The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

CESifo Working Papers
www.cesifo.org/wp

International Tax Competition and the Deficit Bias

Calin Arcalean

CESIFO WORKING PAPER NO. 5627
CATEGORY 6: FISCAL POLICY, MACROECONOMICS AND GROWTH
NOVEMBER 2015

ISSN 2364-1428

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 5627*

International Tax Competition and the Deficit Bias

Abstract

I analyze the dynamic effects of tax competition on public budget deficits. I find that stronger tax competition leads to a fiscal deficit bias at the early stages of financial liberalization. When countries differ in terms of capital mobility, further liberalization leads to external imbalances and diverging fiscal deficits while corporate tax rates converge. Consistent with theory, I find that stronger tax competition increases deficits in a sample of OECD countries, controlling for tax revenues and other standard determinants of fiscal deficits.

JEL-Codes: E620, F620.

Keywords: international tax competition, political economy, deficit bias, redistribution.

Calin Arcalean
Department of Economics
ESADE
Ramon Llull University
Avenida de Torreblanca, 59
Spain – 08172 Sant Cugat del Vallès, Barcelona
calin.arcalean@esade.edu

The author acknowledges financial support from Universitat Ramon Llull, Banc Sabadell and the Spanish Ministry of Education and Science under the grant ECO2011-2492. The usual caveat applies.

1 Introduction

The effect of financial globalization on the governments' ability to redistribute is an important yet only partially understood issue. Starting in the mid 1980s, deregulation in the financial sector and the gradual removal of capital controls have generated a steady increase of financial openness in the developed world. While corporate tax rates have declined from an average of nearly 50% in 1980 to below 30% in 2008, the stock of public debt as a share of GDP has more than doubled during the same period (see figure 1).

A large economic literature studying international capital taxation has shown that higher capital mobility can induce competitive reductions in capital tax rates as countries attempt to expand their domestic tax base. The effects of tax competition on the mix of tax revenues, the level and the structure of public spending are also rather well understood (e.g. Bucovetsky and Wilson (1991), Keen and Marchand (1997), Wildasin (2003), Devereux et al. (2008)).

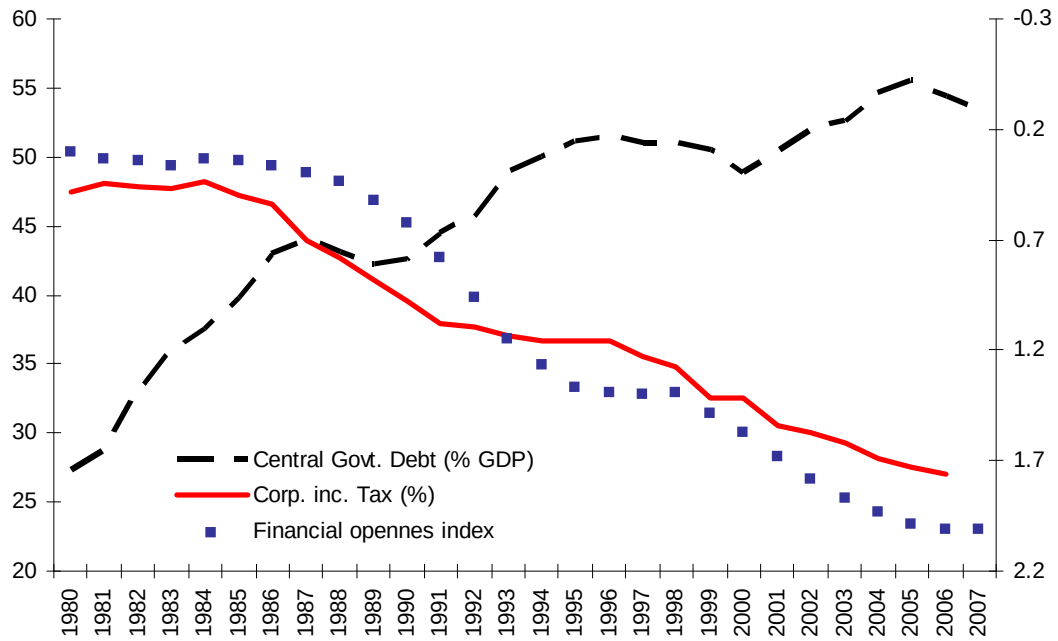
However, despite the systematic buildup of public debt in developed economies, the interactions between tax competition and the intertemporal government budget constraint have been largely ignored. The paper attempts to bridge this gap by connecting two standard problems: on the one hand, the static choice of tax rates under capital mobility which is at the heart of the tax competition literature, and on the other hand, the dynamic optimization over tax and debt policies underlying public finance theories.

I build a stylized dynamic model of tax competition in a multi-country economy with capital accumulation and public debt. Fiscal policies are endogenized through a political economy process. Consistent with the pervasive rise of economic inequality observed in developed economies, the effects of capital mobility on the public budget deficit are mediated by an increase in income disparities which alters redistribution incentives.[1]

The world lasts for two periods. Each country is endowed with a mobile factor (capital)

[1] Between mid 1980s and late 2000s across OECD countries the annual average increase in the Gini coefficient was of 0.3% reflecting widening income disparities in a large majority of member countries. See also Atkinson et al. (2011).

Figure 1: Corporate taxation and public debt



The solid line shows average OECD corporate tax rates (on the left axis, in percentages), the dotted line shows the Chinn-Ito financial openness index (on the right axis, inverted scale). The overall statutory tax rate on distributed profit and the effective average tax rate on capital display similar trends. The dashed line shows the central government debt share in GDP (on the left axis in percentages). The capital taxation and public debt measures are computed as GDP weighted averages in each year. Source: OECD, Chinn and Ito (2006) and author's calculations

and an immobile one (labor). Capital owners are a minority relative to workers. They can invest their capital domestically or, at a cost, abroad. Labor and capital income are taxed but only source taxation of capital income can be implemented. In each country, a government uses capital and labor taxes together with public debt to finance an exogenous level of public spending. The government maximizes the life-time utility of the median voter, which is a worker. The possibility of capital flight implies the domestic tax base depends on foreign fiscal policies.

In this framework, I analyze how domestic fiscal policies respond to higher international capital mobility. First, I show that at the early stages of financial liberalization dynamic tax competition leads not only to lower capital tax rates but also to higher public budget

deficits. Second, the model sheds light on the extensive margin of financial openness: holding capital mobility constant, fiscal deficits increase in the number of countries joining the integrated capital market. If further financial liberalization can only be achieved within a smaller club of countries, e.g. the Euro-zone countries within the European Union, the bias towards deficits persists at higher levels of openness. Third, allowing for heterogeneity in capital mobility across countries, the model predicts that higher outward capital mobility generates lower capital taxation and, at low world levels of financial openness, higher public budget deficits. As financial liberalization progresses, while corporate tax rates converge, initial differences in capital mobility lead to external imbalances and diverging fiscal deficits across countries. The empirical analysis using a panel data set of OECD countries reveals, across a variety of specifications, that stronger tax competition triggered by financial liberalization abroad increases domestic fiscal deficits, controlling for tax revenues and other standard determinants of fiscal deficits.

The intuition behind the deficit bias induced by tax competition is the following. In an open economy, permanently higher capital mobility implies the domestic capital supply is more elastic with respect to local taxes. This lowers capital tax rates in both periods, which increases the income of capital owners. Capital accumulation amplifies these gains, thus further magnifying income disparities in the economy. Workers are worse off in both periods as higher labor income taxes are needed to compensate for the reduction in the capital income tax.

Policies aligned to the interests of workers attempt to increase redistribution from the mobile to the immobile factor. Crucially, while tax competition keeps capital income tax rates down in *all periods*, accumulation implies a higher second period capital tax base in *all countries*. Raising public debt in the first period can thus reduce the tax burden on labor in all periods since it allows a higher share of total public spending (in present value terms) to be financed with capital income taxes.

In general public debt varies non-monotonically with financial openness. When capital

mobility increases from lower levels, public debt can be efficiently used as an intertemporal shift of tax distortions. However, at high levels of capital mobility, tax rates on capital are lower and less elastic with respect to openness. At the same time taxes on the immobile factor are higher so the median voter prefers more intraperiod redistribution and less public debt.

Within the vast tax competition literature[2], while few previous studies have looked at the dynamic effects of tax competition (e.g. Wildasin and Wilson (1996), Wildasin (2003) and Koethenbuerger and Lockwood (2010)), they have not analyzed equilibrium public debt in such environments. An exception is Jensen and Toma (1991). They study public debt in a model of tax competition but exclude capital accumulation, which is central to the current paper. Finally, Cooper et al. (2008) allow for unbalanced public budgets in a fiscal federation but do not consider explicitly strategic tax policies.

More generally, Wildasin (2003) shows that in a world of imperfectly mobile factors, tax competition can trigger redistribution in favor of the owners of immobile resources. While in that case the emphasis falls on elasticity differences between factors, here redistribution arises due to intertemporal differences in the capital tax base. More importantly, the paper goes beyond factor taxation to analyze the effects of these differences for the redistribution through public debt.

The next section presents a two country model of dynamic tax competition with public debt. Section 3 derives equilibrium policies and analyzes the effect of an increase in capital mobility. A generalization of the model to the case of n economies follows in Section 4. In Section 5, I extend the model to asymmetric countries and analyze the effects of heterogeneity in capital mobility. Section 6 tests the model's predictions on data from the OECD countries. Derivations and robustness checks are included in appendices.

[2] See e.g. Wilson (1986), Zodrow and Mieszkowski (1986), Kanbur and Keen (1993), Keen and Marchand (1997), Wildasin (1998), Baldwin and Krugman (2004), Wilson and Janeba (2005), Hindriks et al. (2008).

2 The model

The world consists of two ex-ante identical countries. Asterisks denote the foreign country. Both are imperfectly open economies, i.e. foreign capital investments are costly. The final good is costlessly tradeable. The world lasts for two periods, indexed by $t = 1, 2$.

The population of each country is constant. There are two types of two period lived agents, a measure one of hand-to-mouth workers (denoted by superscript L) and a measure α of capital owners (superscripted K). Workers constitute a majority, i.e. $\alpha < 1$.

Output is produced with a linear technology separable in labor L and capital K: $Y = wL + rK$, $w, r > 0$. Thus factor prices are constant. In appendix B.2 I explore the case of a Cobb-Douglas production function.

Capital owners can invest their resources both at home and, at a cost, abroad. Only source based taxation of capital income is possible. Taxes on labor and capital income finance an exogenous stream of public spending. In the benchmark model, national governments engage in corporate tax competition and can issue public debt to maximize the lifetime welfare of the median voter which is a worker. Governments can credibly commit to repay public debt. To ease notation, whenever possible, I only describe the home economy.

2.1 Households

Workers. Every period, they earn wages normalized to unity. They have no capital endowments and do not save. I later show that given equilibrium public policies, they would not save even if allowed to.

Labor income is taxed at the rate τ_t so workers' consumption flows are $c_t^L = 1 - \tau_t$ and their lifetime utility is:

$$V^L = \ln c_1^L + \beta \ln c_2^L, \ 0 < \beta \leqslant 1. \tag{1}$$

Capital owners. The gross world interest rate is constant and equal to r. Capital

owners start with $a_0 = 1$ units of capital. Thus, aggregate *domestic* capital supply in each economy is equal to α, the measure of capital owners. They invest their capital internationally so as to maximize net of tax income I_t.

Capital invested at home, d_t is taxed at the domestic tax rate θ_t, while capital invested abroad, f_t is taxed at the foreign rate θ_t^* and is subject to some transaction costs $T(f_t)$, $T_f > 0$ and $T_{ff} > 0$. I assume quadratic transaction costs (see e.g. Persson and Tabellini (2002)) While this functional form keeps the analysis tractable, it is not otherwise important.

$$T(f_t) = \frac{f_t^2}{2\phi}, \phi \geqslant 0. \tag{2}$$

Here ϕ measures the mobility of domestic capital, or equivalently, the lack of barriers in investing abroad. The larger ϕ, the higher the capital mobility. The limiting case $\phi = 0$ implies infinite costs of investing abroad and thus can be interpreted as financial autarky.

The income of a capital owner is:

$$I_t = d_t(r - \theta_t) + f_t(r - \theta_t^*) - T(f_t), \tag{3}$$

where r is the interest rate, $d_t + f_t = a_{t-1}$, $f_t \geqslant 0$ for $t = 1, 2$.

Capital owners derive utility only from second period consumption so their lifetime welfare is $V^K = c_2^K$. This assumption is made for simplicity and is not critical for the results, as shown in appendix B. Maximizing c_2^K implies:

$$a_1 = I_1, \tag{4}$$

$$c_2^K = I_2. \tag{5}$$

as well as choosing domestic and foreign investment to maximize income in each period:

$$\max_{\{d_t, f_t\}} d_t(r - \theta_t) + f_t(r - \theta_t^*) - \frac{f_t^2}{2\phi} \text{ s.t. } d_t + f_t = a_{t-1}, t = 1, 2, \text{ given } a_0. \tag{6}$$

Private foreign borrowing is excluded so that $f_t \geqslant 0$. Substituting (2) in (3) and solving (6) yields the levels of foreign and domestic investment respectively:

$$f_t = \max\{\phi(\theta_t - \theta_t^*), 0\} \text{ and } d_t = a_{t-1} - f_t. \tag{7}$$

At an interior solution lower transaction costs increase investment abroad as do higher domestic capital tax rates. The income of a capital owner in period t is therefore:

$$I_t = a_{t-1}(r - \theta_t) + \frac{\phi(\theta_t - \theta_t^*)^2}{2}. \tag{8}$$

The first term in (8) reflects the direct benefits from lower taxation in a closed economy while the second term captures the extra benefits from financial openness, via tax competition.

Denote with k_t the stock of capital available for private investment in the home economy. Capital market clearing implies:

$$\alpha(d_t + f_t^*) = k_t + b_{t-1}, \tag{9}$$

where $d_t = a_{t-1} - f_t$ and f_t^* are the domestic and the foreign investments in the home country, respectively, and b_{t-1} is the stock of outstanding public debt. Similar allocations are found for the foreign country.

2.2 Government

In each country there is a government that uses labor and capital income taxes, τ_t and θ_t respectively, in addition to public debt to finance a constant stream of (unproductive) public spending g.[3] I assume public spending can be financed exclusively from labor

[3] While in general redistribution is also realized through public spending, the argument developed in this paper relies on efficient dynamic tax collection. As shown in appendix B.2, endogenizing spending does not alter its main conclusions.

taxation so $g \leqslant w = 1$. Governments can credibly commit to repay public debt. Source based taxation implies the domestic tax rate θ_t applies to both private and public claims located in a country, irrespective of the nationality of the owner. When $\phi = 0$ capital is immobile and taxation becomes residence based.

Moreover, taxing capital entails a monetary cost that can be thought of as expenditures with the tax administration or as a deadweight loss due to tax evasion:

$$D(\theta) = \gamma \frac{\theta^2}{2}, \ \gamma > 0. \tag{10}$$

The cost is directly proportional with the capital income tax. A higher γ implies the technology used to collect capital income taxes is less efficient.

At $t = 1$, the government starts with $b_0 = 0$ but can run an unbalanced budget. In the case of deficit ($b_1 > 0$), the government has to match the expected rate of return on private capital in the second period in order to raise funds.[4] All public debt is issued to domestic investors hence it does not generate any transaction costs.

At $t = 2$, any outstanding debt is repaid and the budget is balanced so $b_2 = 0$. The government budget constraints (GBC) read:

$$g = \tau_1 + \theta_1 \alpha(d_1 + f_1^*) + b_1 - D(\theta_1) \tag{11}$$

$$g = \tau_2 + \theta_2 \alpha(d_2 + f_2^*) - b_1 r - D(\theta_2). \tag{12}$$

With g fixed, the constraints define τ_1 and τ_2 as functions of the other domestic policies θ_1, θ_2 and b_1. Using (7), the tax base $\alpha(d_t + f_t^*)$ can be rewritten as $\alpha(a_{t-1} - 2\phi(\theta_t - \theta_t^*))$.

Capital owners anticipate domestic and foreign tax rates θ_t, θ_t^* and decide on d_t and f_t for $t = 1, 2$. Governments then choose tax rates $\theta_t, \tau_t, \ t = 1, 2$ and decide how much public debt is needed to finance first period public spending. Agents invest their savings at the beginning of the second period. Governments collect taxes, finance public spending

[4] In appendix B.2 I also allow for public debt adjustment costs.

and repay public debt. Notice that with perfect foresight, private and public choices can be made in period one. Moreover, I assume governments know private policy rules on investment and saving but take fiscal policies abroad as given.

2.3 Political Economy Equilibrium

I now analyze the role of public debt under dynamic tax competition. Fiscal policies are set independently in each country by majority voting at $t = 1$. Thus, implemented policies maximize the lifetime utility of the median voter. Since $\alpha < 1$, the median voter is a worker.

Majority voting on fiscal policies implies that only the welfare of the workers is taken into account. However, the assumption is not very restrictive since both international capital mobility and the domestic deadweight losses associated with capital taxation prevent confiscatory tax rates on capital income. The latter friction can also be interpreted as an inefficiency induced by the lobbying activities of capital owners.

As capital can be invested abroad and only source taxation can be implemented, the domestic tax base depends on the tax rates abroad giving rise to a tax externality and thus to strategic setting of fiscal policies. From the GBC (11) and (12) it is clear that domestic workers' welfare depends, through (7), on both domestic and foreign fiscal policies.

Specifically, governments maximize the lifetime utility of the domestic median voter $V^L = \ln c_1^L + \beta \ln c_2^L$ taking as given foreign policies. In the case of the home country the policies preferred by the median voter are given by:

$$\max_{\underline{\omega} \in \Omega} V^L(\underline{\omega} | a_0, \omega^*) \text{ s.t. (11) and (12)}, \tag{13}$$

where $\underline{\omega} = \{\tau_1, \theta_1, \tau_2, \theta_2, b_1\}$ in the set of feasible allocations Ω. The foreign government solves an analogous problem.

I focus on the case of symmetric Cournot-Nash equilibria.

Definition 1. *A political economy equilibrium with international capital mobility consists of a sequence of private choices on consumption, saving and country specific investment allocations* $\{c_t^L, c_2^K, d_t, f_t\}$ *and* $\{c_t^{L*}, c_2^{K*}, d_t^*, f_t^*\}$*, and a sequence of public policies* $\{\omega, \omega^*\} \in \Omega$ *for* $t = 1, 2$ *such that, in both the home and the foreign country:*

i) workers consume c_t^L*, capital owners choose* d_t, f_t *optimally, taking current and future policies as given;*

ii) capital markets clear;

iii) governments solve (13). In the home country, equilibrium policies are given by:

$$\omega = \{\overline{\omega} \in \Omega | V^L(\overline{\omega}|a_0, \overline{\omega}^*) \geqslant V^L(\underline{\omega}|a_0, \overline{\omega}^*), \forall \underline{\omega} \in \Omega\}. \tag{14}$$

Using the (11), (12) and (7) into 13 yields:

$$\max_{\theta_1, \theta_2, b_1} \ln\left[1 - \left(g - \theta_1\alpha(1 - 2\phi(\theta_1 - \theta_1^*)) - b_1 + \gamma\frac{\theta_1^2}{2}\right)\right] +$$
$$\beta \ln\left[1 - \left(g - \theta_2\alpha(a_1 - 2\phi(\theta_t - \theta_t^*)) + b_1 r + \gamma\frac{\theta_2^2}{2}\right)\right]$$

where $a_1 = (r - \theta_1) + \phi(\theta_1 - \theta_1^*)^2/2$.

To further ease exposition, in the following I assume a storage technology and set $r = 1$. In appendix B.1 I solve the model for different levels of the interest rate.

3 Equilibrium analysis

Solving for the strategic policies defined by (14) yields the following symmetric allocations:

$$\tau_1 = \frac{2g-1+\beta}{1+\beta} - \frac{\alpha^2(\alpha+\gamma+4\alpha\phi)}{(1+\beta)(\alpha+\gamma+2\alpha\phi)^2}, \tag{15}$$

$$\tau_2 = \frac{2\beta g-1+\beta}{1+\beta} - \frac{\alpha^2\beta(\alpha+\gamma+4\alpha\phi)}{(1+\beta)(\alpha+\gamma+2\alpha\phi)^2}, \tag{16}$$

$$\theta_1 = \theta_2 = \frac{\alpha}{\alpha+\gamma+2\alpha\phi}, \tag{17}$$

$$b_1 = \frac{(1-g)(1-\beta)}{1+\beta} + \frac{\alpha^2(\gamma(1-\beta)-2\alpha(\beta-2\phi(1-\beta)))}{2(1+\beta)(\alpha+\gamma+2\alpha\phi)^2}. \tag{18}$$

Since the government maximizes workers' lifetime utility, their marginal utilities are equalized across time.[5] Thus, even if workers could save, they would choose not to.

Tax rates are equal across countries and therefore in a symmetric equilibrium there is no reason to incur the transaction costs associated with foreign investment. However, while $f_t = 0$, equilibrium fiscal policies are affected by the possibility of capital flight. Moreover, revenues from capital taxation in a given period are only affected by financial openness through the tax rate.

To better understand the role of capital mobility, it is instructive to first compute policies in the two limiting cases: autarky (superscripted 0 for $\phi = 0$) and perfect capital mobility (superscripted ∞ for $\phi \to \infty$). On the one hand $\theta_t^0 = \alpha/(\alpha+\gamma)$ indicates that the domestic friction γ is the only feature preventing confiscatory taxation of capital. In this case $b_1^0 = (1-g)(1-\beta)/(1+\beta) + \alpha^2(\gamma(1-\beta)-2\alpha\beta)/(2(1+\beta)(\alpha+\gamma)^2)$, which is positive for γ large enough. On the other hand $\theta_t^\infty = 0$ as perfect mobility precludes collecting any capital tax revenues. First period public spending is funded with labor taxes $\tau_1^\infty = (2g-1+\beta)/(1+\beta)$ and debt $b_1^\infty = (1-g)(1-\beta)/(1+\beta)$ while second period labor

[5] $U_c(c_1^L) = -(1-\tau_1)^{-1}, U_c(c_2^L) = -\beta(1-\tau_2)^{-1}$. Evaluating the first order conditions for τ_1 and τ_2 at the equilibrium values given by (15) and (16) yields $U_c(c_1^L) = U_c(c_2^L) = (1+\beta)(\alpha+\gamma+2\alpha\phi)^2/x$ where $x = 8(1-g)\alpha^2\phi^2 + (\alpha+\gamma+4\alpha\phi)\left(2(1-g)(\alpha+\gamma)+\alpha^2\right)$.

taxes are used to repay debt and fund g.

In general, due to international capital mobility that increases with ϕ, a higher capital income tax rate depresses the tax base. Moreover, capital taxation is costly even in the absence of tax competition, due to domestic deadweight losses γ. Both these costs have distributional effects as lower capital income taxes need to be compensated by higher labor taxation. Thus capital taxes decrease with both ϕ and γ, while labor taxes are increasing in these frictions. A higher capital supply α increases capital taxation and reduces labor taxation.

The role of public debt in this model is easily understood. The two types of frictions faced by governments, summarized by γ and ϕ, are static in nature. Given a constant capital stock across periods, a permanent increase in ϕ would lower current and future capital tax revenues equally so there would be no scope for additional intertemporal consumption smoothing through debt. Capital accumulation increases the second period tax base in all countries. Capital tax revenues are thus relatively less tax elastic at $t = 2$.[6] The difference in revenue elasticity can in turn be used by raising public debt to alleviate the tax burden on labor and therefore to increase workers' welfare in both periods.

In sum, while the ability of the median voter to redistribute period by period through taxation is inherently limited by capital mobility, tax competition has dynamic effects that create a role for intertemporal redistribution through public debt. In the next section I consider the effects of higher capital mobility on the equilibrium fiscal policies.

3.1 The effects of capital mobility on fiscal policies

The cost of cross border capital investments decreases with ϕ. Consider the case of a permanent increase in ϕ at $t = 1$.

Proposition 1. *Higher international capital mobility generates i) higher labor taxation*

[6] Define the elasticity of the capital tax revenue w.r.t. the tax rate θ_t as: $\varepsilon_{\theta t} = \frac{\partial\left[\alpha\theta_t(a_{t-1}-2\phi(\theta_t-\theta_t^*))\right]}{\partial\theta_t}\frac{\theta_t}{\alpha\theta_t(a_{t-1}-2\phi(\theta_t-\theta_t^*))}$. It is straightforward to show that $\varepsilon_{\theta 1} = \frac{\alpha+\gamma}{\alpha+\gamma+2\alpha\phi} > \frac{\gamma}{\gamma+2\alpha\phi} = \varepsilon_{\theta 2}$.

($\partial\tau_t/\partial\phi > 0$) and ii) lower capital taxation ($\partial\theta_t/\partial\phi < 0$).

Proof. $\forall\alpha,\gamma,\phi \geqslant 0$, $\partial\tau_t/\partial\phi = \frac{8\alpha^4\phi\beta^{t-1}}{(1+\beta)(\alpha+\gamma+2\alpha\phi)^3} > 0$ and $\partial\theta_t/\partial\phi = -\frac{2\alpha^2}{(\alpha+\gamma+2\alpha\phi)^2} < 0$. □

Results in i) and ii) are well-known static effects of tax competition: the more mobile capital is, the lower the capital tax and the higher the labor tax. I turn now to the effects on public debt.

Proposition 2. *Higher international capital mobility generates higher public budget deficits ($\partial b_1/\partial\phi > 0$) when capital mobility ϕ increases from low levels. Otherwise, an increase in ϕ lowers the deficit.*

Proof. First, $\partial b_1/\partial\phi = \frac{2\alpha^3(1+\beta-2(1-\beta)\phi)}{(1+\beta)(\alpha+\gamma+2\alpha\phi)^3}$; Setting the numerator to zero yields $\widehat{\phi} = (1+\beta)/(2-2\beta)$. □

The result in Proposition 2 highlights the response of public debt under dynamic fiscal competition. Starting at low levels of ϕ, a marginal increase in capital mobility increases the public budget deficit. After a given threshold $\widehat{\phi}$, further capital mobility is associated with lower public budget deficits. The value of $\widehat{\phi}$ depends on the discount rate of the workers: the more patient they are, the more willing to accept higher labor taxes today ($\partial\tau_1/\partial\beta > 0$) and thus to foster capital accumulation in exchange for intertemporal redistribution through debt and lower taxation in the second period ($\partial\tau_2/\partial\beta < 0$). Interestingly, since $\partial\widehat{\phi}/\partial\beta > 0$, more patient workers imply public budget deficits obtain until higher levels of capital mobility.

The non-monotonic behavior of public debt with respect to capital mobility reflects the changing trade-offs induced by tax competition on both intertemporal and intraperiod redistribution.

At low mobility levels, capital taxation is more elastic with respect to financial openness: $|(\partial\theta_t/\partial\phi)(\phi/\theta_t)| = 2\alpha\phi/(\gamma+2\alpha\phi)$ is increasing in ϕ. Thus higher capital mobility implies large reductions in the equilibrium tax rates in both periods. Relative to these revenue

losses, the increase in the second period tax base through capital accumulation is larger and therefore generates more intertemporal redistribution through public debt.

At high levels of capital mobility, capital tax rates are already low and less elastic with respect to ϕ. As capital accumulation becomes less important, intertemporal redistribution through public debt becomes less effective. The stock of public debt decreases with ϕ. Asymptotically, $\theta_t^{\infty} = 0$, $t = 1, 2$, public spending is funded exclusively with labor taxes and public debt becomes a constant.

Given the result above relies on a few simplifying assumptions, I discuss below some generalizations and robustness checks.

Governments have a direct incentive to stimulate private saving by lowering the capital tax rate in period one. While this also affects the equilibrium level of public debt, it does not drive qualitatively the response of debt to financial openness, as shown in appendix B.1 where I derive equilibrium policies assuming saving is predetermined.

Factor prices have been assumed constant. This simplification allows to separate the effect of tax competition from pecuniary externalities that arise via the interest rate in open economy models of public deficits (e.g. Chang (1990)). Standard production functions, such as Cobb-Douglas, feature complementarity between capital and labor. Thus an increase in the stock of physical capital would typically increase wages and thus the labor tax base. Including this effect would only strengthen the main results as the labor tax base would also increase following higher capital mobility. In appendix B.2 I describe a more general setup where capital and labor are complements and the wage is endogenous. This model also allows capital owners to consume in each period and save optimally. Moreover, given financing costs are likely to increase with the stock of debt, I also introduce adjustment costs in public debt. Finally, I allow for preferences over public spending and endogenize its level. Numerical simulations show the deficit bias carries through in all these generalizations.

While the paper focuses on the effects of changing ϕ at given levels of γ, higher capital

mobility is likely to make tax evasion easier. Since ϕ and γ enter additively in the equilibrium policies (15)-(18), it is easy to see that making γ an increasing function of ϕ only reinforces the role of openness, preserving qualitatively the results derived so far.

Finally, the deficit bias arises under the assumption of a permanent increase in capital mobility at $t = 1$. If foreign investment becomes even less costly in the second period, i.e. $\phi_2 > \phi_1$, this produces additional income gains for capital owners which, in general, are not completely offset by lower saving and thus increase redistribution through public debt. Moreover, in this case a deficit would arise even in the absence of capital accumulation. Since the higher the capital mobility, the lower the equilibrium capital tax rates, capital owners get richer in later periods and governments can smooth the tax distortions on labor by increasing public debt.

4 Multiple countries

In this section, I extend model to the case of n symmetric countries. While higher capital mobility due to financial innovation or deregulation can be thought of as an intensive margin for fiscal competition, a change in the number of countries that belong to the integrated capital market can be considered as an extensive margin of capital mobility. Also, notice that increasing n implies each country becomes smaller relative to the rest of the economy. Thus the analysis casts some light on the role of country size in this framework.

Denote with f_t^i the investment of a domestic agent in country i. Assuming country specific transaction costs $T(f_t^i)$, the income of a domestic capital owner becomes:

$$I_t = d_t(r - \theta_t) + \sum_{i=1}^{n-1} \left(f_t^i(r - \theta_t^i) - T(f_t^i) \right), \tag{19}$$

where $d_t + \sum_{i=1}^{n-1} f_t^i = a_{t-1}$, $f_t^i \geqslant 0$ for $t = 1, 2$ and $i = \{1, 2, ..., n-1\}$.

Assuming symmetric foreign countries i.e. $\theta_t^i = \theta_t^*$ yields f_t^i allocations identical to those in the two country case. Equation (19) becomes:

$$I_t = a_{t-1}(r - \theta_t) + (n-1)\frac{\phi(\theta_t - \theta_t^*)^2}{2}.$$

The government budget constraints become:

$$g = \tau_1 + \theta_1\alpha(d_1 + (n-1)f_1^*) + b_1 - D(\theta_1) \quad (20)$$

$$g = \tau_2 + \theta_2\alpha(d_2 + (n-1)f_2^*) - b_1 r - D(\theta_2). \quad (21)$$

In a symmetric equilibrium, the corresponding policies are:

$$\tau_1 = \frac{2g - 1 + \beta}{1+\beta} - \frac{\alpha^2(\alpha + \gamma + 2n\alpha\phi)}{(1+\beta)(\alpha+\gamma+n\alpha\phi)^2}, \quad (22)$$

$$\tau_2 = \frac{2\beta g - 1 + \beta}{1+\beta} - \frac{\alpha^2\beta(\alpha + \gamma + 2n\alpha\phi)}{(1+\beta)(\alpha+\gamma+n\alpha\phi)^2}, \quad (23)$$

$$\theta_1 = \theta_2 = \frac{\alpha}{\alpha+\gamma+n\alpha\phi}, \quad (24)$$

$$b_1 = \frac{(1-g)(1-\beta)}{1+\beta} + \frac{\alpha^2(\gamma(1-\beta) - 2\alpha(\beta - n\phi(1-\beta)))}{2(1+\beta)(\alpha+\gamma+n\alpha\phi)^2}. \quad (25)$$

Inspection of (22)-(25) reveals that in this framework the market size n and the degree of financial openness ϕ play similar roles with respect to the fiscal policy choices. Thus, holding capital mobility constant, fiscal deficits first increase and then decrease in the number of countries joining the integrated capital market.

Consider the capital mobility threshold $\widehat{\phi}$, derived in Proposition 2, below which public debt increases with financial openness. In the case of n countries, it becomes $\widehat{\phi}(n) = (1+\beta)/(n(1-\beta))$. In general $\partial\widehat{\phi}(n)/\partial n < 0$. This implies the deficit moderating role of financial openness kicks in at lower levels when more countries compete for capital. However, if higher capital mobility (an increase in ϕ) can only be achieved within a smaller club of countries (a decrease in n), e.g. the Euro-zone countries within the European Union,

public budget deficits increase further with ϕ.

While the net effect on the level of public debt depends on the relative magnitudes of the intensive and respectively, the extensive margins of market integration, the multi-country model points towards a possible correlation between the process of financial integration and the persistence of public budget deficits.

5 Cross country differences in capital mobility

In a symmetric equilibrium, the tax rates are equal and therefore there is no reason to incur the transaction costs associated with foreign investment. Allowing for heterogeneous countries would give rise to non-degenerate foreign investment allocations and thus would shed light on the effects of tax competition on both public budget deficits and equilibrium international capital flows.

In the following, I extend the benchmark model to allow for differences in capital mobility across countries. I assume that foreign investment earns a premium z relative to domestic returns r. This is the case if foreign investment takes place through firms that are more efficient, larger or less financially constrained than domestic firms. The theoretical literature on international trade with heterogenous firms (see for example Melitz and Ottaviano (2008)) shows how selection effects generate such productivity wedges, which are also amply documented in the empirical literature on multinationals (e.g. Haskel et al. (2007)). I introduce this feature as a simple way to generate gains from trade and thus to ensure positive bilateral foreign investment flows even in the case of symmetric countries.

Given the initial investment cost (2), the income of a domestic capital owner becomes:

$$I_t = d_t(r - \theta_t) + f_t(r - \theta_t^* + z) - \frac{f_t^2}{2\phi}, \tag{26}$$

Solving the static problem of the capital owner each period yields

$$f_t = \max\{\phi(z + \theta_t - \theta_t^*), 0\}. \tag{27}$$

When gains from foreign investment are large, capital outflows are positive even when domestic capital taxation is relatively low. At an interior solution, after substituting (27) in (26), the income of capital owners becomes:

$$I_t = a_{t-1}(r - \theta_t) + \frac{\phi(z + \theta_t - \theta_t^*)^2}{2}. \tag{28}$$

As before, the first term in (28) represents the direct gains due to lower domestic taxation while the second term contains the extra gains brought by financial openness, related to market (z) or fiscal policies ($\theta_t - \theta_t^*$).

Finally, assume capital owners' preferences are such that they save $a_{t-1}(r - \theta_t)$ and consume the rest. The assumption that savings react only to the direct effect of taxation greatly simplifies the dynamic analysis without loss of generality. The size of the public spending acts only as a shifter for public debt, thus being irrelevant in the comparative statics with respect to other variables. In the following, to make analysis more transparent, I set $g = 1$.

I now use the modified framework to study equilibrium fiscal policies when countries differ in the level of capital mobility. Recall that for domestic capital owners, foreign investment involves a cost inversely proportional to ϕ. Everything else equal, in the following, I assume foreign investment is less costly for capital owners in the home country than for those in the foreign country.

Assumption 1. *Capital outflows from the home country are less costly:* $\phi > \phi^*$.

Solving the model under this assumption yields the following policies:

$$\theta_1 = \theta_2 = \frac{\alpha}{\alpha+\gamma+\alpha(\phi+\phi^*)} - \frac{z\alpha\,(\phi-\phi^*)}{\alpha+\gamma+3\alpha(\phi+\phi^*)}, \tag{29}$$

$$\theta_1^* = \theta_2^* = \frac{\alpha}{\alpha+\gamma+\alpha(\phi+\phi^*)} + \frac{z\alpha\,(\phi-\phi^*)}{\alpha+\gamma+3\alpha(\phi+\phi^*)}, \tag{30}$$

$$b_1 = \alpha^2\Gamma^2\frac{((1-\beta)(\gamma+2\alpha(\phi+\phi^*))-2\alpha\beta)}{2(1+\beta)\Lambda^2}, \tag{31}$$

$$b_1^* = \alpha^2\Gamma^{*2}\frac{((1-\beta)(\gamma+2\alpha(\phi+\phi^*))-2\alpha\beta)}{2(1+\beta)\Lambda^2}. \tag{32}$$

where:

$$\begin{aligned}
\Gamma &= \gamma(1-z(\phi-\phi^*))+\alpha(1+(3-z)\phi+(3+z)\phi^*-z(\phi^2-\phi^{*2})),\\
\Gamma^* &= \gamma(1+z(\phi-\phi^*))+\alpha(1+(3-z)\phi^*+(3+z)\phi+z(\phi^2-\phi^{*2})),\\
\Lambda &= (\alpha+\gamma+3\alpha(\phi+\phi^*))(\alpha+\gamma+\alpha(\phi+\phi^*)).
\end{aligned} \tag{33}$$

Analyzing the expressions for θ_t and θ^* shows that the tax rates can be expressed as deviations from an average tax rate given by the aggregate capital mobility $\phi+\phi^*$. The deviations are proportional to the difference in capital mobility, $\phi-\phi^*$. The equilibrium tax on capital is increasing in the gains from foreign investment z. While not directly taxed, these gains reduce the elasticity of capital in both countries which in turn increases the equilibrium tax rate.

Expressions for b_1 and b_1^*, (31) and (32), show that the public budget deficits are driven both by differences in capital mobility across countries (through the terms Γ and Γ^*) but also by the world capital mobility level.

Consider the difference between the local and the foreign capital income tax:

$$\Delta\theta = \theta-\theta^* = -\frac{2z\alpha(\phi-\phi^*)}{\alpha+\gamma+3\alpha(\phi+\phi^*)}. \tag{34}$$

The following result emerges:

Proposition 3. *Lower costs of investing abroad ($\phi > \phi^*$) imply lower domestic tax rates on capital income ($\theta < \theta^*$).*

As overall capital mobility $\phi+\phi^*$ goes up, the denominator of $\Delta\theta$ increases and tax rates become more similar in the two countries. Interestingly, assuming international differences in capital mobility do not become very large, i.e. $\phi - \phi^*$ is finite, $\lim_{\phi+\phi^*\to\infty} \Delta\theta = 0$, so continued financial liberalization reduces *per se* the asymmetries in capital taxation.

The expressions for public budget deficits (31) and (32) are similar to (18) and it can be shown that Proposition 2 continues to apply in the case of heterogeneous countries. In other words, public debt first increases and then decreases with capital mobility.

Next I study how different levels of capital mobility across countries affect the equilibrium net international capital flows. For the home country, net capital outflows are:

$$F_t = f_t - f_t^* = z(\phi - \phi^*) + (\phi + \phi^*)(\theta_t - \theta_t^*). \tag{35}$$

From equation (35) it is clear that external imbalances arise if either $\phi \neq \phi^*$ or $\theta_t \neq \theta_t^*$.

Thus differential financial openness has two effects on the net capital flows: a direct effect on the volume of foreign investment landing in a particular country and an indirect effect through the endogenous differences in taxation induced by capital mobility.

Assuming identical fiscal policies, net capital outflows arise if $\phi > \phi^*$, i.e. the capital originating in the home country is more mobile. On the other hand, assuming equal mobility levels, the home country experiences net capital outflows if $\theta_t^* < \theta_t$, i.e. the foreign country has lower capital income tax rates. In the latter case, the higher the aggregate capital mobility, $\phi + \phi^*$, the higher the imbalances arising from different capital taxation.

Using the expressions for equilibrium capital tax rates (29) and (30) in (35) yields

$f_t, f_t^* > 0, \forall z > 0$. Net equilibrium outflows are:

$$F_t = F = \frac{z(\phi - \phi^*)(\gamma + \alpha(1 + \phi + \phi^*))}{\alpha + \gamma + 3\alpha(\phi + \phi^*)}. \tag{36}$$

The positive direct effect stemming from capital mobility differences dominates in equilibrium the negative effect through capital taxation. Thus, for the home country, the lower the cost of investing abroad relative to the rest of the world or the higher the aggregate capital mobility, the higher the net capital outflows.

I now turn to consider the implications for relative public debt.

$$\Delta b = b_1 - b_1^* = -\frac{2z\alpha^2(\phi - \phi^*)((1 - \beta)(\gamma + 2\alpha(\phi + \phi^*)) - 2\alpha\beta)}{(1 + \beta)\Lambda}. \tag{37}$$

Proposition 4. *Lower costs of investing abroad imply higher domestic public budget deficits at low world levels of capital mobility, i.e. when* $\phi + \phi^* < \overline{\phi} = \beta/(1 - \beta) - \gamma/(2\alpha)$.

Proof. Solving $(1-\beta)(\gamma+2\alpha(\phi+\phi^*))-2\alpha\beta = 0$ for aggregate openness level $\phi+\phi^*$ yields the result. □

As before, a deficit bias can arise because the tax elasticity of capital is lower in the second period everywhere. In contrast with the benchmark model however, with heterogenous countries, net capital flows induce different elasticities across countries and thus different incentives to use public debt.

At low world levels of capital mobility, cross country differences in ϕ are relatively more important in determining fiscal policies (see discussion after Proposition 3). Capital taxation in the home country is more elastic with respect to ϕ which leads to lower tax rates in both periods. This implies the home country experiences a relatively larger reduction in the tax elasticity of the second period capital supply and thus a larger role for public debt. Eventually, as $\phi + \phi^*$ increases, tax rates everywhere become less elastic with respect to openness while net outflows from the home country increase. As its second period tax base

becomes more eroded, there is less scope for intertemporal redistribution. In contrast, the foreign country receives higher net capital inflows. Given a relatively tax inelastic capital supply in the second period, its deficit can increase even more with aggregate openness despite the simultaneous reduction in tax rates.

To summarize, under tax competition, initial differences in barriers to foreign investment across countries generate divergent trends in public indebtedness despite inducing convergence in corporate tax rates. The deficit bias induced by tax competition is magnified in countries with relatively low costs of investing abroad, in other words, in countries who tend to be less open to foreign capital flows than the rest of the world.

6 Empirical evidence

The previous analysis provides a theory of public debt and taxation in a world where capital is internationally mobile.

One testable prediction, shared with existing literature on tax competition, is that higher capital mobility leads to more tax competition and to convergence in capital tax rates. Among recent contributions, Devereux et al. (2008) find evidence of strategic interactions in corporate tax rates among OECD countries. Crucially, they show that these co-movements are driven by the interactions between countries relatively more open to capital flows. Consistent with this, Redoano (2014) finds corporate tax rates in EU countries respond more strongly to tax rate changes in other EU countries.

The second result, new to the literature, suggests that in the early stages of financial liberalization intensified tax competition induces a bias towards public budgets deficits that is larger in countries with relatively low costs of investing abroad.

Given previous empirical work supports the hypothesis that tax competition triggered by international financial deregulation is an important driver of corporate taxation, in the following I study whether strategic interactions in corporate taxes also have a systematic

bearing on public budget deficits in a sample covering countries that were OECD members in 1980 over the period 1980-2007.

While the theoretical framework suggests a possibly non-monotonic relation between tax induced capital mobility and fiscal deficit, the sample covers the creation of the Economic and Monetary Union in Europe involving a variety of constraints on public budgets both in the participating countries and, via strategic interactions, in the other OECD members. Since these potentially confounding effects make identifying the deficit moderating role of tax competition more tentative, the empirical strategy focuses on estimating the upward sloping relation between capital mobility and fiscal deficits. Nonetheless, with these caveats in mind, in section 6.1 I provide some evidence that is consistent with a non-monotonic response of deficits to tax competition (see also table C.6 in appendix C).

To measure financial openness I use the index proposed by Chinn and Ito (2006) (henceforth *CI*). This index is based on binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Higher values of this index indicate that a country is more open to cross-border capital transactions. An alternative measure, based on the Abiad et al. (2010) (henceforth *ADT)*, is used as a robustness check. As a gauge of the incentives to invest in a particular location I use data on the statutory corporate income tax rate. Public budget deficits are proxied by the share of general government net borrowing in GDP, available from OECD Statistics. To ease interpretation, data is transformed such that positive numbers represent deficits. Demographic and other controls are sourced from the World Economic Outlook database and the Database of Political Institutions respectively. Appendix C provides further details on the data sources and definitions.

I use this data to test whether higher capital mobility leads to budget deficits via the tax competition channel, controlling for standard determinants of fiscal deficits, such as shocks in tax revenues, public spending, electoral cycle or demographic structure. How-

ever, directly estimating the effect of financial openness on public budget deficits has two drawbacks.

First, while the theoretical analysis describes equilibrium outcomes, actual tax rates and budget deficits may fail to adjust instantaneously. Second, given the CI and ADT indices do not distinguish between restrictions to inflows and outflows of capital, a positive and significant effect of openness on deficits, while consistent with the theoretical model, cannot discriminate the tax competition mechanism from alternative effects of financial openness on deficit spending. For example, as emphasized in Kose et al. (2010), easier access to foreign finance could directly imply larger deficits.

Thus, to capture the strength of the tax driven "capital flight" motive that is central to the theoretical model, in the spirit of Devereux et al. (2008), I proxy the heterogeneity in *outward* capital mobility across countries by the weighted average capital tax rate in the competing countries. For country i, the average corporate tax rate in the rest of the world (ROW) is $\overline{\theta}_{-it} = \sum_{j \neq i} y_{jt}\phi_{jt}\theta_{jt} / \sum_{j \neq i} y_{jt}\phi_{jt}$. The weights, output $y_{j,t}$ and financial openness $\phi_{j,t}$ are standard in the literature: larger, less regulated capital markets abroad reduce more the cost of domestic capital flight.

I estimate the following equation:

$$b_{it} = \beta \overline{\theta}_{-it} + \boldsymbol{\gamma}' \mathbf{G}_{it} + \boldsymbol{\delta}' \mathbf{X}_{it} + \mu_i + T_{it} + \varepsilon_{it}, \tag{38}$$

where $\overline{\theta}_{-it}$ is the ROW weighted average of the corporate tax rates, $\mathbf{G}_{it}$ and $\mathbf{X}_{it}$ are vectors of control variables described below and μ_i and T_{it} are country specific fixed effects and country specific linear time trends respectively. The theory predicts β should be negative: as tax competition lowers rates everywhere, countries facing a more mobile domestic tax base run higher deficits.

$\mathbf{G}_{it}$ is a vector of current fiscal variables directly correlated with the deficit. Note that in the model higher tax competition lowers the corporate tax rates θ_j in all periods.

Thus it is not the mechanic effect of lower current revenues that increases the deficit but the tax smoothing opportunities induced by the lower tax elasticity of capital in future periods. However, since such a link between the domestic tax rate and the deficit cannot be excluded empirically, adding the share of capital tax revenues in output as a control allows to estimate it separately. In addition to the direct effect on domestic corporate taxation, tax competition leads to adjustments in other tax rates, such as the tax rate on labor income, which in turn have effects on the deficit. To control for indirect changes in revenues, I also include in $\mathbf{G}_{it}$ the share of total tax revenues in output. The share of public consumption in GDP captures the variation in the demand for public spending. Note that in equilibrium, given b_{it}, $\mathbf{G}_{it}$ and $\overline{\theta}_{-it}$, budget constraints determine θ_{it}. Since all budget variables are determined simultaneously, to mitigate endogeneity of $\mathbf{G}_{it}$ and $\overline{\theta}_{-it}$, they are instrumented with first lags.

Following the literature, the vector $\mathbf{X}_{it}$ includes other standard control variables that proxy for the demand for public spending, included as lags. GDP controls for country size. The growth rate of output proxies for deficit adjustments driven by the business cycle. Demography related variables include the shares of urban, young and old in total population while politics related controls include a set of indicators for executive and legislative election years and the political persuasion of the government party. To control for the cost of debt service, the share of public debt in GDP is included. I include trade openness - the combined share of exports and imports in output - to control for effects not mediated by tax competition.

I also allow for direct effects of financial openness on the deficit. In the theoretical framework capital mobility measures the costs associated with foreign investment. In general, these costs are proportional to *financial openness in the rest of world* (capital inflows not restricted in other countries) but also to the *domestic financial openness* (unrestricted domestic capital outflows). While the *CI* index does not distinguish between restrictions depending on the direction of capital flows, I control both for the country's own *CI* index

and for financial openness in the rest of the world computed as the GDP weighted average in the other countries, $\overline{\phi}_{-it} = \sum_{j \neq i} y_{jt}\phi_{jt} / \sum_{j \neq i} y_{jt}$. As explained above, while positive effects of ϕ_{it} or $\overline{\phi}_{-it}$ on the deficit are consistent with the tax competition channel, they are not sufficient to exclude other explanations. Finally, fixed effects and country specific trends control for unobservables.

Table 1 shows results from panel regressions. Standard errors robust to heteroskedasticity and autocorrelation are included within parentheses.

In addition to $\overline{\theta}_{-it}$, the specification reported in the first column controls for public spending, debt, country size, political and demographic determinants. Columns (2)-(4) add progressively the average openness in the rest of the world, $\overline{\phi}_{-it}$, the share of corporate tax revenues in GDP and the share of total tax revenues in GDP. Finally, column 5 adds the domestic *CI* index. The Wald F statistic, above 20 in all specifications, suggests the model does not suffer from weak identification. The LM test based on the Kleibergen-Paap rk statistic (not reported) rejects underidentification at customary confidence levels.[7]

In all specifications lower average corporate tax rates abroad lead to higher budget deficits. The coefficients are stable in sign, order of magnitude and significance level. A drop in the average corporate tax rate by 10 percentage points, implies on average an increase of the budget deficit share in output by 2.3 to 3.6 percentage points. Given that the average deficit share in the sample is 4.94%, this is a sizeable change. Financial openness in the competing countries exerts direct pressure on budget deficits: a one standard deviation increase in this index (0.27) leads to 1.16 to 1.48 percentage points increases in the deficit.

As expected, controlling for the corporate and total tax revenues (columns 3 and 4) decreases somewhat the coefficient on $\overline{\theta}_{-it}$. Its sign and significance level however are unchanged. Higher public spending is associated with larger deficits as is a higher stock of public debt. Finally, the country's own liberalization could affect domestic budget deficits through other channels than tax competition. The specification in column 5, considering

[7] See Kleibergen and Paap (2006).

Table 1: Tax competition and budget deficits: panel IV estimates

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}_{-it}$)	-0.276***	-0.356***	-0.297***	-0.228***	-0.231***
	(0.10)	(0.10)	(0.09)	(0.08)	(0.08)
CI fin. lib. index ROW ($\overline{\phi}_{-it}$)		5.555***	4.292***	4.720***	4.697***
		(1.28)	(1.17)	(1.08)	(1.09)
Corp. tax revenues/GDP			-1.415***	-0.607***	-0.610***
			(0.18)	(0.18)	(0.18)
Total tax revenues/GDP				-0.933***	-0.933***
				(0.10)	(0.10)
CI index					0.044
					(0.17)
Public spending/GDP	2.179***	2.129***	1.742***	2.271***	2.275***
	(0.18)	(0.18)	(0.16)	(0.18)	(0.18)
Public debt/GDP	5.143***	3.664***	4.221***	8.541***	8.512***
	(0.92)	(0.98)	(0.88)	(0.99)	(1.00)
Size	-0.169	0.236	-0.101	-0.529	-0.545
	(0.68)	(0.71)	(0.61)	(0.51)	(0.52)
Output growth rate	-0.165***	-0.168***	-0.062	-0.025	-0.024
	(0.06)	(0.06)	(0.05)	(0.04)	(0.04)
Proportion urban	85.935***	78.812***	57.823***	65.897***	66.387***
	(0.15)	(0.14)	(0.11)	(0.10)	(0.10)
Proportion old	-22.996	-26.998	-79.649***	-88.566***	-89.527***
	(17.02)	(17.41)	(17.90)	(16.53)	(16.75)
Proportion young	6.227	4.364	15.860	3.798	4.334
	(9.98)	(9.75)	(9.65)	(8.28)	(8.84)
Trade openness	0.038*	0.050**	0.067***	0.049***	0.050***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
1 if party right	-0.567**	-0.353	-0.012	0.025	0.030
	(0.23)	(0.23)	(0.22)	(0.17)	(0.17)
1 if exec. elec. year	0.121	0.048	-0.082	-0.126	-0.130
	(0.42)	(0.44)	(0.46)	(0.30)	(0.30)
1 if if leg. elec. year	-0.094	-0.110	0.030	0.093	0.092
	(0.19)	(0.18)	(0.17)	(0.15)	(0.15)
Observations	449	449	441	441	441
R-squared	0.46	0.48	0.59	0.69	0.69
K-P Wald F	232.15	211.37	138.50	23.42	21.84

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. For country i capital taxation in the rest of the world $\overline{\theta}_{-it}$ is the average statutory corporate tax rate in the other countries, weighted by GDP and the normalized financial openness index based on Chinn and Ito (2006) (CI index). $\overline{\theta}_{-it}$, corporate tax revenues, total tax revenues and public consumption shares in GDP are instrumented with lags. The following (lagged) variables are included as controls: the growth rate of real output, the public debt share in GDP, the domestic CI index, the CI index ROW (GDP weighted averages for the other countries). Country size is proxied by GDP. Proportion old (young) is the share of population over 65 (under 15). Exec. (leg.) elec. year takes value 1 if there was an executive (legislative) election in that year and 0 otherwise. Party right takes value 1 if the government party is defined as conservative. Trade openness is the sum of exports and imports as share of GDP. For data sources and definitions see the appendix C. Regressions include country specific fixed effects and country specific time trends. Heteroskedasticity and autocorrelation robust standard errors within parantheses. The Kleibergen-Paap Wald F statistic is reported. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

this possibility, shows a positive but statistically insignificant coefficient.

Once tax revenues are included, higher output growth rates are no longer good predictors of fiscal consolidations. Deficits increase with urbanization and decrease with the old age dependency ratio. Trade openness tends to increase deficits while political variables are imprecisely estimated.

6.1 Robustness analysis

In order to check the robustness of the results to alternative definitions of financial openness, I reestimate (38) using the ADT index based on Abiad et al. (2010). Coefficients are reported in appendix, table C.2. The effect of average capital taxation in the rest of the world remains negative and significant across specifications.

I also include a quadratic time trend in order to capture more flexibly common unobservable factors. A detrended measure of GDP, obtained by applying the Hodrick-Prescott filter with a smoothing factor of 6.25 was also added to further control for business cycle effects. Table C.3 displays results across specifications and alternative definitions for financial openness.

Since excluding the lagged deficit could bias the coefficients, I also report results from dynamic panel regressions. To mitigate simultaneity issues, regressors, including $\overline{\theta}_{-i,t}^{CI,ADT}$, are lagged. Coefficient estimates are corrected for the bias induced by the autoregressive term in the presence of fixed effects following the procedure developed by Bruno (2004). As shown in table C.4, the coefficient of the average corporate tax abroad remains negative and significant in all specifications.[8]

I also test the robustness of the instrumental variable strategy with respect to the main variable of interest, the average corporate tax rate. While the tax competition literature[9] has often resorted to first time lags to address endogeneity issues, this approach may be

[8] To mitigate simultaneity issues in the determination of tax policies, the lag of $\overline{\theta}_{-i,t}^{CI,ADT}$ is used. Including the contemporaneous levels yields similar results.

[9] See Brueckner (2003) for an overview.

less appropriate when studying a dynamic link between tax competition and public budget deficits. In addition to the dynamic panel exercise described above and which partially alleviates this concern, I investigate alternative strategies.

First, following Chirinko and Wilson (2007) I construct a set of instruments $\overline{\mathbf{X}}_{-it}$ based on spatial lags of contemporaneous control variables that proxy demographic characteristics or voter preferences on fiscal policy. To compute $\overline{\mathbf{X}}_{-it}$ I apply the same weighting procedure used to create $\overline{\theta}_{-it}$. In line with previous literature, I restrict the set of variables to avoid the bias arising from using a large number of instruments in small samples. The IV estimates shown in table C.5 are based on the spatial lags of the dependency ratio, computed as the proportion of young plus the proportion of old in total population and the political persuasion of the government party. Regressions include, in addition to the benchmark specifications, the quadratic trend and the detrended component of GDP. Coefficients on $\overline{\theta}_{-it}$ remain negative and statistically significant throughout. Using (time) lagged values of $\overline{\mathbf{X}}_{-it}$ or including executive and legislative election year data among instruments provides similar results.[10]

Second, I reestimate the dynamic panel regressions using the second lag of the average ROW tax rate. Results, displayed in table C.4 are consistent with those from the benchmark specifications. Additionally including second lags of public spending and tax revenue shares yields similar results.

Finally, in line with the theoretical predictions, I also explore the possibility of a reversal in the effects of financial openness on public budget deficits by adding to the baseline specification an interaction term between the average tax rate $\overline{\theta}_{-it}$ and a linear time trend. As shown in table C.6, the interaction term is positive and significant while the average tax rate remains negative. This is consistent with a non-monotonic effect of tax competition induced by financial liberalization. Results are robust to including additional controls such as a quadratic trend and an additional measure of income shocks. Interestingly, the sign

[10] Not shown for space reasons.

switch, arising between 1993 and 1999 depending on the exact specification, overlaps with the launch of the common currency. In fact, the advent of the Economic and Monetary Union in Europe also led to a number of new fiscal policy constraints while also boosting capital mobility. Splitting the sample to allow for a structural break in 1999, the actual start of the monetary union, yields $\overline{\theta}_{-it}$ coefficients (not reported for space considerations) that remain negative and significant in the early samples and are imprecisely estimated later on.

Summing up, the empirical results are consistent across specifications with those derived from the theoretical framework. Together, they seem to support the conclusion that international tax competition brought by the financial deregulation of the last three decades has indeed contributed to systematically higher public budget deficits in developed countries.

7 Conclusion

The paper explains how international capital mobility can generate a worldwide increase in public indebtedness. Focusing on the dynamic effects of tax competition, the theory rationalizes the joint evolution of corporate taxation and public debt in the industrialized countries during the last 30 years.

The main contributions can be summarized as follows. First, complementary to the literature focusing on the role of uncertainty in open economies, I show that public debt can increase even in a deterministic, perfect foresight world when higher capital mobility escalates both current and future tax competition. A bias toward fiscal deficits, driven by the median voter's preference for redistribution, arises during the initial stages of financial openness. Further reduction of barriers to capital mobility eventually moderates the role of public debt in redistribution. Second, for a given level of capital mobility, public debt can also go up if more countries participate in world capital markets. Interestingly, if higher capital mobility can only be achieved among a smaller club of countries, the fiscal deficit

bias persists at higher levels of openness. Third, international asymmetries in capital mobility imply different incentives to redistribute via taxation vs. public debt. In particular, the bias towards fiscal deficits is worsened in countries that experience relatively low costs of investing abroad. These conclusions are backed by an empirical analysis looking at panel data from OECD countries.

Although results have been derived in a stylized model, the fiscal deficit bias induced by tax competition remains present in a variety of extensions and robustness checks. While this paper has made some progress in understanding the trade-offs induced by tax competition in an intertemporal setting further exploring the implications of capital mobility for redistribution and the dynamics of capital accumulation in richer environments would be of considerable interest. Finally, this paper has focused on a political economy equilibrium. Studying optimal policies in this context is another interesting avenue left for future research.

A Derivation of equilibrium policies

Benchmark model. From (7) it is clear that the equilibrium portfolio allocations d_1, d_2, f_1^* and f_2^* are functions of both domestic and foreign tax and public debt policies. Using these expressions in the government budget constraints (11) and (12) to solve for τ_1 and τ_2 and substituting the resulting expressions in the welfare function (1) yields the government objective function $V^L(\omega, \omega^*)$ where now $\omega = \{\theta_1, \theta_2, b_1\}$. Taking the first order conditions, which are also sufficient, and imposing symmetry yields, for the home country:

$$\theta_1 \quad : \quad \frac{\alpha\beta\theta_2}{2\alpha b_1 + \theta_2(\gamma\theta_2 - 2\alpha(1-\theta_1))} = \frac{\gamma\theta_1 - \alpha(1-2\phi\theta_1)}{2\alpha b_1 + \theta_1(2\alpha - \gamma\theta_1)}; \tag{A.1}$$

$$\theta_2 \quad : \quad \gamma\theta_2 = \alpha(1-\theta_1-2\phi\theta_2); \tag{A.2}$$

$$b_1 \quad : \quad \frac{\beta}{2\alpha b_1 + \theta_2(\gamma\theta_2 - 2\alpha(1-\theta_1))} = \frac{-1}{2\alpha b_1 + \theta_1(2\alpha - \gamma\theta_1)}. \tag{A.3}$$

Solving (A.1)-(A.3) yields the policy rules (15)-(18).

Heterogeneous regions model. For the home country, the first order conditions are:

$$\begin{aligned}
\theta_1 \quad : \quad & \frac{\alpha\beta\theta_2}{2\alpha b_1 + \theta_2(\gamma\theta_2 + 2\alpha\left(-1+\theta_1+z(\phi-\phi^*)+(\theta_2-\theta_2^*)(\phi+\phi^*)\right))} && \text{(A.4)}\\
= \quad & \frac{2\left(\gamma\theta_1+\alpha\left(-1+z(\phi-\phi^*)+(2\theta_1-\theta_1^*)(\phi+\phi^*)\right)\right)}{2\alpha b_1 - \theta_1(\gamma\theta_1 + 2\alpha\left(-1+z(\phi-\phi^*)+(\theta_1-\theta_1^*)(\phi+\phi^*)\right))} \\
\theta_2 \quad : \quad & \gamma\theta_2+\alpha\left(-1+\theta_1+z(\phi-\phi^*)+(2\theta_2-\theta_2^*)(\phi+\phi^*)\right)=0 && \text{(A.5)}\\
b_1 \quad : \quad & \frac{2\beta}{2\alpha b_1 + \theta_2(\gamma\theta_2 + 2\alpha\left(-1+\theta_1+z(\phi-\phi^*)+(\theta_2-\theta_2^*)(\phi+\phi^*)\right))} && \text{(A.6)}\\
= \quad & \frac{1}{-\gamma\theta_1^2/2+\alpha(b_1+\theta_1-\theta_1\phi(z+\theta_1-\theta_1^*)+\theta_1\phi^*(z-\theta_1+\theta_1^*))}.
\end{aligned}$$

Analogous expressions obtain for the foreign country. Using these together with (A.4)-(A.6) yields the equilibrium policies (29)-(32).

B Robustness analysis and extensions

B.1 Robustness analysis

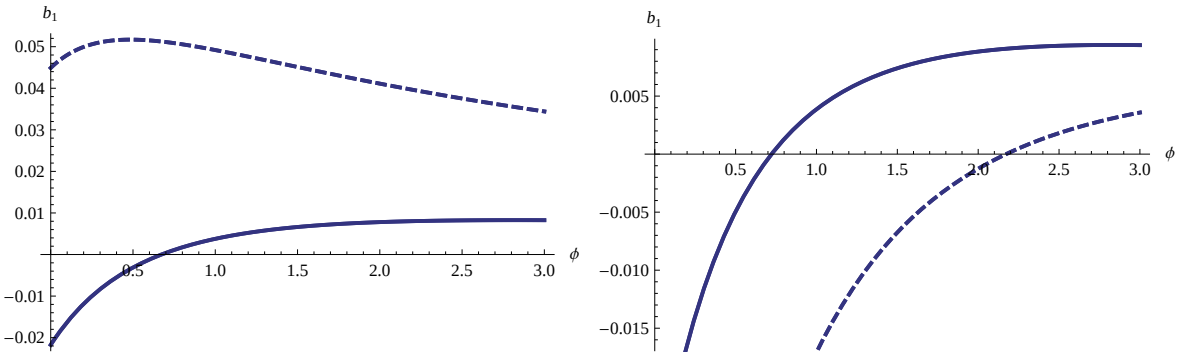
Different interest rate level. Panel (a) of figure B.1 shows the public budget balance for different interest rate levels.

Government takes private saving as given. In the benchmark model, the government has an incentive to set lower taxes in the first period in order to increase savings. To show that the qualitative response of public debt to financial openness is not driven by this channel, I derive equilibrium policies when the government takes s_1 as given:

$$\begin{aligned}
\overline{\theta}_1 &= \frac{\alpha}{\gamma+2\alpha\phi}, && \text{(B.1)}\\
\overline{\theta}_2 &= \frac{\alpha}{\gamma+2\alpha\phi} - \left(\frac{\alpha}{\gamma+2\alpha\phi}\right)^2 && \text{(B.2)}\\
\overline{b}_1 &= \frac{\alpha\left(\gamma+4\alpha\phi\right)\left(\left(1-\frac{\alpha}{\gamma+2\alpha\phi}\right)^2-\beta\right)}{2(1+\beta)(\gamma+2\alpha\phi)^2}. && \text{(B.3)}
\end{aligned}$$

As expected, comparing (17)-(18) to (B.1)-(B.3) shows that $\overline{\theta}_1 > \theta_1$, i.e. first period capital taxes are higher when private saving is taken parametrically. In turn, $\frac{\alpha}{\gamma+2\alpha\phi} - \left(\frac{\alpha}{\gamma+2\alpha\phi}\right)^2 < \frac{\alpha}{a+\gamma+2\alpha\phi} \Leftrightarrow \alpha\left(\frac{1}{\gamma+2\alpha\phi} - \frac{1}{a+\gamma+2\alpha\phi}\right) < \left(\frac{\alpha}{\gamma+2\alpha\phi}\right)^2 \Leftrightarrow \frac{\alpha^2}{(a+\gamma+2\alpha\phi)(\gamma+2\alpha\phi)} < \left(\frac{\alpha}{\gamma+2\alpha\phi}\right)^2$ so $\overline{\theta}_2 < \theta_2$ as savings are lower under the alternative assumption and thus more tax elastic. As revenues are collected earlier than in the benchmark case, public debt is strictly lower (see panel (b) of figure B.1). Nonetheless, it is easy to check that it varies non-monotonically with ϕ.

Figure B.1: Public budget deficit b_1 as a function of capital mobility ϕ (benchmark model)



(a) Different interest rates

(b) Parametrical private saving

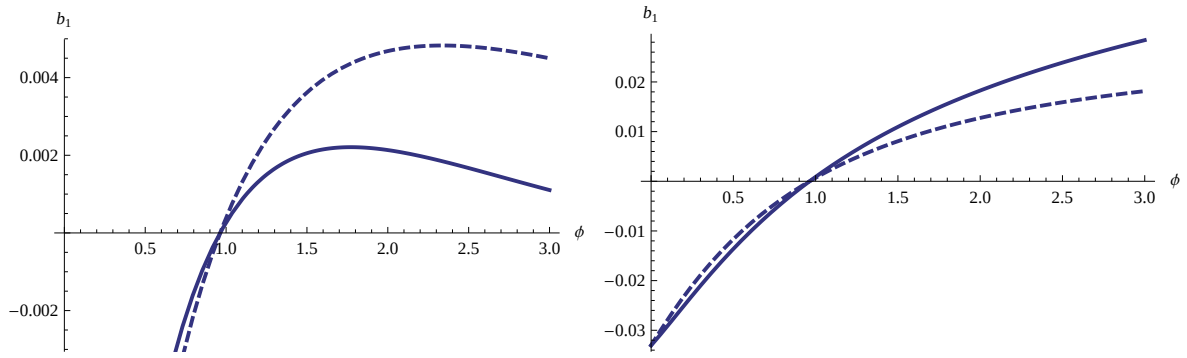
Panel (a) shows the effects of changing the interest rate q from 1 (solid) to 1.5 (dashed). Panel (b) shows the case when governments take private saving as a parameter (dashed) relative to the benchmark (solid). $\gamma = 1.6$, $\alpha = 0.9$, $\beta = 0.7$.

Different foreign investment premia (heterogeneous country model). Panels (a) and (b) in figure B.2 display the deficits in the home and foreign country respectively, for $z = 1$ and $z = 0.5$.

B.2 Extended model

In the following I extend the benchmark model in four directions. First I, consider the case of Cobb-Douglas technology that allows for complementarity between labor and capital and thus links the wage to the stock of capital. Second, I allow capital owners to consume in each period and save optimally. Third, I introduce a convex adjustment cost

Figure B.2: Public budget deficit b_1 as a function of capital mobility ϕ (heterogeneous countries)



(a) Home (b) Foreign

Panel (a) shows the effects of changing the premium on foreign investment from z=1 (solid line) to z=0.5 (dashed line) in the home country. Panel (b) displays the effects in the foreign country. $\phi* = \phi/2$, $\gamma = 1.6$, $\alpha = 0.9$, $\beta = 0.7$.

in public debt. Fourth, I endogenize public spending assuming it is valued by workers.

i) Technology. Output is produced by competitive firms using a constant returns to scale technology: $Y_t = A_t K_t^{\rho} L_t^{1-\rho}$, where A_t is the productivity parameter, K_t and L_t are the aggregate stocks of capital and labor respectively and $0 < \rho < 1$. Competitivr factor markets imply: $w_t = (1-\rho)A_t \left(K_t/L_t\right)^{\rho}$ and $r_t = \rho A_t \left(K_t/L_t\right)^{-\rho}$. Productivity is assumed to be proportional to aggregate capital per worker: $A_t = \overline{A}\left(K_t/L_t\right)^{1-\rho}$. This technological externality à la Romer (1986) leads to factor prices: $w_t = (1-\rho)\overline{A}K_t$ and $r_t = \rho\overline{A}$.

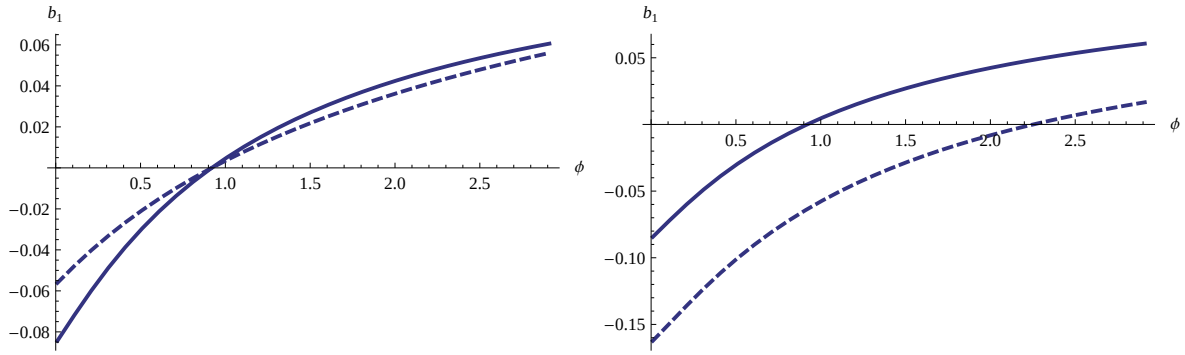
ii) Preferences of capital owners. Given tax rates $\theta_t, \theta_t^*, t = 1, 2$, $c_1^K = a_0(r_1 - \theta_1) + \phi(\theta_1 - \theta_1^*)^2/2 - s_1$ and $c_2^K = s_1(r_2 - \theta_2) + \phi(\theta_2 - \theta_2^*)^2/2$, capital owners solve:

$$\max_{c_1^K, c_2^K, s_1} \ln c_1^K + \ln c_2^K \ . \tag{B.4}$$

Equivalently, they choose private saving s_1 to maximize:

$$\log\left(a_0(r_1 - \theta_1) + \frac{\phi(\theta_1 - \theta_1^*)^2}{2} - s_1\right) + \beta \log\left(s_1(r_2 - \theta_2) + \frac{\phi(\theta_2 - \theta_2^*)^2}{2}\right). \tag{B.5}$$

Figure B.3: Public budget deficit b_1 as a function of capital mobility ϕ (extended model, symmetric countries)



(a) Debt adjustment costs

(b) Endogenous public spending

Panel (a) displays public budget deficit in the extended model, assuming public spending is exogenously set to g = 0.1. The solid line shows the case of $\mu = 0$ (no adjustment costs). The dashed line shows the case of $\mu = 2$. Plots in panel (b) compare exogenous public spending (solid line, g = 1) with the case of endogenous public spending described in appendix B.2 (dashed line, $\delta = 0.5$). $\overline{A} = 6$, $\gamma = 1.6$, $\alpha = 0.9$, $\beta = 0.7$ and $\rho = 0.9$.

iii) Cost of public debt. Issuing b_1 also entails a quadratic cost of $\mu b_1^2/2,\ \mu > 0$ that is paid in the first period.

iv) Endogenous public spending. I extend workers' preferences over public spending in each period, g_1 and g_2 respectively, so that:

$$V^L = \ln c_1^L + \delta \ln g_1 + \beta \ln c_2^L + \beta\delta \ln g_2,\ 0 < \beta \leqslant 1, \delta > 0. \tag{B.6}$$

The model is solved numerically for different levels of openness and adjustment costs. Panel (a) in figure B.3 shows the public budget deficit as a function of financial openness under extensions i)-iii) but keeping public spending exogenous. Panel (b) in figure B.3 endogenizes public spending. Plots show the behavior of budget deficits follows the benchmark model. As expected, deficits are lower under adjustment costs. Since the adjustment cost also applies to budget surpluses ($b_1 < 0$), these are lower too.

C Data Appendix

The sample period is 1980-2007. OECD membership in 1980 includes Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Japan, Luxembourg, Netherlands, Norway, New Zealand, Portugal, Sweden, United States. Table C.1 provides definitions, sources and summary statistics of the variables used in the empirical exercise.

Table C.1: Definitions, sources and summary statistics

Variable	Description	Mean	St. Dev.	Min.	Max.	Source
Total statutory corporate tax rate	combined central government and sub-central government rate	36.97	8.6	12.5	61.75	OECD Statistics, Center for Business Taxation
Public budget deficit	general government net borrowing/lending, as a percentage of GDP, positive numbers represent deficits	-2.06	4.32	-16.01	18.41	OECD Economic Outlook
CI Financial openness index, row	GDP weighted averages, excluding the reference country	1.88	0.26	0.92	2.2	Chinn and Ito (2006)
ADT Financial openness index, row	GDP weighted averages, excluding the reference country	2.79	0.21	2.15	3	Abiad et al (2010)
Public spending	general government consumption expenditure, as percentage of GDP	19.38	3.76	9.94	28.84	OECD Statistics
Total tax revenues	Total tax revenues as a percentage of GDP	36.07	7.09	21.76	52.96	OECD Statistics
Corporate tax revenues	general government revenues from corporate taxes, as a percentage of GDP	2.98	1.62	0.27	12.76	OECD Statistics
Trade Openness	total trade (exports and imports) share in GDP	53.44	28.43	13.56	183.31	WDI database, World Bank
Public debt	General government liabilities, as a percentage of GDP	49.2	29.76	0.82	164.55	WEO database, Cecchetti and Zampolli (2011)
GDP	current prices, constant exchange rates, OECD base year, trillion USD	0.91	1.75	0.01	11.66	OECD Statistics
Real GDP growth rate	annual growth rate real GDP	2.65	2.01	-6	9.98	WEO database
Proportion urban	in percentages	72.18	12.54	42.78	97.36	WDI database,
Proportion young	share of population below 15	0.21	0.03	0.13	0.32	WDI database
Proportion old	share of population over 65	0.29	0.05	0.2	0.52	WDI database
Executive Election Held	1 if election held that year, 0 otherwise	0.03	0.18	0	1	Database of Political Institutions, World Bank
Legislative Election Held	1 if election held that year, 0 otherwise	0.3	0.46	0	1	Database of Political Institutions
Party right	1 if the chief executive party is characterized as conservative, 0 if center or left	0.47	0.5	0	1	Database of Political Institutions

Table C.2: Tax competition and budget deficits: panel IV estimates using the ADT index of financial openness

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}_{-it}$)	-0.358***	-0.429***	-0.334***	-0.252***	-0.253***
	(0.10)	(0.11)	(0.10)	(0.08)	(0.08)
ADT fin. lib. index ROW ($\overline{\phi}_{-it}$)		5.998**	2.834	8.512***	8.209***
		(2.46)	(2.32)	(2.08)	(2.13)
Corp. tax revenues/GDP			-1.671***	-0.679***	-0.643***
			(0.22)	(0.22)	(0.23)
Total tax revenues/GDP				-0.999***	-1.021***
				(0.12)	(0.12)
ADT index					0.286
					(0.24)
Public spending/GDP	2.143***	2.170***	1.746***	2.306***	2.308***
	(0.20)	(0.20)	(0.17)	(0.18)	(0.18)
Public debt/GDP	6.151***	4.891***	5.534***	8.509***	8.646***
	(1.06)	(1.26)	(1.11)	(1.11)	(1.15)
Size	0.422	1.163	-0.594	0.056	-0.029
	(1.15)	(1.21)	(1.14)	(0.94)	(0.96)
Output growth rate	-0.167***	-0.159**	-0.038	-0.006	-0.006
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)
Proportion urban	79.215***	73.663***	50.090***	58.280***	60.883***
	(15.65)	(14.96)	(12.09)	(10.53)	(11.06)
Proportion old	-30.412	-31.794	-93.685***	-94.758***	-97.789***
	(19.53)	(19.53)	(20.93)	(18.87)	(19.27)
Proportion young	15.162	19.920*	32.574***	14.197	17.176*
	(11.69)	(11.80)	(11.68)	(9.85)	(10.30)
Trade openness	0.039	0.054**	0.072***	0.053***	0.058***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
1 if party right	-0.780***	-0.631**	-0.162	0.007	0.061
	(0.25)	(0.27)	(0.26)	(0.21)	(0.20)
1 if exec. elec. year	0.088	0.013	0.016	-0.055	-0.053
	(0.44)	(0.47)	(0.49)	(0.32)	(0.32)
1 if if leg. elec. year	-0.079	-0.059	0.028	0.124	0.125
	(0.20)	(0.20)	(0.18)	(0.16)	(0.16)
Observations	419	419	411	411	411
R-squared	0.43	0.43	0.55	0.65	0.65
K-P Wald F	200.69	220.06	36.24	18.22	17.48

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. For country i capital taxation in the rest of the world $\overline{\theta}_{-it}$ is the average statutory corporate tax rate in the other countries, expressed as a percentage and weighted by GDP and ADT, a financial openness index based on Abiad et al (2010). $\overline{\theta}_{-it}$, corporate tax revenues, total tax revenues and public consumption shares in GDP are instrumented with lags. See notes in table 1 and table C.1 for details on the other control variables. Regressions include country specific fixed effects and country specific time trends. Heteroskedasticity and autocorrelation robust standard errors within parantheses. The Kleibergen-Paap Wald F statistic is reported. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

Table C.3: Additional control variables

CI Index

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}^{CI}_{-it}$)	-0.256**	-0.365***	-0.367***	-0.171*	-0.164*
	(0.11)	(0.12)	(0.11)	(0.09)	(0.09)
CI fin. lib. index ROW ($\overline{\phi}_{-it}$)		5.302***	5.071***	4.010***	4.011***
		(1.38)	(1.27)	(1.20)	(1.20)
Corp. tax revenues/GDP			-1.468***	-0.498***	-0.488**
			(0.18)	(0.19)	(0.20)
Total tax revenues/GDP				-0.986***	-0.989***
				(0.11)	(0.11)
CI index					-0.070
					(0.21)
Detrended GDP	-10.232***	-8.578**	-4.779	0.581	0.513
	(3.32)	(3.46)	(3.27)	(2.22)	(2.25)
Quadratic time trend	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	449	449	441	441	441
R-squared	0.47	0.48	0.59	0.69	0.69
K-P Wald F	199.01	180.85	99.62	16.01	14.09

ADT Index

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}^{ADT}_{-it}$)	-0.326***	-0.423***	-0.430***	-0.177*	-0.186*
	(0.11)	(0.14)	(0.13)	(0.10)	(0.11)
ADT fin. lib. index ROW ($\overline{\phi}_{-it}$)		5.257	6.581**	5.267**	5.511**
		(3.46)	(3.21)	(2.52)	(2.55)
Corp. tax revenues/GDP			-1.710***	-0.596**	-0.588**
			(0.23)	(0.23)	(0.23)
Total tax revenues/GDP				-1.018***	-1.027***
				(0.12)	(0.12)
ADT index					0.139
					(0.27)
Detrended GDP	-11.492***	-11.715***	-8.930**	-2.482	-2.420
	(3.72)	(3.93)	(3.53)	(2.21)	(2.24)
Quadratic time trend	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	425	425	416	416	416
R-squared	0.35	0.18	0.17	0.35	0.34
K-P Wald F	84.11	30.92	27.98	31.37	30.18

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. Capital taxation in the rest of the world $\overline{\theta}_{-it}$ is the average statutory corporate tax rate weighted by GDP and the normalized financial openness index based on Chinn and Ito (2006) (CI) and Abiad et al (2010) (ADT). $\overline{\theta}_{-it}$, corporate tax revenues, total tax revenues and public consumption shares in GDP are instrumented with lags. The full set of control variables (not shown) is included. See notes in table 1 and table C.1 for details. In addition to country specific fixed effects and country specific time trends, all regressions include a quadratic time trend as well as the detrended component of GDP. Heteroskedasticity and autocorrelation robust standard errors within parantheses. The Kleibergen-Paap Wald F statistics is reported. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

Table C.4: Bias corrected dynamic panel IV estimates

	(1)	(2)	(3)	(4)	(5)
1^{st}lag corp. tax rate ROW $\overline{\theta}_{-it}^{CI}$	-0.268***	-0.286***	-0.277**	-0.280*	-0.281*
	(0.09)	(0.09)	(0.12)	(0.16)	(0.15)
1^{st}lag corp. tax rate ROW $\overline{\theta}_{-it}^{ADT}$	-0.293***	-0.354***	-0.355***	-0.362**	-0.363**
	(0.10)	(0.11)	(0.13)	(0.17)	(0.18)

	(1)	(2)	(3)	(4)	(5)
2^{nd}lag corp. tax rate ROW $\overline{\theta}_{-it}^{CI}$	-0.374***	-0.391***	-0.408***	-0.408**	-0.409**
	(0.10)	(0.10)	(0.14)	(0.17)	(0.17)
2^{nd}lag corp. tax rate ROW $\overline{\theta}_{-it}^{ADT}$	-0.404***	-0.451***	-0.482***	-0.482**	-0.489**
	(0.11)	(0.12)	(0.15)	(0.20)	(0.21)

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. For country i capital taxation in the rest of the world $\overline{\theta}_{-it}^{CI}$ is the average statutory corporate tax rate in the other countries, weighted by GDP and the normalized financial openness index based on Chinn and Ito (2006). $\overline{\theta}_{-it}^{ADT}$ is similarly computed using the financial index of Abiad et al (2010). Regression in the upper (lower) part of the table include the first (second) lag of $\overline{\theta}_{-it}$ in addition to country specific fixed effects, country specific time trends and the same sets of control variables, across specifications (1)-(5), as those in tables 1 and C.2. Coefficients are bias corrected up to order $O(1/NT^2)$, following Bruno (2004). * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

Table C.5: Alternative IV strategies: spatial lags

CI Index

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}^{CI}_{-it}$)	-0.509***	-0.800***	-0.850***	-0.731***	-0.735***
	(0.17)	(0.22)	(0.22)	(0.19)	(0.19)
CI fin. lib. index ROW ($\overline{\phi}_{-it}$)		6.579***	6.125***	5.076***	5.082***
		(1.77)	(1.81)	(1.65)	(1.65)
Corp. tax revenues/GDP			-0.809***	-0.332	-0.339
			(0.18)	(0.22)	(0.23)
Total tax revenues/GDP				-0.527***	-0.525***
				(0.11)	(0.11)
CI index					0.017
					(0.27)
Observations	457	455	446	446	446
First stage F statistic	26.51	22.43	23.46	28.07	26.22
R-squared	0.40	0.35	0.38	0.47	0.47
Hansen J statistic, p-value	0.137	0.863	0.449	0.386	0.387
K-P Wald F	86.37	67.78	65.65	68.54	63.66

ADT Index

	(1)	(2)	(3)	(4)	(5)
Corp. tax rate ROW ($\overline{\theta}^{ADT}_{-it}$)	-0.650***	-1.173***	-1.340***	-1.107***	-1.132***
	(0.18)	(0.32)	(0.33)	(0.26)	(0.27)
ADT fin. lib. index ROW ($\overline{\phi}_{-it}$)		16.011***	18.891***	15.612***	16.133***
		(6.02)	(6.11)	(5.07)	(5.35)
Corp. tax revenues/GDP			-0.995***	-0.395	-0.392
			(0.21)	(0.26)	(0.26)
Total tax revenues/GDP				-0.604***	-0.614***
				(0.13)	(0.13)
ADT index					0.234
					(0.45)
Observations	425	425	416	416	416
First stage F statistic	23.92	17.90	19.81	23.96	22.32
R-squared	0.35	0.18	0.17	0.35	0.34
Hansen J statistic, p-value	0.007	0.299	0.135	0.190	0.215
K-P Wald F	84.11	30.92	27.98	31.37	30.18

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. Capital taxation in the rest of the world $\overline{\theta}_{-it}$ is the average statutory corporate tax rate weighted by GDP and the normalized financial openness index based on Chinn and Ito (2006) (CI) and Abiad et al (2010) (ADT). $\overline{\theta}_{-it}$ is instrumented with similarly weighted rest of the world averages of the dependecy ratio (proportion old + proportion young) and the political affiliation of the government party. Corporate tax revenues, total tax revenues and public consumption shares in GDP are included as lags together with the full set of control variables (not shown). See notes in table 1 and table C.1 for details. In addition to country specific fixed effects and country specific time trends, all regressions include a quadratic time trend as well as the detrended component of GDP. Heteroskedasticity and autocorrelation robust standard errors within parantheses. The first stage F and the Kleibergen-Paap Wald F statistics are reported together with the p-value of the Hansen J test. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

Table C.6: Non-monotonic effects

	(1)	(2)	(3)	(4)
	CI Index		*ADT Index*	
Corp. tax rate ROW ($\overline{\theta}_{-it}$)	-0.318***	-0.992***	-0.337***	-0.813**
	(0.07)	(0.22)	(0.08)	(0.33)
$\overline{\theta}_{-it} * time$	0.016**	0.073***	0.016*	0.052*
	(0.01)	(0.02)	(0.01)	(0.03)
Fin. lib. index ROW ($\overline{\phi}_{-it}$)	3.695***	4.076***	4.274*	5.861**
	(1.19)	(1.22)	(2.57)	(2.68)
Fin. lib. index ($\overline{\phi}_{it}$)	-0.111	-0.005	0.089	0.191
	(0.20)	(0.21)	(0.27)	(0.29)
Corp. tax revenues/GDP	-0.388*	-0.307	-0.529**	-0.451*
	(0.21)	(0.22)	(0.24)	(0.26)
Total tax revenues/GDP	-1.031***	-1.056***	-1.045***	-1.077***
	(0.11)	(0.12)	(0.12)	(0.14)
Detrended GDP		-3.089		-2.622
		(2.35)		(2.12)
Quadratic trend	*no*	*yes*	*no*	*yes*
Observations	441	441	411	411
R-squared	0.70	0.68	0.67	0.65
K-P Wald F	10.52	13.04	10.37	15.38

Notes: The dependent variable is the general government public budget deficit expressed as a share in GDP. Positive values represent deficits. Capital taxation in the rest of the world $\overline{\theta}_{-it}$ is the average statutory corporate tax rate weighted by GDP and the normalized financial openness index based on Chinn and Ito (2006) (CI) and Abiad et al (2010) (ADT). *Time* is a linear trend. $\overline{\theta}_{-it}$, corporate tax revenues, total tax revenues and public consumption shares in GDP are instrumented with lags. The full set of control variables (not shown) is included. See notes in table 1 and table C.1 for details. In addition to country specific fixed effects and country specific time trends, specifications (2) and (4) include a quadratic trend as well as the detrended component of GDP. Heteroskedasticity and autocorrelation robust standard errors within parantheses. The Kleibergen-Paap Wald F statistics is reported. * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, *** indicates significance at the 1 percent level.

References

Abiad, A., E. Detragiache, and T. Tressel (2010, June). A new database of financial reforms. *IMF Staff Papers 57*(2), 281–302.

Atkinson, A. B., T. Piketty, and E. Saez (2011, March). Top incomes in the long run of history. *Journal of Economic Literature 49*(1), 3–71.

Baldwin, R. E. and P. Krugman (2004). Agglomeration, integration and tax harmonisation. *European Economic Review 48(1)*(February), 1–23.

Brueckner, J. K. (2003). Strategic Interaction Among Governments: An Overview of Empirical Studies. *International Regional Science Review 26*(2), 175–188.

Bruno, G. S. F. (2004, July). Approximating the bias of the lsdv estimator for dynamic unbalanced panel data models. KITeS Working Papers 159, KITeS, Centre for Knowledge, Internationalization and Technology Studies, Universita' Bocconi, Milano, Italy.

Bucovetsky, S. and J. D. Wilson (1991, November). Tax competition with two tax instruments. *Regional Science and Urban Economics 21*(3), 333–350.

Chang, R. (1990). International coordination of fiscal deficits. *Journal of Monetary Economics 25*(3), 347–366.

Chinn, M. D. and H. Ito (2006, October). What matters for financial development? capital controls, institutions, and interactions. *Journal of Development Economics 81*(1), 163–192.

Chirinko, B. and D. J. Wilson (2007). Tax competition among U.S. states: racing to the bottom or riding on a seesaw? Technical report.

Cooper, R., H. Kempf, and D. Peled (2008). Is It Is Or Is It Ain'T My Obligation? Regional Debt In A Fiscal Federation. *International Economic Review 49*(4), 1469–1504.

Devereux, M. P., B. Lockwood, and M. Redoano (2008). Do countries compete over corporate tax rates? *Journal of Public Economics 92*(5-6), 1210–1235.

Haskel, J. E., P. S. C, and M. J. Slaughter (2007, 03). Does inward foreign direct investment boost the productivity of domestic firms? *The Review of Economics and Statistics 89*(3), 482–496.

Hindriks, J., P. Peralta, and S. Weber (2008). Competing in taxes and investment under fiscal equalization. *Journal of Public Economics 92*(12), 2392–2402.

Jensen, R. and E. F. Toma (1991, November). Debt in a model of tax competition. *Regional Science and Urban Economics 21*(3), 371–392.

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

Keen, M. and M. Marchand (1997). Fiscal competition and the pattern of public spending. *Journal of Public Economics 66*, 33–53.

Kleibergen, F. and R. Paap (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of Econometrics 133*(1), 97–126.

Koethenbuerger, M. and B. Lockwood (2010, February). Does tax competition really promote growth? *Journal of Economic Dynamics and Control 34*(2), 191–206.

Kose, M. A., E. Prasad, K. Rogoff, and S.-J. Wei (2010, January). *Financial Globalization and Economic Policies*, Volume 5 of *Handbook of Development Economics*, Chapter 0, pp. 4283–4359. Elsevier.

Melitz, M. J. and G. I. P. Ottaviano (2008, 01). Market size, trade, and productivity. *Review of Economic Studies 75*(1), 295–316.

Persson, T. and G. Tabellini (2002). *Political Economics: Explaining Economic Policy*. MIT Press Books. The MIT Press.

Redoano, M. (2014). Tax competition among European countries. Does the EU matter? *European Journal of Political Economy 34*(0), 353 – 371.

Romer, P. M. (1986, October). Increasing Returns and Long-run Growth. *Journal of Political Economy 94*(5), 1002–37.

Wildasin, D. E. (1998). Nash equilibria in models of fiscal competition. *Journal of Public Economics 35*, 1229–240.

Wildasin, D. E. (2003). Fiscal competition in space and time. *Journal of Public Economics 87*(11), 2571–2588.

Wildasin, D. E. and J. D. Wilson (1996, May). Imperfect mobility and local government behaviour in an overlapping-generations model. *Journal of Public Economics 60*(2), 177–198.

Wilson, J. D. (1986). A theory of interregional tax competition. *Journal of Urban Economics 19*(3), 296–315.

Wilson, J. D. and E. Janeba (2005). Decentralization and international tax competition. *Journal of Public Economics 89*(7), 1211–1229.

Zodrow, G. R. and P. Mieszkowski (1986). Pigou, Tiebout, property taxation, and the underprovision of local public goods. *Journal of Urban Economics 19*(3), 356–370.