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Why is There No Race to the Bottom in Capital Taxation?

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This article explains the absence of a race to the bottom in capital taxation by analyzing fiscal competition under budget rigidities and tax equity constraints (fairness norms). We outline a political economic model of tax competition that treats the outcome of tax competition as one argument in the governments utility function, the others being public expenditure and tax equity. In accordance with previous theoretical research, tax competition tends to cause a reduction in taxes on mobile capital and an increase in the tax rates on relatively immobile labor in our model. Yet, our model predicts that governments do not fully abolish taxes on mobile capital. Instead, the government being least restricted by budget constraints and equity norms cuts tax rates to levels slightly below the lowest tax rates of those countries, in which governments are more constrained, where effective constraints are country size, budget rigidities and fairness norms. Analyzing data from 23 Organization for Economic Co-operation and Development countries between 1975 and 2004 we find empirical support for the hypotheses derived from our theoretical model.

A striking feature of international tax competition is the fact that independent jurisdictions share a mobile tax base. As a consequence, a country lowering its capital tax rate attracts an immediate inflow of capital, thereby reducing the tax base of other countries. These respond to the shrinking tax base and to declining tax revenues by lowering their capital tax rate to competitive levels. In equilibrium, tax rates on mobile capital approach zero in all countries. This result has become popular under the ''race to the bottom'' hypothesis.[1] Yet, tax revenues are for governments what buoyancy is for swimmers: vital. As a consequence, the early models of tax competition—models predicting capital tax rates converging to zero—sent alarming shock waves to politicians. These dire expectations were fueled by political scientists who predicted that governments will find it

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[1] See Wildasin (1989); Wilson (1986); and Zodrow and Mieszkowski (1986). Wilson (1999) and Wilson and Wildasin (2004) provided for comprehensive surveys on subsequent research. The zero capital tax equilibrium was most prominently described by Frey (1990), Scharpf (1997), and Tanzi (1995).

increasingly difficult to finance the provision of public goods and to redistribute income (Hicks and Swank 1992; Lee and McKenzie 1989).[2]

Already in 1997, Dennis Quinn stated that the race to the bottom hypothesis does not ''match reality'' (Quinn 1997, 533). Since then, numerous studies (Basinger and Hallerberg 2004; Hays 2003) supported Quinn's assertion by providing empirical evidence at odds with the predictions of the ''race to the bottom'' models.[3] No doubt, the prediction of zero capital tax rates was not in line with reality when it was first formulated and it did not come true since. The lack of empirical support for the ''race to the bottom'' hypothesis must provide relief to politicians—but perhaps not so much to social scientists who saw their predictions washed away.

In principle, social scientists may use three different arguments to bridge the apparent gap between the zero tax rate prediction and the overwhelming empirical evidence. First, these early models do not forecast the year the equilibrium is reached. Social scientists can therefore maintain that the model makes correct predictions but the world has not yet converged to the equilibrium outcome. To our knowledge, no one made such a claim which indeed would effectively render the theory unfalsifiable. Second, proponents can contend that this prediction was never meant literally. In other words, the alleged zero tax rate equilibrium merely suggests a decline in the level of tax rates on mobile capital bases. Of course, early models of tax competition look much more plausible if we do not take their predictions at face value. It is not clear, however, why predictions of theories should not be taken literally.

We are thus left with a third response—a potential remedy which, in fact, has been proposed by much of the succeeding research on tax competition. Both economists and political scientists have augmented the standard tax competition model to derive predictions more in line with the empirical evidence. We will in some detail discuss actually suggested modifications to the theory of tax competition in the literature review. Here, we may just say that the economists' explanation of the absence of a race to the bottom in capital taxation largely differs from theories provided by political scientists. According to the former, capital owners have an incentive to keep their capital within the boundaries of a high-tax jurisdiction as the government provides efficiency-enhancing goods to them. In the latter's view, political constraints prevent governments from reducing capital tax rates to competitive levels.

This article offers an alternative explanation for the persistence of positive tax rates on mobile factors. Rather than stating that (some) governments *cannot* reduce tax rates on mobile factors to competitive levels, we explain why governments are *unwilling* to do so. We follow the previous literature in one important aspect: tax policies are effectively restricted by international tax competition. Yet, the political objectives of maintaining a balanced budget and of meeting societal demand for tax equity also influence tax policies. In other words, whereas previous research has at least implicitly assumed that the imperatives of tax competition fully dominate political decisions, we hold that governments continue to tax mobile capital even in the absence of political constraints.

No doubt, the goal of attracting mobile capital shapes public policies. At the same time, however, governments are concerned with the provision of public

[2] According to scholars of this tradition, the fiscal externalities of tax competition cause an under provision of public goods. See Chamley (1986); Hays (2003); Hoyt (1991); Steinmo (2002); Swank and Steinmo (2002); Wilson (1999); and Wilson and Wildasin (2004). Andrews (1994) predicts that governments lose sovereignty over domestic tax policies.

[3] For example, Steinmo (2002) shows that Sweden has changed its tax system in recent years. However, he finds little evidence for the race to the bottom argument that countries like Sweden had to abandon the high-tax regime or to reduce welfare spending.

goods and the unequal treatment of mobile and immobile tax bases. Indeed, voters reduce political support when governments run large deficits, cut spending on relevant issues, and implement policies which voters perceive as unfair.

Governments thus face a *trilemmatic choice* when choosing a tax system. They can simultaneously reach only two of the following three policy goals: (i) maintain a solid capital base; (ii) generate sufficiently high-tax revenue; and (iii) avoid social inequity by treating different incomes differently. In consequence, our model makes testable predictions about the level of capital taxation, the level of labor taxation, and the ratio between both tax rates. We test these hypotheses empirically using data from 23 Organization for Economic Co-operation and Development (OECD) countries between 1975 and 2004. We account for the strategic nature of tax competition and incorporate budget rigidities and fairness norms in a spatial panel-data model. In our model, both budget constraints and fairness norms determine a country's response to international tax competition.

No Race to the Bottom: A Literature Review

Indicative stylized facts emphasize the discrepancy between zero tax rate predictions and the empirical evidence. Although most OECD countries lowered tax rates on mobile capital, cuts in total government spending remained rare and relatively modest—some countries even raised taxes on mobile capital (Genschel 2002; Steinmo 2002; Swank 1998). In consequence, albeit that the variance among countries' tax systems has declined gradually, convergence remains far from perfect even after controlling for country size (Kanbur and Keen 1993; Plümper and Schulze 1999). No doubt taxes on mobile capital continue to be the rule rather than the exception and countries continue to implement different tax systems (Figure 1).

Both marginal corporate tax rates as well as effective tax rates on mobile capital remain, on average, far from zero in OECD countries. Despite the significant decline in top rates on corporate income from the mid-1980s onwards, effective tax rates stay relatively stable over time. Governments apparently cut marginal tax rates but they simultaneously broaden the tax base to maintain sufficient tax

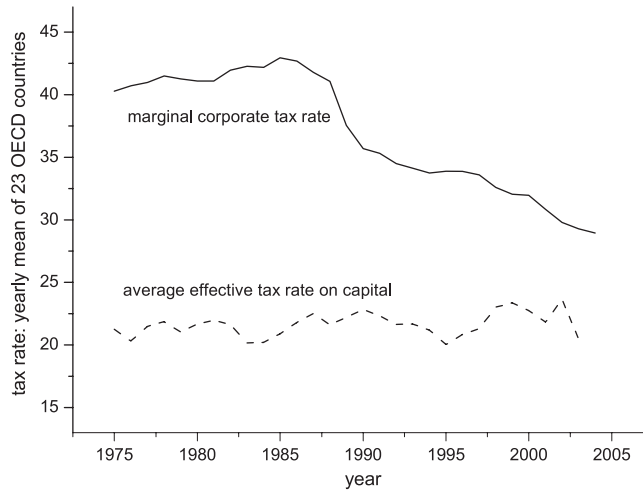

FIG. 1. Annual Average of Marginal Corporate and Average Effective Tax Rates on Capital for 23 OECD Countries Between 1975 and 2004

revenues (Ganghof 2000a, 2007; Hicks and Swank 1992; Keen and Marchand 1997; Swank and Steinmo 2002).

Later models of tax competition can be seen as an attempt to bring theoretical predictions closer to the observed reality of tax policies in OECD countries. Indeed, authors of these models have a point in blaming the simplicity of first generation models for their failure to correctly predict tax policies and the changes in taxation.

According to economists working on augmented, second generation models of tax competition, governments draw on tax revenues to provide services to the capital owners. Governments thus compensate capital owners for the higher-tax rates (Devereux, Griffith, and Klemm 2002; Devereux, Lockwood, and Redoano 2008; Slemrod 2004). A country's tax burden is not the only important factor driving location decisions of corporations and savers. Their locational choices are also informed by the relative quality of public infrastructure across jurisdictions (Oates 1996; Wildasin 1989). If they perceive taxes as price for publicly provided infrastructure, capital owners and investors will accept comparably high tax rates (Sinn 2003, 30).

These economic models fail to convince for at least three reasons: First, capital taxes are unrelated to the use of infrastructure. For the economists' argument to hold, capital owners must be willing to pay taxes for the usage of infrastructure rather than moving to a jurisdiction in which similar infrastructure investment is financed by labor taxes, which indeed is not very plausible. Second, if the usage of infrastructure cannot be directly linked to individual tax burdens, infrastructural investment constitutes a collective action problem in which those individuals and corporations are best off who are able to avoid taxation while still having access to infrastructure. And third, tax competition usually takes place among countries of relatively similar qualities of infrastructure. To fully compensate for effective tax rate differences, the effect of variation in infrastructures on corporate profits must equal the influence of tax differences on profits. In other words, these augmented models lift the prisoners' dilemma logic of the early models to a higher plane, as they argue that the investment decisions of capital owners depend on net taxation rather than gross taxation. This may explain why governments providing larger benefits to capital owners are able to implement higher-tax rates without causing capital flights. These theories, however, fail to provide an explanation for why the ''net'' level of capital taxation exceeds zero in equilibrium.

In our view, political scientists offer far more compelling explanations for the absence of a race to the bottom in capital taxation. Referring to huge differences in institutional and constitutional settings of countries, political scientists argue that political, institutional, and economic constraints prevent governments in some countries from effectively competing with low-tax countries such as Ireland and Luxemburg (Basinger and Hallerberg 2004; Genschel and Plümper 1997; Hays 2003; Steinmo and Tolbert 1998). Political explanations of persistence in capital tax rates come in two versions. The first version refers to the alleged high costs of shifting tax revenues to immobile factors and especially to labor (Garrett 1998a, 1998c; Rodrik 1997, 1998; Swank 2006; Swank and Steinmo 2002). If deficit spending decreases political support (Ganghof 2000b), and governments at the same time need to maintain a fairly large level of public good provision, a reform of capital taxation to reach competitive levels does not seem to be a politically viable option (Genschel 2002). This theory clarifies how political constraints mediate the consequences of tax competition and effectively prevent a race to the bottom in capital taxation. However, it overlooks that tax revenues do not necessarily decline when tax rates are lowered. In fact, lower tax rates ease the pressure of capital flight or even attract the inflow of foreign capital. High levels of public good provision can be compatible with low tax rates and in

some countries such as Ireland low tax rates are even the key to growing tax revenues and an improvement in public good provision (Plümper and Troeger 2008).

The second prominent explanation for positive capital tax rates refers to institutional and political constraints to governments' executive power. Tax reforms inevitably leave at least some groups in the society worse off. If these groups are influential and compensation is difficult, the political costs may erase the race to the bottom. Distributional conflicts always emerge; whether they impede tax reforms or not depends on the country's institutional setting.[4] Political constraints either result from the number of veto players in the political system (Basinger and Hallerberg 2004; Ganghof 1999, 2006; Hallerberg and Basinger 1998, 1999) or from the preferences of parties' specific voter clienteles (Basinger and Hallerberg 2004; Clark and Hallerberg 2000; Ganghof 2006, 141ff; Garrett 1995, 1998b; Garrett and Mitchell 2001).[5] The partisan explanation partly mirrors our fairness argument. However, where we are interested in different levels of fairness constraints across countries, the partisan explanation of tax competition looks at different responses of left and conservative parties.[6] While we argue that left parties from countries which have different levels of fairness constraints will respond differently to tax competition, the partisan literature implicitly assumes that the response of left governments ceteris paribus is identical across countries.

Predictions generated by later economic and political science theories are consistent with broad trends in capital taxation. Arguments brought forward by political scientists gain explanatory power by adding a dash of political realism to the early tax competition models. These augmented models, however, usually accept the basic setting of first generation tax competition models. Most of them still predict a convergence toward zero capital tax rates when political constrains become significantly weaker or when tax competition becomes fiercer.[7] This leads to a logical problem: if political constraints do not change the incentive structure but only impair the government's political autonomy, then the model implicitly assumes that the government intends to maximize aggregate welfare by reducing capital tax rates while the other actors, veto players for example, do not care about the adverse consequences of tax competition for high-tax countries. This leaves unclear why some political actors respond to the changing incentive structure and others do not. Our explanation avoids such an inconsistency. In our model, the absence of a race to the bottom does not solely result from political constraints but also from limits to perfect capital mobility.

Our argument is broadly in line with recent arguments on tax systems (Ganghof 2006). Like Ganghof, we explain capital taxation by looking beyond a single tax instrument and also highlight the importance of what he dubs capital-labor equity and what we call fairness considerations. These similarities, however, should not conceal the differences. Ganghof is mainly interested in the institutional determinants of political responses to assumed tax competition; we are interested in how initial conditions influence political responses to country differences in effective tax rates. Thus, contrary to Ganghof's main argument we do not take tax competition as historically given and treat the pressure as constant.

[4] Compare Basinger and Hallerberg (2004); Hallerberg and Basinger (1998, 1999); Hays (2003); Swank (2006); and Swank and Steinmo (2002).

[5] Kastner and Rector (2003) show how the same logic of partisan ideology and veto players applies to the implementation of capital controls.

[6] We therefore distinguish both arguments and test them separately in the empirical analysis.

[7] A referee pointed out to us that partisan theories of tax competition argue that tax rates should vary depending on which party controls the government. This implies that at least one (the left) party prefers tax rates higher than zero. We fully agree, but would like to stress that the deviation from zero tax rates is assumed rather than explained.

Rather, we theoretically model the strategic interaction between governments and we use a spatial econometric set-up to account for these strategic interactions in the empirical analyses. In addition, Ganghof does not discuss the possibility of governments choosing deficits to counterbalance the adjustment pressures of tax competition. In explaining adjustment strategies partly by initial debt levels, we demonstrate that some governments—especially those in low-debt countries—use fiscal policies to maintain relatively high capital tax rates.

The Model

If we follow empirical results, subsequent theoretical research and perhaps even common wisdom, early theoretical models of tax competition depart in four relevant ways from ''real world'' tax competition. First, the assumption of perfectly mobile capital remains unconvincing. Although capital owners react to differences in tax rates, they neither respond immediately nor perfectly. Second, governments are not unconstrained maximizers of tax revenue. As voters can link tax rates to tax revenue and tax revenue to public good provision, and as democratically controlled governments take voters' preferences into account, theories need to explicitly model domestic political constrains. Third, countries are not identical and differ at least in the degree of political autonomy and in country size. And fourth, the world consists of more than two countries. While we typically can generalize from three to more than three, and even to an infinite number of countries, inferences from two to three countries are often not valid.

Our model factors these aspects. Yet, it necessarily remains stylized and makes simplifying assumptions (albeit less than previous models). We model tax competition among three countries with an imperfectly mobile capital basis and an immobile tax base (income from labor) and where governments are unequally constrained by budget constraints and fairness norms. Moreover, governments have no preference about capital taxes but aim at maximizing their political support. In other words, effective tax rates are an instrument, not a policy goal. To reach their ends governments use two instruments—the tax rate on mobile and immobile factors. Political support hinges on the extent to which individuals are taxed (the tax burden on capital and labor), on the level of public good provision, and on the avoidance of deviations from societal fairness norms. Finally, capital mobility is a function of the interest-rate difference between any two countries.

The underlying logic of our model is straightforward: the domestic electorate favors a low tax burden. At the same time, however, voters prefer a relatively high level of government spending. Obviously, there is a trade off between both objectives—unless a country is able to attract capital from abroad. Therefore, governments prefer to draw on foreign capital bases. In addition, voters may be concerned about a ''fair'' distribution of tax burdens and reduce government support when the difference between effective tax rates on labor and capital increases. As we will demonstrate, governments are able to act more aggressively in international tax competition if the domestic fairness norms are less strict and less influential. Like others before us (i.e., Goodspeed 1999), we employ a combination of analytical and computational methods[8] to derive predictions on tax policy choice.

[8] We adopt the following terminology to describe our computational model: A *move* is a change in the tax system. A government may (but does not have to) simultaneously optimize taxes on mobile and immobile tax bases. A *period* consists of successive moves of all three countries.

Analysis of the Model

We study the outcome of tax competition among three countries ($j = A, B, C$). The model allows us to vary the following parameters: the size of the mobile and immobile capital base, respectively; the reaction of capital owners to taxation (i.e., the elasticity of capital supply); the reaction of ''voters'' to budget deficits; the level of public expenditure; the relation between the tax rate on mobile and immobile factors considered ''fair''; and the mobility of capital given international differences in tax rates on mobile capital. Finally, we use weights to vary the importance of budget constraints and fairness norms for government support. Parameters can be chosen independently and we vary parameter sizes across countries in our analysis of ''tax competition among heterogeneous countries.'' We are interested in the effect of budget constraints and fairness norms on the outcome of tax competition and analyze Nash-equilibria and comparative statics to derive predictions.

The Basic Setting:
Suppose an economy where agents generate income from two kinds of assets $i_i = m_i + n_i$. Capital M denotes the mobile and capital N stands for the immobile source available in a country with $Y = M + N$.[9] The government disposes of two tax instruments, τ_m and τ_n so that its share of the economy is given by

$$G = (\tau_m M + \tau_n N)/(M + N) \tag{1}$$

Agents have preferences over private consumption, government provision of public goods, and tax equity. The government minimizes a loss function with three interrelated elements: the absolute level of taxation, the resulting public deficits given the government provides the level of public goods demanded by the electorate, and a measure of tax equity. More precisely, the government loss function L_g is simultaneously influenced by

(i) the level of taxation;
(ii) budget deficits; and
(iii) deviations from a ''fair'' ratio between taxes on mobile capital and relatively immobile labor.

All these factors enter the loss function positively. Accordingly, governments avoid high tax rates, budget deficits, and ''unfair'' tax systems whenever possible, but not under all conditions.

Given voters' preferences for low tax burdens, optimal provision of public goods and tax equity, the government minimizes a loss function of the following type

$$\begin{aligned} L_g(\tau_m, \tau_n) = {} & \tau_m^{\alpha} + \tau_n^{\beta} + (E - (\tau_m M + \tau_n N))^{\gamma} \\ & + \left[((\tau_m + \mu)/\tau_n)^2 + (\tau_n/(\tau_m + \mu))^2\right]^{\lambda}, \end{aligned} \tag{2}$$

where $0<\alpha, \beta, \gamma, \lambda<1$, μ measures deviations from $\tau_m/\tau_n = 1$ as fairness criterion and E denotes government expenditure. For the sake of simplicity and without loss of generality, we assume the following restriction:

[9] For the sake of simplicity, we assume that M and N are exogenous to the capital tax rates. While this assumption is certainly wrong (the capital stock should actually grow faster if effective capital tax rates decline), our argument does not depend on it. Quite to the contrary: if investment and thus the capital stock increases with low effective capital tax rates, tax competition is a self-enforcing process because the price governments are competing for becomes more attractive.

$$E - (\tau_m M + \tau_n N) \geq 0 \tag{3}$$

In other words, governments cannot save. The first-order conditions for optimal tax rates in closed economies are

$$\frac{\partial \mathrm{L}_g}{\partial \tau_m} = \alpha \tau_m^{\alpha-1} - \gamma M (E - \tau_m M - \tau_n N)^{\gamma-1} + \lambda \left(\frac{2(\mu + \tau_m)}{\tau_n^2} - \frac{2\tau_n^2}{(\mu + \tau_m)^3} \right) \left(\frac{(\mu + \tau_m)^2}{\tau_n^2} + \frac{\tau_n^2}{(\mu + \tau_m)^2} \right)^{\lambda-1} \equiv 0 \tag{4}$$

and

$$\frac{\partial \mathrm{L}_g}{\partial \tau_n} = \beta \tau_n^{\beta-1} - \gamma N (E - \tau_m M - \tau_n N)^{\gamma-1} + \lambda \left(-\frac{2(\mu + \tau_m)^2}{\tau_n^3} + \frac{2\tau_n}{(\mu + \tau_m)^2} \right) \left(\frac{(\mu + \tau_m)^2}{\tau_n^2} + \frac{\tau_n^2}{(\mu + \tau_m)^2} \right)^{\lambda-1} \equiv 0 \tag{5}$$

To derive a unique solution, we drop the last term of the equation that accounts for tax-fairness and set $\gamma = 1$. Optimal tax policy becomes

$$\tau_n = (\beta / N)^{1/(1-\beta)} \tag{6}$$

$$\tau_m = (\alpha / M)^{1/(1-\alpha)} \tag{7}$$

To describe the properties of our model, we exemplify the optimal τ_m and τ_n for a variety of parameter values. Consider first the simplest economy, where $M = N$, $0 < \alpha = \beta$, and tax equity translates into $\tau_m = \tau_n$. Under this condition, it is optimal for the government to set $\tau_m = \tau_n$ and to avoid budget deficits [i.e., public expenditure equals tax revenue $E - (\tau_m M + \tau_n N) = 0$]. We treat these results as reference points to which we compare the predictions of the ''open economy'' computational models. If $\alpha \neq \beta$, the government's loss function is minimized given the government chooses a lower (higher) tax rate on the capital base, whose owners react more (less) elastically. If $\alpha < \beta$, the government loss function is minimized when $\tau_m > \tau_n$. Ceteris paribus, an increase in α (β) is associated with lower (higher) tax rates on mobile capital and a higher (lower) taxation of immobile assets. The intuition of this outcome is straightforward. When α is larger, the government becomes more dependent on capital owners' support and therefore reduces effective capital tax rates. One more result is interesting: the equilibrium outcome of tax rates in the closed economy depends on the relative size of the tax bases.

Now let us introduce the assumption that the capital base M is mobile and N immobile (which does not need to be literally true, it is a valid simplification if M is more mobile than N). In consequence, governments have an incentive to reduce capital tax rates, because a reduction in tax rates may actually increase the tax revenue. This is the case if the tax base effect exceeds the tax rate effect:[10]

$$(\tau'_{m,j} - \tau_{m,j} M_j) < \tau'_{m,j} \sum_{-j=1}^{N-j} (\tau'_{m,j} - \tau_{m,-j})^{\sigma} M_{-j} \tag{8}$$

[10] In reality, governments may not only lower capital tax rates to attract an inflow of mobile capital from abroad, they may also seek to generate technology imports (Van Pottelsberghe and Lichtenberg 2001). However, this additional dash of realism only increases the government's incentive to engage in tax competition. The question we seek to answer becomes only more puzzling.

Here, the subscript denotes country j while $-j$ stands for the ''rest of the world.'' $(\tau'_{m,j} - \tau_{m,-j})^{\sigma} M_{-j}$ is the capital inflow from countries $-j$.[11] Assuming open capital accounts necessarily renders the government's loss function slightly more complicated:

$$\begin{aligned} L_g^j(\tau_m, \tau_n) = \tau_{m,j}^{\alpha} + \tau_{n,j}^{\beta} + \left[E_j - (\tau_{m,j} M_j + \tau_{n,j} N_j) - (\tau_{m,j} - \tau_{m,-j})^{\sigma} M_{-j}\right]^{\gamma} \\ + \left[((\tau_{m,j} + \mu_j)/\tau_{n,j})^2 + (\tau_{n,j}/(\tau_{m,j} + \mu_j))^2\right]^{\lambda} \end{aligned} \tag{9}$$

Governments have an incentive to cut taxes on mobile capital to attract capital and to avoid capital outflows. However, a reduction in capital tax rates induces three interrelated consequences for the government's loss function: (i) loss from taxation (the term in the first line in (9) declines); (ii) deficits may increase or reduce political losses, depending on whether the tax base effect outweighs the tax rate effect (i.e., if inequality (8) is satisfied); and (iii) loss from not corresponding to the voters' fairness norms may grow as the ratio between τ_m and τ_n deviates from the optimal ratio.

Thus, governments will not necessarily cut taxes on mobile capital. If at least one of the other countries has already implemented very low tax rates on the mobile capital base, governments may further political support by raising taxes on mobile capital, when they cannot match or undercut the low tax rates of the other country. Moreover, it is very often not optimal to change τ_m and leave τ_n unchanged. Depending on the relative weights of budget deficits and fairness norms, it might be more suitable to reduce τ_n (if fairness norms matter most) or to push τ_n up (if deficits matter most).

The incentive to decrease tax rates on mobile capital is not limited to one country. All governments have identical incentives to engage in tax competition when capital controls are abolished. Tax competition is a strategic game between governments leading, most likely, to a prisoners' dilemma. The game can hardly be solved algebraically, but it is straightforward to compute the equilibria. All tax systems $[\tau_m|\tau_n]$ chosen by a government represent a Nash-equilibrium in mixed strategies, where all governments maximize a best response function which takes the tax rates of the other countries into consideration. There is always a single best response.

Tax Competition Among Three Homogeneous Countries:

We now turn to studying tax competition among three identical countries. At the beginning of the game, government A chooses an optimal combination of taxes on mobile capital and relatively immobile labor. A tax system is optimal when it minimizes the government's loss function. After country A has moved, countries B and finally, country C determine their tax rates, and so on. The experiment ends in equilibrium.[12] Typically, we find separating mixed-strategy equilibria. Equilibria in pure strategies emerge if and only if one least restricted government exists. In this case, the least constrained country attains an inflow of capital from other countries. When two or more governments face similar or

[11] It is straightforward to provide a microfoundation for the assumption that capital outflow is a function of interest-rate differentials. Suppose the transfer of capital to foreign markets is connected with small transaction costs. These transaction costs are nonprohibitive, if the agent transfers large amounts of mobile capital. However, for agents with a relatively small mobile capital stock, the transaction costs may become prohibitively high when differences in the effective tax rate are low.

[12] On average, it takes approximately 10 iterations until we obtain a Nash-equilibrium. Assuming perfect foresight, adjustment would be immediate but equilibria would remain identical.

TABLE 1. An Example of a Nash-Equilibrium in Mixed Strategies

Period	*Country A* $\tau_m \mid \tau_n$	*Country B* $\tau_m \mid \tau_n$	*Country C* $\tau_m \mid \tau_n$
1	.30|.32	.29|.32	.33|.35
2	.28|.31	.27|.31	.33|.35
3	.33|.35	.30|.32	.29|.32
4	.33|.35	.28|.31	.27|.31
5	.33|.35	.33|.35	.30|.32
6	.29|.32	.33|.35	.28|.31
7	.27|.31	.33|.35	.33|.35

identical low restrictions, a limited number of possible tax systems alternates between countries.[13]

We focus on two interrelated analytical questions. First, how do budget rigidities and fairness norms affect the outcomes of tax competition? Second, what is the influence of budget constraints and fairness norms on the tax structure (i.e., the difference between the tax burden on mobile and immobile factors)?

To ensure a feasible analysis, we hold all parameters fixed and solely vary the weights on budget rigidities and on fairness norms in the government's loss function. Table 2 presents the outcome of variations in both budget rigidities (on the *y*-axes) and fairness norms (on the *x*-axes). Before we discuss these results, let us briefly explain how to read Table 2. To give an example of what is reported (and what is not reported) in each cell: The equilibrium for tax competition between homogenous countries, where the weight on fairness equals 0.3 and the weight on budget rigidities equal 0.6 takes the form as shown in Table 1. The equilibrium for tax competition between homogenous countries, where the weight on fairness presented in Table 1 equals 0.3 and the weight on budget rigidities equal 0.6 takes the following forms:

Table 1 displays three repeated Nash-equilibria in mixed strategies. The sequence of moves repeats itself three times, where the first and the third equilibrium are shaded in gray, the second is white. This pattern repeats itself infinitely (i.e., period 8 outcome equals period 1 outcome).

Without loss of generality and to limit expositional complexity, Table 2 reports the upper and lower bounds of each country's strategy. In the example presented in Table 1, we just present [.27|.31] as the lower and [.33|.35] as the upper bound of the simulation. The first line of each cell reports the lowest combination of tax rates $[\tau_m|\tau_n]$ countries have chosen, while the second line depicts the highest combination of tax rates $[\tau_m|\tau_n]$.

Table 2 demonstrates that in our model, fairness norms and budget constraints influence tax policies in open economies. Both variables affect the equilibrium of our simulation. Ceteris paribus, budget rigidities moderately and negatively affect the tax rate on mobile capital, but largely increase the tax rate on immobile labor. Fairness considerations also affect tax policies. In the presence of budget rigidities, fairness norms prevent the government from driving a wedge between the tax rates on mobile and immobile factors. Governments

[13] The current version of our computational model does not assume perfect foresight on behalf of the governments. Governments have no information on *future* tax rates in other countries, while they possess perfect information on the *current* tax rates implemented in all countries. This assumption is less restrictive and arbitrary than it may appear at a first glance, because perfect foresight would not substantively alter the results, but only significantly shorten the adjustment process. Rather than dribbling toward the Nash-equilibrium, perfectly informed governments would jump to the unique Nash-equilibrium strategy. Our simulation thus mirrors the basic insight of evolutionary game-theory that agent strategies in the long run converge to equilibrium if agents are learning, or a Darwinian selection process exists (Fudenberg and Levine 1999).

Table 2. The Impact of Budget Rigidities and Fairness Norms on the Outcome of Tax Competition

			Fairness norms			
			Low *0.1*	*0.3*	*0.5*	*High* *1.0*
Budget rigidities	Low					
		0.6	.26|.35	.27|.31	.28|.30	.28|.30
			.31|.36	.33|.35	.33|.34	.33|.34
		1.0	.29|.44	.33|.39	.34|.38	.35|.37
			.35|.43	.37|.40	.38|.40	.38|.39
		1.4	.29|.46	.34|.42	.35|.40	.37|.39
			.37|.44	.38|.42	.39|.41	.39|.40
	High					

therefore tend to raise taxes on mobile capital and lower taxes on relatively immobile labor. In the extreme case, where high budget rigidities and strong fairness norms coexist, tax competition is unlikely to exert a strong influence on governments' tax policies. Our second question concerns the impact of our main variables on the tax structure implemented by governments. If fairness norms do not restrict politicians, the difference between taxes on mobile and immobile factors can become very large. If fairness norms are strong, differences remain small. This result is of course intuitively plausible.

Tax Competition Among Heterogeneous Countries:
The assumption of identical countries is not very realistic. It thus seems obvious to examine whether the results presented in the previous subsection remain robust when we vary the impact of fairness norms and budget constraints on the outcome of tax competition across countries. Due to space constraints we cannot discuss all details of the analysis of tax competition among heterogeneous countries. We present a representative selection of our simulation results in Appendix B and only summarize our findings here.

First, the government in the least restricted country minimizes its loss function by implementing the highest capital tax rate, which will not be undercut by other countries. Consequently, tax competition has less severe consequences when all but one government is constrained. Equilibrium tax rates on mobile capital turn out to be relatively low when more than one government faces negligible domestic limits. In other words, the severity of tax competition is determined by the competition between the two most unrestricted countries.

Second, holding everything else constant, countries in which governments are least restricted by fairness considerations implement the lowest tax rates on mobile capital and become capital importers. This result remains valid for the opposite case: governments which are most restricted by fairness norms implement the highest tax rates on mobile capital and become capital exporters. Accordingly, fairness norms come at a price; the price a country with an egalitarian electorate has to pay is highest when fairness norms are weaker in other countries.

Third, if fairness norms largely vary among countries, the divergence in tax rates on mobile capital can stay significantly large regardless of capital mobility. The variance in tax rates and tax systems may still decline, but the more countries differ with respect to fairness norms and budget constraints, the larger the remaining variation in tax systems will be across countries.

Fourth, mirroring the results of variations in fairness norms, tax competition becomes more severe when (at least) two governments are unrestricted by budget constraints. Both governments greatly cut their tax rates on mobile capital, while the more constrained government cannot follow. Thus, unrestricted

TABLE 3. Summary of Hypotheses

Definition	*Capital taxation*	*Labor taxation*	*Labor to capital tax ratio*
Foreign capital taxation	++	−−	−−
Budget rigidity	++	+	−
Fairness norms	+	−	−−

governments set competitively low tax rates on mobile capital to attract the mobile capital base of the more restricted country. If there is much to compete for, the least constrained governments can trade-off budget deficits and violations of fairness norms to attract the internationally mobile capital.

Discussion of Findings and Summary of Hypotheses

In the absence of capital controls, governments face a double incentive: they compete for internationally mobile capital and at the same time need to consider the reaction of their domestic constituency. Not all governments are doing equally well in international tax competition. The more restraining the domestic political economy, the less competitive a country can act in the international arena. Equilibrium tax rates tend to be higher for all countries if there is a single country with an unrestricted government. Table 3 summarizes our theoretical hypotheses with respect to three ''dependent variables,'' that is, the tax rate on mobile capital, the tax rate on labor, and the ratio between both tax rates; ''++'' describes strong positive and ''+'' weak (insignificant) positive effects. The same logic applies to negative effects.

Our model holds that budget constraints significantly increase capital tax rates, insignificantly increase labor tax rates, and have a negative effect on the labor tax to capital tax ratio. We expect a positive effect of fairness norms on capital and no or a lower positive effect[14] on labor taxation—both are possibly insignificant while the impact of fairness norms on the tax system should be significant. According to our model, higher fairness norms decrease the ratio of labor taxes to capital taxes and the gap between the two tax rates should become smaller. In broad accordance with the tax competition literature, we expect a strong positive impact of foreign tax rates on domestic ones. If the other countries reduce their tax rate on mobile capital, the country under investigation should follow suit. On the other hand, competitive pressures on capital taxation should drive up labor taxes and, therefore, induce a significant effect on tax systems.

Empirical Analysis

The preceding section has modeled tax competition as a two-level game between three opportunistic governments. Given the game-theoretical nature of the argument, the predictions of the computational model are ''strategic'': a government's choice of a tax system does not only depend on the domestic constraints, but also on tax setting strategies in other countries. Essentially, this translates into a regression of a country's tax rate on the tax rate of adjacent economies (and other variables; see Specification and Estimation). Yet, given the strategic nature of the argument, the empirical test faces a severe endogeneity problem. As country j's tax rates (by assumption) depend on the tax rates in the $-j$ countries and vice versa, the other countries' tax rates are not exogenous. We solve this problem via a standard instrumental variable approach, where the tax rates on the right-hand side are instrumented appropriately.

[14] Countries with prevalent fairness norms have typically larger governments.

Specification and Estimation

We account for the strategic nature of tax competition by estimating a *reaction function* for capital and labor taxes and the ratio between capital and labor taxes (Brueckner 2003; Franzese and Hays 2007).[15] In its general form, the tax reaction function can be written as

$$\tau_{jt} = R(\tau_{-jt}, Z_{jt}), \quad \forall j \in N, j \neq -j, \tag{10}$$

where τ_{jt} is the tax burden of country j at time t. τ_{-jt} denotes a vector of tax burdens of all other countries $-j$. Z is a vector of K control variables affecting the (capital and labor) tax rates in country j. To obtain a straightforward estimation equation, we rewrite equation 10 so that

$$\tau_{jt} = \beta \sum_{j \neq -j} \omega_{j,-j}\tau_{-jt} + Z_{jt}\theta + \varepsilon_{jt}, \tag{11}$$

where the τ on the right-hand side is the spatial lag and ε_{jt} represents the classical error term of linear models. $\omega_{j,-j}$ represents a weighting scheme taking larger values if the $-j$ jurisdiction exerts a relatively large influence on country j. We assume that a country's response to other countries' change in tax rates depends on the amount of capital the other country is able to attract.[16] Thus, the tax system of country j is a function of its own political economy and the constellation of tax rates implemented by other countries, which mirrors our theoretical two-level game. We expect lower taxes on capital and higher taxes on labor when the rest of the world cuts its tax rate on mobile capital.

To isolate the impact of budget rigidities and fairness norms we include these variables separately.[17] The estimation equation 11 becomes

$$\tau_{jt} = \beta_1 \sum_{j \neq -j} \omega_{j,-j}\tau_{-jt} + \beta_2 D_{jt} + \beta_3 F_{jt} + Z_{jt}\theta + \alpha_j + \varepsilon_{jt}, \tag{12}$$

where D and F denote budget rigidities and fairness norms, respectively. For τ on the left-hand side, we employ average effective tax rates on capital and labor, which are defined as the revenue of factor incomes to the corresponding tax base (Mendoza, Razin, and Tesar 1994; see Appendix A for details).[18] To account for tax competition effects, we include instrumented spatial lags of effective capital tax rates into the right-hand side of the empirical models. The spatial lags are substantially weighted by Foreign Direct Investment (FDI).[19] FDI is

[15] We run separate regressions for capital and labor tax burden as well as the ratio between these taxes. Therefore, we remove the subindices m and n on the τ's throughout.

[16] We do not treat the spatial effect as a pure nuisance but are interested in the substantial effects of capital taxation in other countries. See Basinger and Hallerberg (2004) and Franzese and Hays (2007) for the importance of using theoretically inspired substantial weights for spatial capital lags.

[17] An obvious extension would be to incorporate interaction terms between tax rates of adjacent economies (τ) and fairness norms (F) as well as budget rigidities (D). However, we treat the weighted tax rate of foreign countries as endogenous (see below) applying an instrumental estimation. This would raise severe problems in estimation, if, as in our case, the interaction effects and the tax rate of adjacent economies are highly correlated.

[18] Average Effective Tax Rates (AETR) are the only tax measures which allow us to directly compare capital and labor tax burdens.

[19] Assuming that governments mimic ''successful'' countries' tax policies more closely than that of struggling countries, Troeger (2008) weights the spatial tax lag with FDI inflows. We also use FDI inflows as weight for the spatial capital tax lag. Note, however, that FDI inflows are likely to be endogenous to domestic capital tax rates and therefore the weight is endogenous to the spatial lag. This is certainly true, yet, this endogeneity still would not bias the coefficient of the spatial lag but only render the estimation as less efficient. As Plümper and Troeger (2007) have shown elsewhere, inefficiency is not a trivial problem because it leads to unreliable point estimates and not—as many seem to believe—only to higher standard errors. However, one has to weight unbiasedness against efficiency and in this case we believe instruments are the smaller of these two nuisances.

measured as actual net inflows of foreign direct investment as percentage share of the Gross Domestic Product (GDP). This variable is available from the World Development Indicators (WDI) provided by the World Bank (2006).

As societal fairness norms cannot be directly observed, we use two different operationalizations: initial pre-tax income inequality in a country and fiscal redistribution to compensate for the observed inequality on the one hand, and survey data from the International Social Surveys Program (ISSP) on the other. We discuss the results from pre-tax income inequality and redistribution variables in the section on Empirical Analysis and treat the survey data estimation as a robustness check discussed in section on Robustness. We use the ISSP data only as a robustness check because the coverage is limited—only 17 of the 23 countries in our sample are included in the survey at most.

The change in the Gini coefficient between pre-tax and post-tax inequality captures the response of governments to domestic fairness norms reasonably well. In particular, we use the pre-tax Gini coefficient measuring income inequality provided by Mahler and Jesuit (2006, Fiscal Redistribution Data Set) which is based on data from the Luxembourg Income Study (LIS 2006). As LIS data are only available for 13 OECD countries and up until 2002, we fill in the missing values by computing Gini coefficients based on data from the LIS project and the University of Texas Inequality Project (UTIP–UNIDO 2002).

From the ISSP survey data, we use the country mean and standard deviations of the answers to the question whether ''it is the responsibility of the government to reduce the differences in income between people with high incomes and those with low incomes.'' This question was asked in both the ''Role of Government Surveys I, II, and III'' which took place in 1985, 1990, and 1996 and the ''Social Inequality Surveys I, II, and III'' (in 1987, 1992, and 1999). The answering categories are 1, strongly agree; 2, agree; 3, neither agree nor disagree; 4, disagree; and 5, strongly disagree. Thus, a lower value indicates a higher demand for redistribution.

Budget rigidities (proxied by the share of central government debt to GDP) are available from the OECD National Accounts (2006). Our operationalization assumes that all governments can run deficits if the *ex ante* debt burden is low. For example, the continental European welfare states responded to the first oil crisis by largely increasing deficits to curb unemployment. Eight years later, the governments of the very same countries could not respond likewise to the second oil crises, because the *ex ante* debt burden was much higher. Along similar lines, governments in countries with low debt burdens can respond to increasing tax competition by allowing for larger deficits while governments in countries with higher debt rates do not have the same option. We therefore assume—in line with empirical evidence—that initially high debt rates indicate government constraints. Yet, the contemporaneous values of this variable prove to be endogenous to tax competition. We rely upon the Sargan-*C* statistic to determine the lag-structure which renders government debt exogenous to the tax rates.[20]

Z denotes the vector of control variables. We include variables found to be significant in earlier empirical studies of tax competition (Basinger and Hallerberg 2004; Swank 2006). The share of elderly population (over 64) and the unemployment rate capture pressures on social security systems and therefore spending (both WDI, World Bank 2006). We add trade openness (Imports + Exports/GDP), annual GDP growth and the natural logarithm of per capita income (World Bank 2006) to the right-hand side of the model. To operationalize the overall

[20] Specifically, the Sargan-*C* statistic for orthogonality of suspected instruments (H_0: the instrument is exogenous) allows us to determine the appropriate leg length for the debt variable and choose the first lag that appears to be exogenous. We obtain the following *C*-Statistics: first lag: 2.8, second lag: 2.6, and third lag 1.6. Accordingly, only the third lag does not lead to a rejection of the nil-hypothesis of exogeneity. This is the lag we choose.

level of legal capital mobility, we calculate the annual average of Quinn's (1997) measure of capital account restrictions for all 23 countries.[21] To account for partisan influences on tax policies we use data on left and Christian democratic cabinet portfolios (Swank 2002).[22] Finally, the natural logarithm of total population (World Bank 2006) accounts for the effect of country size on tax policies.

As our theoretical model holds, capital tax rates in jurisdictions j and $-j$ are jointly determined by strategic interaction between governments. Our research design mirrors these theoretical considerations. Rewriting equation 10, we get

$$\tau = \beta W\tau + Z\theta + \varepsilon, \tag{13}$$

where W is the weighting matrix with the typical element $\omega_{j,-j}$. The reduced form is

$$\tau = (I - W)^{-1} Z\theta + (I - W)^{-1}\varepsilon \tag{14}$$

Equation 14 defines the equilibrium of the strategic game. The equilibrium is determined by a linear combination of the Z variables of *all* jurisdictions. τ depends on the inner product of the k^{th} row of $(I - W)^{-1}$ and the error term ε. Put differently, the tax rates on the right-hand side of equation 10 are correlated with the error term. Hence, Ordinary Least Squares (OLS) leads to biased and inconsistent parameter estimates.

Fortunately, a two-stage least squares estimation approach can easily deal with this problem. In the first step we regress $W\tau$ on Z and WZ (including the α_j's) and use the fitted values $\hat{W\tau}$ as instruments for $W\tau$.[23] IV-estimation implies regressing the weighted linear combination of the τ's from the right-hand side of equation 10 on Z_j and on the same linear combination of all Z_j's.

A consistent estimation of equation 14 requires instruments uncorrelated with the error term but highly correlated with the endogenous variables (i.e., τ_j). Following standard tax competition arguments, we draw on economic variables known to influence capital taxation as instruments. As the endogenous right-hand side variable is the FDI weighted spatial lag of capital taxation, we construct spatial lags of all instruments with according weights. We take the spatial lags of the ''Quinn-measure'' (Quinn 1997) for legal capital mobility, the pre-tax Gini coefficients (LIS, UTIP), the GDP per capita, government consumption to total GDP, trade openness, and total population (all World Bank 2006) as instruments.

From this set of potential instruments, we included only those passing the Sargan over-identification test (Wooldridge 2002, 98). Further, we test the validity of our instruments with an *F*-test for the (joint) significance of the excluded instruments in the first-stage regression, and employ a Durbin–Wu–Hausman test for endogeneity of the instrumented spatial capital tax lag (Davidson and MacKinnon 1993). According to these tests, our instrumental equation eliminates existent endogeneity problems. As the Wooldridge test (Wooldridge 2002, 176–7) for serial correlation in the idiosyncratic errors of a linear panel-data model implies the existence of arbitrary serial correlation, we implement heteroscedastic and autocorrelation consistent Newey–West type (Newey and West 1987) standard errors and variance–covariance estimates.

[21] The economic variables unemployment rate, GDP growth, and trade openness enter the estimation equation 1-year lagged to avoid endogeneity bias and as suggested by the Sargan-*C* statistic.

[22] As we have shown elsewhere (Plümper, Troeger, and Manow 2005), changes in cabinet portfolios impact policy outcomes with different time lags mainly caused by differences in the electoral system. To account for an appropriate lag-structure, we lag the portfolio variables by 1 year in countries with a majoritarian electoral system and 2 years in countries with a proportional electoral system.

[23] For details on this procedure see Wooldridge (2002, 90ff). We calculate the correct standard errors based on the Fixed Effect 2 Stage Least Squares (FE2SLS) residuals (Wooldridge 2002, 83).

Estimation Results

The estimation results for capital and labor taxes, as well as the ratio between capital and labor tax burdens, are reported in Table 4. The sample includes 23 OECD[24] countries and spans from 1975 to 2004. The Durbin–Wu–Hausman test in the lower block rejects the null that OLS is consistent and efficient for most of the models[25]—a result which together with the Sargan test statistic indicates the appropriateness of our IV approach.

Our estimation results back our theory.[26] We obtain a significant positive parameter estimate for the tax rate of adjacent economies (i.e., a positive sloped reaction curve). This finding is in line with previous empirical evidence (Altshuler and Goodspeed 2002; Devereux, Lockwood, and Redoano 2008; Egger, Pfaffermayr, and Winner 2005; Egger et al. 2006). The positive significant coefficient also lends support to the argument that governments do not take tax policy in all foreign countries equally into account but bring domestic capital tax rates closer in line with capital tax rates in countries successful in attracting mobile capital. However, as can be seen from the coefficients for budget rigidity (proxied by central government debt) and fairness norms (fiscal redistribution), the ability of governments to cut tax rates is limited by the domestic constraints they face. Both variables have a significantly positive impact on the capital tax burden and the coefficients remain robust over time. An increase in the severity of tax competition does not eliminate the dependence of the tax rates on budget rigidities and fairness norms. If budget rigidities are strong and foreign countries have already chosen competitively low tax rates, governments need to implement higher capital tax rates to prevent larger budget deficits and, as a consequence thereof, a loss in voter support.

The same holds true for societal fairness norms. The electorate punishes the policymaker for driving a significant wedge between tax rates on labor and capital. We find support for this hypothesis. The pre-tax Gini coefficient measures the initial inequality in a society. Consistent with our theoretical predictions, we find that a higher pre-tax inequality lowers the capital tax rates. This effect is moderated by the electoral demand for tax equity (absolute redistribution) which pushes the two tax rates closer to each other. Thus, the more governments are constrained by societal fairness norms, the higher the tax rate imposed on capital and the lower (though not significant—see models 2a and 2b) the tax rate on the immobile factor leading to a more equal tax system (models 3a and 3b).

The same can be observed for budget constraints. The more rigid the budget becomes the less able are governments to engage in international tax competition and the smaller becomes the gap between labor and capital tax rates. Contrary to the theoretical predictions, governments do not seem to cut tax rates on labor in case tax competition is less fierce. The FDI-weighted spatial capital tax lag does not affect labor tax rates significantly (Models 2a and 2b). Even though policymakers enjoy more leeway in domestic taxation if tax rates on capital abroad remain fairly high, the demand for public goods and a sticky budget

[24] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Models 1b, 2b, and 3b only include 21 countries since no data on cabinet portfolios is available for Iceland and Luxembourg.

[25] Only in model 3b, the Durbin–Wu–Hausman test clearly rejects endogeneity of the spatial lag. In this case the substantial findings remain unchanged when using a simple fixed effects model without instrumenting the spatial capital tax lag.

[26] The intercept of the full models is arbitrarily high, which is driven by the coefficient of the log(population) variables. However, suppressing this variable does not alter the substantive results (all confidence intervals—with the exception of the intercept—overlap). To show that the predicted results remain reasonable despite the artificially high intercept, we calculated the predicted tax rates and tax ratios for a country which has mean values for all variables in the model. The results are shown in the summary statistics of Table 4.

TABLE 4. Estimation Results

	Model 1a AETR on capital	*Model 1b AETR on capital*	*Model 2a AETR on labor*	*Model 2b AETR on labor*	*Model 3a Tax ratio labor/capital*	*Model 3b Tax ratio labor/capital*
Spatial Lag (SL)	0.014***	0.015***	0.003	−0.003	−0.001	−0.001**
capital tax,	(0.004)	(0.004)	(0.003)	(0.003)	(0.000)	(0.000)
FDI weighted						
Equality	−93.011***	−64.015***	30.285***	17.175*	8.099***	5.105***
(pre-tax Gini)	(14.987)	(15.619)	(9.891)	(9.578)	(1.519)	(1.153)
Equality (absolute	27.892***	18.779**	−6.605	−0.464	−1.773*	−1.565**
redistribution)	(9.466)	(9.426)	(6.233)	(5.777)	(0.961)	(0.696)
Debt ($t-3$)	0.127***	0.074*	0.176***	0.071***	−0.007***	−0.004
	(0.023)	(0.041)	(0.015)	(0.025)	(0.002)	(0.003)
Dependency ratio		1.411***		0.366		−0.126***
		(0.432)		(0.266)		(0.032)
Unemployment		−0.175		0.483***		0.039***
($t-1$)		(0.148)		(0.091)		(0.011)
GDP growth ($t-1$)		0.369***		−0.259***		−0.044***
		(0.135)		(0.083)		(0.010)
Trade openness		−0.045		0.023		0.006*
($t-1$)		(0.044)		(0.027)		(0.003)
Ln(total population)		−14.892*		−19.086***		0.493
		(8.336)		(5.103)		(0.604)
Capital mobility		0.018		0.383		0.073
(world)		(2.15)		(1.316)		(0.158)
Ln(GDP per capita)		−1.95		12.334***		0.176
		(5.009)		(3.069)		(0.369)
Left cabinet portfolio		0.028***		0.001		−0.001*
(optlag)		(0.010)		(0.006)		(0.001)
Christian democratic		0.0004		0.007		0.001
Cabinet portfolio		(0.021)		(0.013)		(0.002)
(optlag)						
Intercept	71.311***	311.546**	12.574***	207.192**	−2.463***	−10.237
	(5.823)	(145.045)	(3.845)	(88.803)	(0.590)	(10.483)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Tax rate (ratio)	27.69	26.82	36.67	37.17	1.66	1.68
mean-country						
Adjusted R^2	0.728	0.731	0.837	0.873	0.603	0.750
Number of	642	598	641	597	641	583
observations						
F statistic	41.721	29.682	77.741	74.042	24.398	33.981
[*p*-value]	[.000]	[.000]	[.000]	[.000]	[.000]	.000
Anderson-test	3,621.222	3,709.937	3,615.657	3,703.561	3,615.657	3,631.731
[*p*-value]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]
DWH-test: χ^2	2.063	3.622	54.239	8.699	6.522	0.649
[*p*-value]	[.151]	[.057]	[.000]	[.004]	[.011]	[.421]
Sargan-test: χ^2	8.91	6.618	9.174	23.215	3.109	2.690
[*p*-value]	[.113]	[.251]	[.102]	[.000]	[.683]	[.748]

Notes. Values given in parentheses represent standard errors; ***significant at 1%; **significant at 5%; *significant at 10%. *F*-test for significance of the overall model; Anderson LR-test for relevance of instruments; Durbin–Wu–Hausman (DWH) chi-squared statistic [H_0: regressor is exogenous (i.e., OLS is consistent and efficient)]; Sargan-test for over identifying restrictions (H_0: the instruments are valid instruments, i.e., uncorrelated with the error term, and the excluded instruments are correctly excluded from the estimated equation).

cause them not to cut labor tax rates. Yet, the gap between labor and capital tax rates decreases in such a case as the international pressure to lower tax rates on mobile capital is alleviated.

Perhaps most importantly, our model provides a microfoundation for a tax system effect of tax competition. More precisely, we expect the ratio between labor taxes and capital taxes to increase with the severity of tax competition, but to decline with budget constraints and fairness norms. According to models 3a and 3b, the tax burden shifts from capital to labor taxation when tax competition becomes more severe, though the shift is smaller in countries where budget constraints and fairness norms restrict governments. Fairness norms influence the tax structure of a country considerably. Our results not only lend strong support to the hypotheses derived from our model, but also to arguments brought forward by other scholars (Bretschger and Hettich 2002; Rodrik 1997). That is, international tax competition leads to a shift of tax burdens to immobile factors rather than causing a decline in total government spending.

Table 5 summarizes the findings for the theoretically interesting variables and compares the empirical results to the predictions of the theoretical model. These empirical findings are consistent with the predictions derived from our model. Yet, there are some minor deviations. Fairness norms appear to have a stronger empirical effect on capital tax rates than our model predicts. Moreover, tax rates on capital in other countries mostly affect domestic capital taxation and much less so the tax rate imposed on dependent labor and the tax ratio. Accordingly, governments do not cut labor tax rates if tax competition becomes less intense.

The estimated effects of the control variables are also broadly in line with theoretical expectations. First, the larger the share of older people in a society the higher the pressure on national pension and health systems becomes. This leads to a greater demand for government spending, which in turn has to be financed by higher tax revenue from both immobile (model 2b—even though the coefficient does not turn out to be significant) and mobile (model 1b) factors of production. Second, higher unemployment rates amplify the pressure on social security systems which leads to significantly higher tax rates on wage income. The effect on capital tax rates is negative but remains insignificant, which supports the view that high unemployment provides an incentive for tax competition because governments benefit from the employment effects of capital inflows. Both findings are in line with empirical results presented in Swank and Steinmo (2002). Third, the results for the 1-year lagged annual growth rates are again consistent with earlier findings (Basinger and Hallerberg 2004; Swank and Steinmo 2002). Wealthier or faster growing countries can afford to ignore international tax competition, which leads to slightly higher capital tax rates, lower labor tax rates and a more equal distribution of tax burdens. Fourth, measures of the trade openness of a country and the competitiveness of international markets (overall restrictions to capital account transactions) do not seem to have a significant effect on tax policies once we control for other factors. Yet, trade openness significantly increases the gap between tax rates on labor and capital suggesting that openness indeed leads to a shift of parts of the tax burden from more mobile to less mobile tax bases. Finally, we find some support for partisan

TABLE 5. Comparison of Theoretical Predictions and Empirical Results

Definition		*Capital taxation*	*Labor taxation*	*Labor to capital tax ratio*
Foreign capital taxation	Prediction	++	−−	−−
	Estimation	++	No effect	−
Budget rigidity	Prediction	++	+	−
	Estimation	++	++	−
Fairness norms	Prediction	+	−	−−
	Estimation	++	−	−−

arguments. While Christian democratic governments do not implement overall different tax policies, left governments on average set higher tax rates on capital income and thus allow for smaller differences between capital and labor tax rates.

Robustness

De facto inequality and redistribution is not entirely independent of the tax system. Some countries, especially liberal market economies, use tax progression and a broad tax base to redistribute income (Plümper and Troeger 2008). Accordingly, our estimation of the role of fairness to some extent suffers from endogeneity and could thus be biased. We conduct an additional test of our hypotheses which deals with this problem: in particular, we employ survey data measuring the electorate's stance toward government intervention into the economy and redistribution. Table 6 demonstrates that our hypotheses are supported if we account for the conditional dependence of redistribution on the tax system. A higher public demand for redistribution leads to higher effective capital tax rates, a stronger reliance of revenues from capital taxes and a more equal tax system. The impact of all other variables in the three models remains virtually unchanged when using the survey measure to operationalize societal fairness norms.

A second source for concern results from the computation of effective tax rates. Although the techniques we use to compute effective tax rates are standard, we cross check the stability of our results and especially that of the capital tax and the tax ratio models by using the share of corporate income tax reve-

TABLE 6. Robustness Test 1: Operationalization of ''Fairness''

	Model 4 *AETR on capital*	*Model 5* *AETR on labor*	*Model 6* *Tax ratio labor/capital*
		ISSP	
SL capital tax, FDI weighted	0.018*** (0.005)	−0.001 (0.003)	−0.001** (0.000)
ISSP: income redistribution (mean)	−18.628*** (4.535)	−2.164 (3.138)	1.376*** (0.340)
ISSP: income redistribution (SD)	−1.237 (3.811)	−3.136 (2.637)	0.009 (0.287)
Debt ($t-3$)	0.129*** (0.049)	0.127*** (0.034)	−0.005 (0.004)
Dependency ratio	0.797* (0.461)	0.364 (0.321)	−0.118*** (0.035)
Unemployment ($t-1$)	−0.741*** (0.168)	0.406*** (0.116)	0.071*** (0.013)
GDP growth ($t-1$)	0.121 (0.147)	−0.369*** (0.101)	−0.035*** (0.011)
Trade openness ($t-1$)	0.038 (0.05)	0.025 (0.035)	0.001 (0.004)
Ln(total population)	−28.052*** (8.249)	−13.408** (5.708)	1.234** (0.621)
Capital mobility (world)	1.28 (2.492)	−3.162* (1.725)	0.035 (0.191)
Ln(GDP per capita)	−2.791 (5.346)	17.716*** (3.703)	0.248 (0.410)
Left cabinet portfolio (optlag)	0.021* (0.011)	0.003 (0.008)	−0.001 (0.001)
Christian democratic cabinet portfolio (optlag)	−0.025 (0.021)	0.018 (0.015)	0.002 (0.002)
Intercept	574.313*** (149.315)	90.39 (103.344)	−25.419** (11.228)
Fixed effects	Yes	Yes	Yes
Adjusted R^2	0.746	0.858	0.749
Number of observations	481	480	468
F statistic	29.597	60.297	30.895
[p-value]	[.000]	[.000]	[.000]

Notes. Values in parentheses represent standard errors; ***significant at 1%; ** significant at 5%; * significant at 10%; F-test for significance of the overall model; ISSP, International Social Surveys Program; SL, Spatial Lag.

nues to total tax revenues (see Quinn 1997 for a discussion of the advantage of using tax revenues as dependent variable). Again, we find that our main results and inferences hold: revenues from capital taxation are relatively higher in countries with higher budget constrains and more prevalent societal fairness norms (see Table 7, model 7).

Finally, we account for correlated errors across models. We have argued (and we made this point more explicit in another article, Plümper and Troeger 2008)

TABLE 7. Robustness Test 2: Tax Revenues and Correlated Errors

	Model 7 Corporate tax revenue/ total tax revenue	*Model 8 AETR on capital*	*Model 9 AETR on labor*	*Model 10 Tax ratio labor/ capital*
			Correlated error terms	
SL capital tax, FDI weighted	0.0001***	0.016***	−0.003	−0.001***
	(0.000)	(0.003)	(0.002)	(0.000)
Equality (pre-tax Gini)	−0.170***	−63.927***	17.180**	5.192***
	(0.050)	(10.038)	(8.549)	(0.744)
Equality (absolute redistribution)	0.042	21.567***	−1.644	−1.375***
	(0.030)	(6.082)	(5.162)	(0.448)
Debt ($t-3$)	0.0003**	0.046*	0.083***	−0.004*
	(0.000)	(0.026)	(0.022)	(0.002)
Dependency ratio	−0.007***	1.291***	0.414*	−0.147***
	(0.001)	(0.275)	(0.237)	(0.021)
Unemployment ($t-1$)	−0.00002	0.035	0.394***	0.043***
	(0.0004)	(0.095)	(0.082)	(0.007)
GDP growth ($t-1$)	0.002***	0.314***	−0.235***	−0.044***
	(0.000)	(0.087)	(0.074)	(0.006)
Trade openness ($t-1$)	0.0003**	−0.023	0.014	0.007***
	(0.0001)	(0.028)	(0.024)	(0.002)
Ln(total population)	−0.024	−16.299***	−18.487***	0.489
	(0.027)	(5.289)	(4.544)	(0.393)
Capital mobility (world)	0.001	0.870	0.023	0.101
	(0.007)	(1.365)	(1.173)	(0.103)
Ln(GDP per capita)	0.039**	−2.799	12.682***	0.101
	(0.016)	(3.174)	(2.724)	(0.241)
Left cabinet portfolio (optlag)	−0.00004	0.021***	0.004	−0.002***
	(0.00003)	(0.006)	(0.006)	(0.000)
Christian democratic cabinet portfolio (optlag)	−0.0001*	−0.026*	0.018	−0.0004
	(0.0000)	(0.014)	(0.012)	(0.001)
Residuals AETR on labor (2b)		0.523***		0.021***
		(0.054)		(0.005)
Residuals tax ratio (3b)		−7.094***	3.029***	
		(0.325)	(0.378)	
Residuals AETR on capital (1b)			0.374***	−0.062***
			(0.039)	(0.003)
Intercept	0.281	339.616***	195.348**	−9.456
	(0.461)	(92.0399	(79.064)	(6.804)
Fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.794	0.887	0.898	0.897
Number of observations	590	597	597	583
F statistic	43.267	83.636	90.28	89.036
[p-value]	[.000]	[.000]	[.000]	[.000]

Notes. Values in parentheses represent standard errors; ***significant at 1%; **significant at 5%; *significant at 10%; F-test for significance of the overall model; SL, Spatial Lag.

that effective capital tax rates and effective labor tax rates are not necessarily independent of each other. This implies that the errors of our single equation models are not necessarily independent of each other. We therefore predicted the residuals of models 1b, 2b, and 3b and found the residuals to be acceptably highly correlated to each other. We nevertheless included the predicted residuals of models 2b and 3b in the re-estimation of model 1b, the residuals of 1b and 3b in the re-estimation of model 2b and the residuals of 1b and 2b in the re-estimation of model 3b to also account for a possible correlation between the error processes and the substantive explanatory variables (see models 8–10). All our results prove to be robust, which lends additional support to our theoretical predictions as well as our inferences. If anything, the inclusion of the predicted residuals renders the empirical estimation more efficient, leading to smaller standard errors and higher significance levels.

Conclusions

The ability of governments to compete with other countries for mobile capital is constrained by the domestic political economy. The more severe budget constraints and the more prevalent societal fairness norms are, the lower the government's ability to reduce taxes on mobile capital in the presence of international competitive pressures. Reversing the logic of the argument, the domestic political economy exerts a large, and in many cases, even dominant influence on tax rates even when countries abolish capital controls. Tax systems, therefore, should continue to systematically vary within OECD countries, though tax policies certainly, but only partially diffuse between countries.

Empirical evidence supports our theoretical model. Both budget constraints and fairness norms shape the tax rates on mobile and immobile capital and in sum largely influence tax systems. Our study also supports the recent turn to computational models in political science. By employing a computational framework, we are able to derive a more complex set of hypotheses from our model. Our research method enables us to examine the case of three countries, which even may be heterogeneous. For homogenous countries our findings are quite plausible: budget rigidities have an impact on the level of tax rates on mobile capital and relatively immobile labor, while fairness norms exert a strong impact on the tax structure. The effect of fairness norms is weak unless the government faces severe budget constraints. The analysis of heterogeneous countries demonstrates that our model's predictions do not depend on the assumption of homogeneity but carry over to tax competition among unequal countries.

Our model offers an interesting perspective on tax competition. The bulk of existing theories of tax competition predict convergence of tax policies. Our model, however, under all initial conditions, generates separating equilibria. Most interestingly, tax policies remain diverse even in a population of homogeneous countries. Tax policy differences become larger when countries become more dissimilar, though the heterogeneity of countries is not a necessary condition of enduring differences in tax systems. According to our model, and consistent with empirical observations, tax competition maintains diversity in tax systems rather than leading to full convergence in tax policies. Our theoretical model also predicts the absence of a race to the bottom in capital taxation. Tax competition is not the end of the world as we know it.

Appendix A: Calculation of Implicit Tax Ratios

Implicit tax ratios are calculated according to Mendoza, Razin, and Tesar (1994) and the extensions in Volkerink and de Haan (2001, 37):

$$\text{LAB} = \frac{\delta \cdot 1,100 + 2,100 + 2,200 + 300}{\text{CoE} + 3,000}$$

$$\text{CAP} = \frac{(1-\delta) \cdot 1,100 + 1,200 + 4,000 + 5,125 + 5,212 + 6,100}{\text{OS} - 3,000},$$

where δ is the fraction of personal income taxes attributable to labor income.

The calculations are based on data from the OECD Revenue Statistics (2006) and OECD National Accounts (2006). A major difficulty in the determination of δ is to split personal income taxes into labor and capital income. For some countries these items are not reported in the Revenue Statistics. In this case we follow Volkerink and de Haan (2001) to approximate δ by

$$\delta^* = \frac{\text{CoE}}{\text{OSPUE} + \text{CoE}}$$

For countries that allow for an exact distinction between labor and capital taxes the correlation coefficient between δ and δ^* is 0.89.

The codes used in the formulas correspond to the OECD classification in the OECD Revenue Statistics: 1,100…Taxes on income, profits, and capital gains of individuals; 1,200…Corporate taxes on income, profits, and capital gains; 2,100…Social security contributions of employees; 2,200…Social security contributions of employers; 3,000…Taxes on payroll and workforce; 4,000…Taxes on property; 5,125…Taxes on investment goods; 5,212…Motor vehicle duties, not paid by households; 6,100…Other taxes solely paid by businesses.

For the OECD National Accounts items we use abbreviations in capitalized letters: OS, Total operating surplus of the economy; OSPUE, Operating surplus of private unincorporated enterprises; CoE, Compensation of employees (= wages and salaries plus social security contributions of employers and employees).

Appendix B: Simulation Results for Heterogeneous Countries

We first define ideal-type countries according to the parameter settings. The first digit of the two digit codes defines various levels of budget rigidities (entry 1 indicates low budget rigidities and entry 3 high budget rigidities); the second digit defines the prevalence of fairness norms (entry 1 indicates low and entry 4 high equality). Table B1 illustrates the defined country types.

Table B1. Classification of Countries

			Fairness norms			
			Low *0.1*	*0.3*	*0.5*	*High* *1.0*
Budget rigidities	Low					
		0.6	type 11	type 12	type 13	type 14
		1.0	type 21	type 22	type 23	type 24
		1.4	type 31	Type 32	type 33	type 34
	High					

We now report results from selected typical combinations of countries. As the computational model does not produce chaotic outcomes—that is, large changes in the equilibrium outcome following small changes of parameter values—the

reported outcomes are sufficient to demonstrate the properties and the robustness of our model. Complete output files are available upon request.

TABLE B2. Tax Competition Among Countries of Different Fairness Levels

Country types			*Tax system chosen by country*		
A	*B*	*C*	*A*	*B*	*C*
11	11	11	.26|.35	.28|.35	.31|.36
11	11	12	.25|.34	.27|.35	.33|.35
11	11	13	.25|.34	.26|.34	.33|.34
11	11	14	.25|.34	.26|.34	.33|.34
21	21	21	.29|.44	.31|.43	.35|.42
21	21	22	.29|.43	.30|.43	.38|.41
21	21	23	.28|.43	.29|.43	.38|.41
21	21	24	.27|.43	.28|.43	.39|.40
31	31	31	.29|.46	.30|.46	.37|.44
31	31	32	.28|.46	.29|.45	.39|.44
31	31	33	.29|.45	.30|.45	.40|.43
31	31	34	.28|.46	.29|.45	.41|.42

TABLE B3. Tax Competition Among Countries of Different Budget Constraints

Country types			*Tax system chosen by country*		
A	*B*	*C*	*A*	*B*	*C*
11	11	31	.23|.33	.24|.33	.36|.47
11	11	21	.24|.34	.25|.34	.35|.44
11	11	11	.26|.35	.28|.35	.31|.36
11	21	31	.26|.34	.27|.43	.36|.46
11	21	21	.26|.34	.35|.44	.35|.44
11	31	31	.23|.33	.36|.47	.36|.47
14	14	34	.25|.26	.26|.27	.41|.43
14	14	24	.25|.26	.26|.27	.40|.41
14	14	14	.28|.30	.29|.31	.33|.34
14	24	34	.30|.30	.39|.40	.40|.42
14	24	24	.30|.31	.39|.40	.39|.41
14	34	34	.30|.30	.40|.42	.40|.42

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