \text{(6c)}\\
z_H &: \mu\gamma t_H f(\hat{a})\, c^{-1\prime}(.)\left(u_x^H + u_y^H/\theta_H\right) + (\lambda+\gamma)\left(u_x^H + u_y^H/\theta_H\right) = 0 && \text{(6d)}
\end{aligned}$$

This is not exactly equivalent to the previous problem, but we can immediately see that the "no distortion at the top" result survives, and so does the "no distortion at the bottom" in the case of a nonbinding IC constraint. The same is true for Lemma 1. Proposition 1 goes through with the same logic as before. For the ease of notation, define $u^U(t_H)$ as the highest level of utilitarian objective $\gamma u^H + (1-\gamma)\, u^L$ attainable at tax t_H given some level of tax in the other country. Equivalently, $u^U(t_H)$ is the level of utilitarian objective obtained by fulfilling all first-order conditions except for (6c).

Proposition 1U Tax competition lowers the tax on the high-skilled, $t_H^o < t_H^a$.

Proof. From Lemma 1, $t_H^o \neq t_H^a$. Under our assumptions, autarky tax is a unique weighted utility maximizer in autarky, so $u_a^U(t_H^a) > u_a^U(t_H^o)$. Suppose $t_H^o > t_H^a$. The government deviating to t_H^a from above in open economy gets the same revenue as in autarky plus any revenue stemming from inflow of high types. This allows to keep balanced budget while lowering both t_L and t_H and therefore increasing u^H and u^U. Hence, the weighted

[8]For a discussion see Mirlees (1982) and Simula and Trannoy (2009).

utility at t_H^a in open economy is at least as high as weighted utility at t_H^a in autarky, $u_o^U(t_H^a) \geq u_a^U(t_H^a)$. In the symmetric candidate equilibrium, the population in open economy is the same as in autarky, so with the same t_H the government has to charge the same t_L in autarky and in open economy in order to keep the balanced budget. Hence, the weighted utility remains the same, $u_o^U(t_H^o) = u_a^U(t_H^o)$. Collecting the relations discussed, we get $u_o^U(t_H^a) \geq u_a^U(t_H^a) > u_a^U(t_H^o) = u_o^U(t_H^o)$, so for any $t_H^o > t_H^a$ there exists a profitable deviation to t_H^a. Thus, the only possible candidate equilibrium is $t_H^o < t_H^a$. ■

Survival of Proposition 2 is shown in the appendix.

To sum up, our result about the effect of tax competition on employment of the "poor" is robust to the changes in the specification of government's objective function.

4 Asymmetric countries

Suppose now that the two countries we consider are of different size. Assume that whereas country B still has population of measure 1, country A has a population of measure $m > 1$. Otherwise the countries are identical; in particular, a is still distributed on a unit interval, only in the country A every point is m times more populated.

The following two FOCs are changed for the Leviathan in country A (we consider here the more relevant case of $t_H^A > t_H^B$):

$$t_L \quad : \quad (1-\gamma)\, m - \mu u_x^L + \lambda u_x^{HL} = 0, \tag{7a}$$

$$t_H \quad : \quad \gamma \left(m - m \int_0^{\hat{a}} dF(a) - m t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H \right) - \lambda u_x^H = 0. \tag{7b}$$

For country B, the only equation altered is

$$t_H : \gamma \left(1 + m \int_0^{\hat{a}} dF(a) - m t_H f(\hat{a})\, c^{-1\prime}(.)\, u_x^H \right) - \lambda u_x^H = 0. \tag{8}$$

We see that, compared to the symmetric situation, the relative importance of tax competition terms is increased for the small country (B) and reduced for the large country (A). Intuitively, the small country is more aggressive in tax competition, since it has more to gain (through attracting a foreign tax base) and less to lose from it (through reduced taxes from the home tax base).

Proposition 3 *In equilibrium of the asymmetric game, $t_H^A > t_H^B$.*

Proof. Suppose the contrary is true. The case of $t_H^A = t_H^B$ is clearly inconsistent with the sets of FOC above. Consider the case of $t_H^A < t_H^B$. The condition for the country A not to have incentive to deviate to t_H^B and for the country B not to have incentive to deviate to t_H^A is

$$\gamma \left(m + \int_0^{\hat{a}} dF(a) \right) t_H^A + (1-\gamma)\, m t_L\left(t_H^A\right) \geq \gamma m t_H^B + (1-\gamma)\, m t_L\left(t_H^B\right), \tag{9}$$

$$\gamma \left(1 - \int_0^{\hat{a}} dF(a) \right) t_H^B + (1-\gamma)\, t_L\left(t_H^B\right) \geq \gamma t_H^A + (1-\gamma)\, t_L\left(t_H^A\right). \tag{10}$$

In the appendix we show that these conditions can be rewritten as

$$\gamma \left(t_H^B - t_H^A\right) \leq (1-\gamma) \left(t_L\left(t_H^A\right) - t_L\left(t_H^B\right)\right),$$

which is clearly inconsistent with expression (10) above. ■

Intuitively, absence of deviations requires that a change in revenue due to the tax on the rich must be smaller than the change in the revenue due to the tax on the poor. But if that were the case, country B could decrease its tax from t_H^B to t_H^A and get more than compensated by the increase of tax from $t_L\left(t_H^B\right)$ to $t_L\left(t_H^A\right)$, even without taking into account the inflow of migrants. Thus, our assumption that $t_H^A < t_H^B$ is incompatible with equilibrium conditions, hence $t_H^A > t_H^B$.

While more aggressive behavior of the smaller country is a robust result in tax competition models (e.g., Haufler 2001, ch. 5), Proposition 3 allows us to formulate a new testable hypothesis: The positive effect of opening borders on employment of low-skilled workers is more pronounced in a small country.

Proposition 1A Tax competition lowers the tax on the high-skilled, $t_H^o < t_H^a$.

Proof. From Proposition 3, $t_H^A > t_H^B$.
Suppose that $t_H^o > t_H^a$ in country A and $t_H^o \geq t_H^a$ in country B. We know that $R^a\left(t_H^a\right) > R^a\left(t_H^o\right)$ in each country, as t_H^a is a unique maximizer in autarky

under our assumptions. The government of country A deviating to t_H^a from a higher tax gets the same revenue in open economy as in autarky plus any revenue stemming from inflow of high types. Hence, the revenue in country A at t_H^a in open economy is at least as high as the revenue at t_H^a in autarky, $R_B^o(t_H^a) \geq R_B^a(t_H^a)$. Since the equilibrium population of country A in open economy is lower than in autarky (or the same, if country B sets $t_H^o = t_H^a$), with the same taxes the government gets at least as high revenue in autarky as in open economy, $R^o(t_H^o) \leq R^a(t_H^o)$. Collecting the relations discussed, we get $R^o(t_H^a) \geq R^a(t_H^a) > R^a(t_H^o) \geq R^o(t_H^o)$, so for any $t_H^o > t_H^a$ in country A there exist a profitable deviation to t_H^a.
Now suppose $t_H^o > t_H^a$ in country A and $t_H^o < t_H^a$ in country B. Because $t_H^A > t_H^B$, the population in country A is now smaller than in autarky. Moreover, the share of the rich is reduced from γ to

$$\frac{\gamma\left(1 - \int_0^{\hat{a}} dF(a)\right)}{1 - \gamma \int_0^{\hat{a}} dF(a)}.$$

In a closed economy, lower share of the "rich" means that Leviathan wants to distort the labor supply of the "poor" less, thus charging them higher tax (lower marginal tax) and, via incentive compatibility constraint, charging the "rich" lower tax. Denote this optimal tax level for the country A with reduced population and without migration threat t_H^r. From conditions (1a)-(1d), we have $t_H^r < t_H^a$. In open economy, there is migration threat that may push the optimal tax even lower, so we have $t_H^A \leq t_H^r$. We arrive at contradiction with the initial assumption that $t_H^o > t_H^a$ in country A.
To sum up, we have shown that $t_H^o \geq t_H^a$ is not possible for either of two countries. ■

Proposition 2 still holds, as its proof does not hinge on the symmetry assumption.

As far as existence of equilibrium is concerned, we follow the same logic as for the symmetric situation. Firstly, we need that the first order conditions modified correspondingly as in (7a)–(8) define best responses. Second, we need the two best responses to intersect. It is still true that $BR(t_H^a) < t_H^a$ and $BR(0) \geq 0$ for each country. So, given that the first order conditions define best responses, by continuity there exists at least one intersection on the interval $[0, t_H^a]$.

5 Conclusion

We have analyzed tax competition in a simple optimal-income-taxation model. We show that the tax on the high-skilled decreases and employment of the low-skilled increases with respect to autarky. Our results are robust to a number of modifications concerning the government's objective function and symmetry of the two competing countries.

There are important limitations that we share with many optimal-taxation models. First, there is no account of capital, although it should be even more mobile than high-skilled labor. We focus on income taxation because we want to clearly identify the effect of combining competition with the principal–agent framework that underlies optimal taxation models. Second, due to the simple linear production technology in one good economy, there are no general-equilibrium or trade effects of the wage changes that could lead to repercussions on the effects discussed.

We see several new directions for future research in the framework we have considered. Extensions of our model could assume countries that differ with respect to the national objective function or could allow for some mobility of low-skilled workers. We also hope that this paper will encourage empirical work on the labor market effects of migration opportunities. Based on our model, we would expect that tax competition for mobile high-skilled workers has more pronounced implications for low-skilled workers in small countries.

6 Appendix

6.1 Proposition 2

A binding IC constraint for the high type implies no distortion at the top in both autarky and open economy case. Because of that, $t_H^a > t_H^o$ implies $u^H(x^a, y^a) := u_a^H < u^H(x^o, y^o) := u_o^H$. Hence, for any z,

$$x(z)\,|_{u^H(x,y)=u_a^H} < x(z)\,|_{u^H(x,y)=u_o^H}. \tag{11}$$

Note that $t_H^a > t_H^o$ implies $t_L^a < t_L^o$. For Leviathan government this happens because of the binding satisfaction constraint; for Rawlsian and utilitarian government, because of the binding government budget constraint. This implies that for the low type, the open economy equilibrium couple satisfies

$$\{x, z\} \in \{x < z + x^a - z^a\} \cap \mathbb{R}_+^2. \tag{12}$$

Since the IC constraint is binding, the open economy equilibrium couple (for the low type) also satisfies $\{x, z\} : \left\{x(z)\,|_{u^H(x,y)=u_o^H}\right\}$. But because (11) holds, for any z that satisfies (12), we must have $z > z^a$. Hence, $z^a < z^o$.

For any of the three government objectives we have $z_L^a < z_L^o$, Q.E.D.

6.2 The corner solution

The consequences of competition for mobile labor that we have analyzed suggest that the Leviathan may want to force the "poor" not to work, $z_L = 0$, and the "rich" to work as much as possible and to tax them as much as possible as well. This depends on the value of γ.

Remark 1 *Assume the technical condition* $u_{xy}^H < \min\left\{-\theta_H u_{xx}^H, -u_{yy}^H/\theta_H\right\}$ *holds. Then for sufficiently high* γ*, a tax-revenue-maximizing allocation is characterized by* $z_L^a = 0$*.*

Proof. Suppose $z_L^a > 0$. Then a small reduction in z_L will lead to an increase in z_H that will keep the IC constraint satisfied. From the satisfaction and "no distortion at the top" constraints, that will also reduce t_L and increase t_H by amounts $dt^L/dz^L < 1$ and $dt^H/dz^H > 1$ correspondingly. Obviously, as long as $\gamma > \frac{dt^L/dz^L}{(dt^H/dz^H)(-dz^H/dz^L)+dt^L/dz^L}$, such a change will increase tax revenue without violating any constraint. Thus, at the optimum $z_L^a = 0$. ■

Note that in situations with $z_L^a = 0$ we have $t_L^a < 0$ from the satisfaction constraint, that is the "poor" receive a subsidy.

6.3 Proposition 3

From the conditions of no deviation (9)-(10), we first single out the change in population:

$$\int_0^{\hat{a}} dF(a) \geq m\frac{t_H^B}{t_H^A} + \frac{1-\gamma}{\gamma}m\frac{t_L\left(t_H^B\right)}{t_H^A} - \frac{1-\gamma}{\gamma}m\frac{t_L\left(t_H^A\right)}{t_H^A} - m,$$

$$1 + \frac{1-\gamma}{\gamma}\frac{t_L\left(t_H^B\right)}{t_H^B} - \frac{t_H^A}{t_H^B} - \frac{1-\gamma}{\gamma}\frac{t_L\left(t_H^A\right)}{t_H^B} \geq \int_0^{\hat{a}} dF(a).$$

Now, we can rewrite this as a single condition

$$1+\frac{1-\gamma}{\gamma}\frac{t_L\left(t_H^B\right)}{t_H^B}-\frac{t_H^A}{t_H^B}-\frac{1-\gamma}{\gamma}\frac{t_L\left(t_H^A\right)}{t_H^B} \geq m\frac{t_H^B}{t_H^A}+\frac{1-\gamma}{\gamma}m\frac{t_L\left(t_H^B\right)}{t_H^A}-\frac{1-\gamma}{\gamma}m\frac{t_L\left(t_H^A\right)}{t_H^A}-m.$$

Multiplying through by $t_H^A t_H^B$ and collecting the terms, we arrive at

$$0 \geq \left(mt_H^B - t_H^A\right)\left(t_H^B - t_H^A\right) + \frac{1-\gamma}{\gamma}\left(t_L\left(t_H^B\right) - t_L\left(t_H^A\right)\right)\left(mt_H^B - t_H^A\right).$$

Since $mt_H^B - t_H^A > 0$, we can divide through to obtain

$$0 \geq t_H^B - t_H^A + \frac{1-\gamma}{\gamma}\left(t_L\left(t_H^B\right) - t_L\left(t_H^A\right)\right)$$

or, equivalently,

$$\gamma\left(t_H^B - t_H^A\right) \leq (1-\gamma)\left(t_L\left(t_H^A\right) - t_L\left(t_H^B\right)\right).$$

6.4 Inexistence of closed economy equilibrium with binding IC constraint for the low productivity type

In the closed economy setup with Leviathan government, suppose the IC constraint for the low type is binding. Formally, $L = \gamma t_H + (1-\gamma) t_L + \mu\left(u\left(z_L - t_L, z_L/\theta_L\right) - u_0\right) + \lambda\left(u\left(z_L - t_L, z_L/\theta_L\right) - u\left(z_H - t_H, z_H/\theta_L\right)\right)$, $u^{LH} := u\left(z_H - t_H, z_H/\theta_L\right)$. The FOCs are

$$\begin{aligned} t_L &: 1 - \gamma - \mu u_x^L - \lambda u_x^L = 0, &\text{(13a)}\\ z_L &: (\mu+\lambda)\left(u_x^L + u_y^L/\theta_L\right) = 0, &\text{(13b)}\\ t_H &: \gamma + \lambda u_x^{LH} = 0, &\text{(13c)}\\ z_H &: -\lambda\left(u_x^{LH} + u_y^{LH}/\theta_L\right) = 0. &\text{(13d)} \end{aligned}$$

Since $\gamma > 0$, $\lambda > 0$ and $u_x^{LH} > 0$, the third line can never be satisfied. Since $L_{t_H} = \gamma + \lambda u_x^{LH} > 0$, it would be optimal for the government to set the highest possible tax on the high productivity type, thus hitting its satisfaction constraint. This, however, cannot be the case, as "the rich" would prefer to mimic the poor. Thus, our initial assertion that the IC constraint for "the poor" is binding must be wrong.

Another way to see this is through the "no distortion at the bottom" result that characterizes an equilibrium with a binding IC constraint for the low productivity type (line two on the display). At the optimal t_L, $dx/dz|_{u^L=u_0} = 1$. At optimal t_H, $dx/dz|_{u^L=u_0} > 1$, as otherwise the high type would want to mimic the lower type. Clearly, the government could offer the high type the same tax scheme as the lower type and get higher revenue than before (tax revenue is maximized at $dx/dz = 1$ given a condition $u = u_0$). Such a pooling situation would certainly also not be an optimum, as the government could get higher revenue offering the "rich" a menu for which their IC constraint is binding. Thus, an equilibrium with "no distortion at the bottom" and a binding IC constraint of the "poor" cannot exist, if the government objective is revenue maximization.

Intuitively, it may seem surprising that regardless of the value of γ, i.e. also when there are very few "rich", the government will prefer not to distort their labor supply decision at the expense of distorting the choice of the "poor". The thing is that as γ approaches zero, the distortion imposed on the lower type also vanishes. Formally, from (1a)-(1c) we have

$$t'_L = \frac{\gamma \left(u_x^{HL} + u_y^{HL}/\theta_H \right)}{(1-\gamma)\, u_x^H + \gamma u_x^{HL}},$$

that is the marginal tax rate on the "poor" approaches zero as their share approaches unity. Thus, we have the "no distortion on the bottom" result in the limit, but never for $\gamma > 0$.

The inexistence result is robust to the changes in the government objective considered in this paper. Indeed, a Rawlsian or Utilitarian government will always prefer to keep the IC constraint of the high (rather than the low) type binding (in the former case because they only care about the poor; in the latter case on pure efficiency grounds)

References

[1] F. Bierbrauer, C. Brett and J. Weymark, Strategic nonlinear income tax competition with perfect labor mobility, CESifo Working Paper 3329 (2011).

[2] J. Edwards, M. Keen, Tax competition and Leviathan, European Economic Review 40 (1996), 113–134.

[3] J. Farrell and P. Klemperer, Coordination and lock-in: competition with switching costs and network effects, in: M. Armstrong, R. Porter (Eds.), Handbook of Industrial Organization, Elsevier, Volume 3, 2007, 1967–2072.

[4] A. Haufler, Taxation in a Global Economy, Cambridge University Press, 2001.

[5] B. Huber, Tax competition and tax coordination in an optimum income tax model, Journal of Public Economics, 71 (1999), 441–458.

[6] J. Mirrlees, An exploration in the theory of optimum income taxation, The Review of Economic Studies, Vol. 38, No. 2 (1971), 175–208.

[7] J. Mirlees, Migration and optimal income taxes, Journal of Public Economics 18 (1982), 319-341.

[8] M. Morelli, H. Yang and L. Ye, Competitive nonlinear taxation and constitutional choice, mimeo, 2010.

[9] P. Osmundsen, K.P. Hagen, G. Schjelderup, Internationally mobile firms and tax policy, Journal of International Economics, 45 (1998), 97–113.

[10] P. Osmundsen, G. Schjelderup, K. P. Hagen, Personal income taxation under mobility, exogenous and endogenous welfare weights, and asymmetric information, Journal of Population Economics 13 (2000), 623–637.

[11] G. Piaser, Labor mobility and income tax competition. In: Gregoriou, G.N.,Read, C. (Eds.), International Taxation Handbook. Elsevier, 2007.

[12] W. Richter, Delaying integration of immigrant labor for the purpose of taxation, Journal of Urban Economics 55 (2004), 597–613.

[13] H.-W. Sinn, The New Systems Competition, Blackwell Publishing, 2003.

[14] L. Simula and A. Trannoy, Shall we keep highly skilled at home? The optimal income tax prospective, Uppsala Center for Fiscal Studies Working Paper 2009:9, 2009.

[15] L. Simula and A. Trannoy, Optimal income tax under the threat of migration by top-income earners, Journal of Public Economics 94 (2010), 163–173.

[16] J. Stiglitz, Self-selection and Pareto efficient taxation, Journal of Public Economics, 17 (1982), 213–240.

[17] G. R. Zodrow, P. Mieszkowski, Pigou, Tiebout, property taxation and the underprovision of local public goods, Journal of Urban Economics 19 (1986), 356–370.

Oxford University Centre for Business Taxation
Working Paper series

WP12/06 Kevin S Markle *A Comparison of the Tax-motivated Income Shifting of Multinationals in Territorial and Worldwide Countries*

WP12/05 Li Liu *Income Taxation and Business Incorporation: Evidence from the Early Twentieth Century*

WP12/04 Shafik Hebous and Vilen Lipatov *A Journey from a Corruption Port to a Tax Haven*

WP12/03 Neils Johannesen *Strategic line drawing between debt and equity*

WP12/02 Chongyang Chen, Zhonglan Dai, Douglas A. Shackelford and Harold H. Zhang, *Does Financial Constraint Affect Shareholder Taxes and the Cost of Equity Capital?*

WP12/01 Stephen R. Bond and Irem Guceri, *Trends in UK BERD after the Introduction of R&D Tax Credits*

WP11/23 Krautheim, Sebastian and Tim Schmidt-Eisenlohr *Wages and International Tax Competition*

WP11/22 Haufler, Andreas, Pehr-Johan Nörback and Lars Persson *Entrepreneurial innovation and taxation*

WP11/21 Mancini, Raffaele, Paolo M. Panteghini and Maria laura Parisi *Debt-Shifting in Europe*

WP11/20 Xing, Jing *Does tax structure affect economic growth? Empirical evidence from OECD countries*

WP11/19 Freedman, Judith *Responsive regulation, risk and rules: applying the theory to tax practice*

WP11/18 Devereux, Michael P. and Simon Loretz *How would EU corporate tax reform affect US investment in Europe?*

WP11/17 Vella, John, Clemens Fuest and Tim Schmidt-Eisenlohr *Response on EU proposal for a Financial Transaction Tax*

WP11/16 Loretz, Simon and Socrates Mokkas *Evidence for profit-shifting with tax sensitive capital stocks*

WP11/15 Weisenbach, david A. *Carbon taxation in the EU: Expanding EU carbon price*

WP11/14 Bauer, Christian, Davies, Ronald B. and Andreas Hauer *Economic Integration and the Optimal Corporate Tax Structure with Heterogeneous Firms*

WP11/13 Englisch, Joachim *National Measures to Counter Tax Avoidance under the Merger Directive*

WP11/12 de la Feria, Rita and Clemens Fuest *Closer to an Internal Market? The Economic Effects of EU Tax Jurisprudence*

WP11/11 Englisch, Joachim *EU Perspective on VAT Exemptions*

WP11/10 Riedel, Nadine and Hannah Schildberg-Hörisch *Asymmetric Obligations*

WP11/09 Böhm, Tobias and Nadine Riedel *On Selection into Public Civil Service*

WP11/08 Auerbach, Alan J. and Michael P. Devereux *Consumption and Cash-Flow Taxes in an International Setting*

WP11/07 Becker, Johannes and Clemens Fuest *Tax Competition: M&A versus Greenfield Investment*

WP11/06 Riedel, Nadine *Taxing Multinationals under Union Wage Bargaining*

WP11/05 Liu, Li and Rosanne Altshuler *Measuring the Burden of the Corporate Income Tax under Imperfect Competition*

WP11/04 Becker, Johannes and Clemens Fuest *The Taxation of Foreign Profits - The Old View, the New View, and a Pragmatic View*

WP11/03 Konrad, Kai *Search Costs and Corporate Income Tax Competition*

WP11/02 Hellerstein,Walter *Comparing the Treatment of Charities Under Value Added Taxes and Retail Sales Taxes*

WP11/01 Dharmapala, Dhammika and Nadine Riedel *Earnings Shocks and Tax-Motivated Income-Shifting: Evidence from European Multinationals*

WP10/23 Schmidt-Eisenlohr, Tim *Towards a Theory of Trade Finance*

WP10/22 Freedman, Judith and John Vella *HMRC's Management of the UK Tax System: The Boundaries of Legitimate Discretion*

WP10/21 de la Feria, Rita *Reverberation of Legal Principles: Further Thoughts on the Development of an EU Principle of Prohibition of Abuse of Law*

WP10/20 Hauer, Andreas and Frank Stähler *Tax competition in a simple model with heterogeneous firms: How larger markets reduce profit taxes*

WP10/19 Cnossen, Sijbren *Improving the VAT Treatment of Exempt Immovable Property in the European Union*

WP10/18 Grubert, Harry and Richard Krever *VAT and Financial Supplies: What should be taxed?*

WP10/17 Gendron, Pierre-Pascal *VAT Treatment of Public Sector Bodies: The Canadian Model*

WP10/16 Niepmann, Friederike and Tim Schmidt-Eisenlohr *Bank Bailouts, International Linkages and Cooperation*

WP10/15 Bond, Stephen and Jing Xing *Corporate taxation and capital accumulation*

WP10/14 Lockwood, Ben *How should financial intermediation services be taxed?*

WP10/13 Becker, Johannes, Fuest, Clemens and Nadine Riedel *Corporate tax effects on the quality and quantity of FDI*

WP10/12 Fuest, Clemens and Nadine Riedel *Tax Evasion and Tax Avoidance in Developing Countries: The Role of International Profit Shifting*

WP10/11 Wildasin, David E. *State Corporation Income Taxation: An Economic Perspective on Nexus*

WP10/10 Becker, Johannes and Marco Runkel *Corporate tax regime and international allocation of ownership*

WP10/09 Simpson, Helen *How do firms' outward FDI strategies relate to their activity at home? Empirical evidence for the UK*

WP10/08 Voget, Johannes, *Headquarter Relocations and International Taxation*

WP10/07 Devereux, Michael P. and Simon Loretz *Evaluating Neutrality Properties of Corporate Tax Reforms*

WP10/06 Davies, Ronald B. and Lourenço S. Paz, *Tarifs Versus VAT in the Presence of Heterogeneous Firms and an Informal Sector*

WP10/05 Finke, Katharina, Heckemeyer, Jost H., Reister Timo and Christoph Spengel *Impact of Tax Rate Cut Cum Base Broadening Reforms on Heterogeneous Firms - Learning from the German Tax Reform 2008*

WP10/04 Koh, Hyun-Ju and Nadine Riedel *Do Governments Tax Agglomeration Rents?*

WP10/03 Dischinger, Matthias and Nadine Riedel *The Role of Headquarters in Multinational Profit Shifting Strategies*

WP10/02 Vrijburg, Hendrik and Ruud A. de Mooij *Enhanced Cooperation in an asymmetric model of Tax Competition*

WP10/01 Bettendorf, Leon, van der Horst *Albert, de Mooij, Ruud A. and Hendrik*
Vrijburg, Corporate tax consolidation and enhanced cooperation in the European Union

WP09/32 Bettendorf, Leon, Devereux, Michael P., van der Horst, Albert, Loretz,
Simon and Ruud A. de Mooij *Corporate tax harmonization in the EU*

WP09/31 Karkinsky, Tom and Nadine Riedel *Corporate Taxation and the Choice*
of Patent Location within Multinational Firms

WP09/30 Becker, Johannes and Clemens Fuest *Transfer Pricing Policy and the*
Intensity of Tax Rate Competition