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Taxing capital and labor when both factors are imperfectly mobile internationally

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Abstract

We revisit the standard theoretical model of tax competition to consider imperfect mobility of both capital and labor. We show that the mobility of one factor affects the taxation of both factors, and that the race-to-the-bottom narrative (with burden shifting) applies essentially to capital exporting countries. We test our predictions for a panel of 28 OECD countries over 1997-2014. We find capital taxation to be less sensitive to capital mobility in net capital importing countries than for net capital exporters. Various robustness checks support this conclusion. Qantitatively, though, rising capital mobility contributes much less than population ageing to the decline of capital tax rates over the period studied.

Keywords: tax competition, globalization, imperfect factor mobility.

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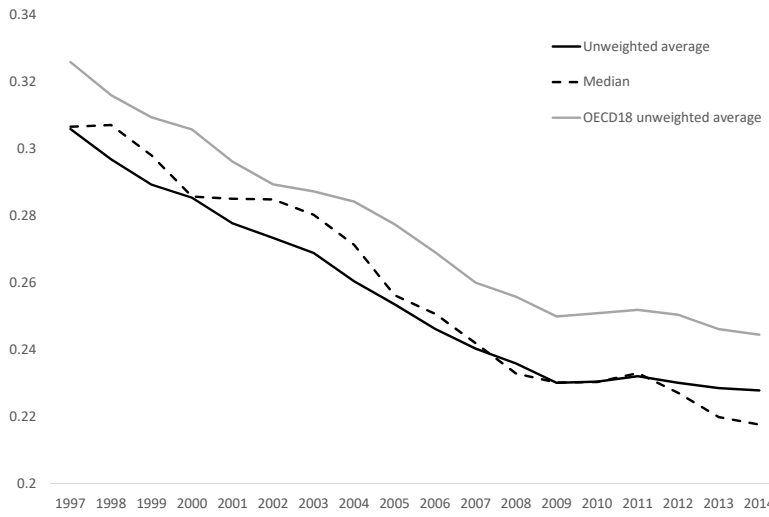
1 Introduction

The theoretical literature on tax competition generally finds that, when capital is mobile whereas land (or labor, or consumption) is not, it is optimal for a benevolent government not to tax capital, hence to finance the provision of public goods only through taxing immobile bases (see Zodrow and Mieszkowski, 1986, Wilson, 1999).[1] As a matter of facts, corporate tax rates have generally decreased in advanced economies since the 1980s (see Figure 1), while wealth taxes were hollowing out in most countries.

Figure 1: Effective Average Tax Rate on corporate income, 28 OECD countries*



*Australia, Austria, Canada, Chile, Czech Rep., Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Mexico, Netherlands, Norway, Poland, Portugal Slovak Rep., Slovenia, Spain, Sweden, Turkey, United Kingdom, United States. The OECD18 grouping excludes Chile, Czech Rep., Hungary, Israel, South Korea, Mexico, Poland, Slovak Rep., Slovenia and Turkey.
Source: Oxford University Centre for Business Taxation.

Strikingly, though, the empirical literature has remained quite inconclusive on the impact of international capital mobility on the taxation of capital (see the meta analysis of Adam et al., 2013). This surprising non-result may be explained in different ways. First, higher inequalities resulting partly from globalization may have raised the demand for insurance against shocks (compensation effect of globalization, see Rodrik, 1998). Second,

[1] Within a general equilibrium model, though, Mendoza and Tesar, 2005 show that capital mobility may not trigger a "race to the bottom" in capital taxation because taxing labor entails inefficiency costs.

financial integration has come together with some forms of social and political integration, which may have had opposite effects on capital taxation (Dreher, 2006). Third, financial globalization has been concommittant to population ageing: even in autarky, an ageing median voter may have voted in favor of declining taxes on capital.[2] Finally, financial globalization, like trade openning up, is a common feature of advanced economies over the 1990s and 2000s. As evidenced e.g. by Slemrod (2004), this makes it it difficult to identify its impact once time fixed effects are introduced.

In this paper, we address the above-mentioned pitfalls and further explore two additional explanations for the apparent limited effect of financial globalization on capital taxation. The first one is the simultaneous increase in the mobility of labor. Although in general labor mobility has remained limited over the last three decades, the mobility of at least skilled labor has increased, especially within the European Union where legal barriers to labor mobility have been eliminated. Figure 2 compares a measure of *de facto* labor and capital mobility for OECD countries. From 1997 to 2014, labor mobility among OECD countries increased by 42% on average. This increase may appear modest compared to the rise in de facto capital mobility (+223% over the same period).[3] However, this increase is substantial *per se*, especially when considering that its concentration on a minority of skilled workers.

The literature on tax competition generally enphasizes the burden shifting impact of capital mobility, or equivalently the "compensation effect" of globalization, which both end up in reduced capital taxation and increased labor taxation following financial globalization (see, e.g. Adam and Kammas, 2007). However, labor mobility may alter this result in two ways. First, labor mobility may put downward pressure on labor taxation, at least at relatively high levels of compensation. Liebig et al. (2007), Kleven et al. (2013) and Kleven et al. (2014) find very high elasticities for top-income foreign workers to tax differentials. Since foreign workers are a relatively small proportion of the high-income population, Piketty and Saez (2012) and Lehmann et al. (2014) retain an elasticity of

[2] Adam and Kammas (2007) find a significant, negative impact of the share of the population over 65 years on corporate income tax rates. In general, though, the empirical literature does not control for population ageing.

[3] Due to the high volatility of capital flows, we compare a flow measure of labor mobility to a stock measure of capital mobility. Averaging labor and capital mobility over 6-year windows, we find that gross capital flows increased in 2009-2014 by 158% compared to 1997-2002. During the same period, labor mobility increased by 38%.

0.25 for top-income earners. Lehmann et al. (2014) show that, if the semi-elasticity of migration increases for higher incomes, then it is optimal to reduce the marginal tax rates on top-income earners. Second, to the extent that the skilled workers are in the position to take decisions concerning the location of capital (both at the firm level and as savers), labor and capital mobility are likely to be intertwined. More mechanically, labor and capital mobility interact since the marginal productivity of one factor depends on the quantity of the other factor (see Wilson, 1995).[4]

The second feature we would like to study is the fact that even capital is not perfectly mobile internationally. In particular, a large literature has evidenced a home bias in international portfolio choices.[5] At the macroeconomic level, imperfect capital mobility translates into a wedge between after-tax returns across countries, depending on whether each country is a net capital exporter or importer.[6] More capital mobility reduces this wedge, with ambiguous impact on tax rates. However, the literature on tax competition generally considers capital to be perfectly mobile, which leads to an equalization of after-tax returns. An exception is Lee (1997) who introduces transaction costs within a two-jurisdictions model. In his setting, tax competition may lead to higher capital tax rates because each jurisdiction disregards the fact that raising its own tax depresses the after-tax return in both jurisdictions. Yet, the transaction cost is given, whereas in the macroeconomic literature, an indebted country will need to offer higher after-tax rerurn than the rest of the world if it wants to keep its foreign capital.

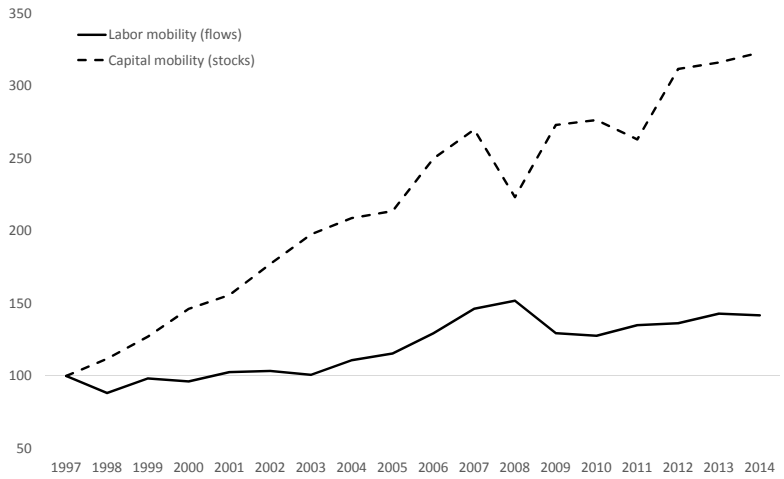
We consider a model of tax competition *à la* Zodrow and Mieszkowski (1986) where the benevolent government of a small open economy maximises the average household's utility that depends of the consumption of both a private good and of a public good. The latter good is financed through two taxes at the source: one on capital and the other one on labor. Both capital and labor are imperfectly mobile internationally. However, there is an asymmetry between capital and labor: while workers must be residents of the same

[4] In Bucovetsky and Wilson (1991) and Razin and Sadka (1991), labor supply is endogenous, which attenuates the standard result of taxation falling on the immobile base. However, to the extent that the elasticity of labor supply is finite, the mobile base stays under-taxed compared to the immobile one. These authors do not consider labor mobility across jurisdictions. Bucovetsky (2003) and Razin and Sadka (2012) do consider labor mobility, but they assume an heterogeneity between local and immigrant workers in terms of productivity or capital endowment.

[5] See the seminal paper by French and Poterba (1991), or the literature review by Lewis (1999).

[6] Horioka and Ford (2017) also explain why return differentials are not eliminated by financial integration.

Figure 2: De facto capital and labor mobility: OECD countries, 1997-2014



Note: Capital mobility is the sum of total assets and liabilities in percent of GDP (source: Lane and Milesi-Ferretti, 2004, updated). Labor mobility is the sum of inflows and outflows of non-nationals from other OECD countries, divided by the total population of the country (source: OECD database). The graph shows unweighted OECD averages.

country where they work, capital owners may be residents or non-residents.[7]

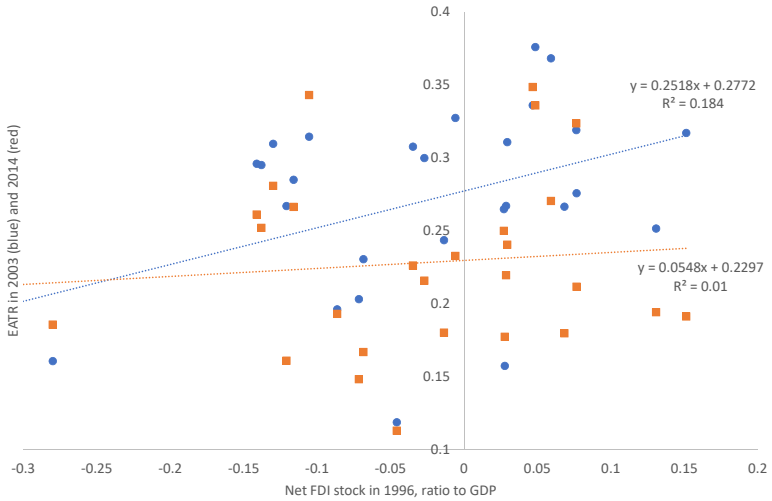
We first show that capital and labor taxation generally coexist. We then study the impact of factor mobility on both tax rates, through a full derivation of a simplified model and through simulations of the general model. We find that the government will reduce the tax rate on capital as a result of increased capital mobility (race to the bottom) and increase the tax rate on labor (burden shifting), but mostly for a country that is a net capital exporter. For a net capital importer, the results are more mixed. In contrast, being a net exporter or importer of labor has ambigous effect on the impact of labor mobility because the international position of a country on the labor market needs to be considered in combination with its position on the capital market.

The intuition of our result is the following. In a world of imperfect capital mobility, a capital-importing country needs to offer a higher ater-tax return than the rest of the

[7]This assumption, sometimes labeled "regional model" is standard in the literature, especially for international tax competition (see Wilson, 1999). However the literature on local tax competition has sometimes studied "metropolitan" models where individuals commute between home and work, see Braid (1996). In Richter and Wellisch (1996), households work in their country of residence while holding capital in other jurisdictions. However their capital (land) is in fixed supply in each jurisdiction.

world, hence a lower tax rate, in order to attract capital. Conversely, a country with high capital endowment may enjoy a higher tax rate than the rest of the world.[8] Along financial globalization, these after-tax returns diminish: the net capital importing country may raise its tax rate whereas the net capital exporter has to reduce its own tax rate. Considering the net position of each country in terms of foreign direct investment in 1996 (with a positive sign for a net capital exporter), Figure 3 shows a positive relationship with the Effective Average Tax Rate (hence the effective corporate income tax rate) in 2003 but this relationship vanishes in 2014.[9]

Figure 3: Net FDI position in 1996 and EATR in 2003 (blue circles) and 2014 (red squares)



Note: A positive Net FDI position points to a net capital exporter. 28 OECD countries.
Sources: Oxford University Centre for Business Taxation and Lane and Milesi-Ferretti.

We test our theoretical predictions on a panel of 28 OECD countries over the period 1997-2014, by successively studying the impact of factor mobility on the effective average tax rate on corporate capital and on the tax wedge on relatively high wages (gross income representing 167% of average earnings). We pay careful attention to several other variables that may also have affected tax rates over this period, namely trade openness, ageing, government spending and debt, and political leadership. We also include country and

[8] Peralta and van Ypersele (2005) also highlight the importance of capital endowments in a two-country framework where labor is not mobile.

[9] We use 2003 because it is the first year when we have the tax rates for our 28 OECD countries.

time fixed effects, and we interact factor mobility with proxies of factor importing or exporting status.

We find evidence that capital mobility has a negative impact on capital taxation and a positive impact on labor taxation, but essentially for capital exporting countries. Conversely, labor mobility has ambiguous impact on both tax rates. Quantitatively, though, we find a much larger contribution of population ageing than of increased capital mobility to the decline of corporate income tax rates over the period studied.

We finally carry out three robustness tests. The first addresses the potential endogeneity of factor mobility. The second one shows that the convergence speed of capital tax rates depends on the net capital position of a country, which is another way of looking at the same phenomenon. Finally, we provide two placebo exercises for the value-added tax and for the taxation of wages at the minimum income.

We conclude that the mixed results obtained in the literature concerning the link between international capital mobility and capital taxation may be related to improperly controlling for other factors, notably trade openness and ageing, failing to account for labor mobility, and to the extreme assumption of full capital mobility versus full labor immobility.

Our results suggests that a country that opens up to capital inflows may be less vulnerable in its ability to tax capital than a country that opens up to capital outflows. But also that these effects are second order compared to population ageing or (in the case of labor taxation), to the increase in government spending and debt.

The remainder of the paper is organized as follows. In Section 2, we outline the theoretical setting and solves a simplified version. Section 3 presents the calibration and simulation of the complete model. Section 4 introduces the empirical strategy and the data used. The econometric results are presented in Section 5. Section 6 concludes.

2 Theory

We consider a small open economy where production is achieved using two internationally mobile factors - capital and labor. A public good is financed through source taxation of capital and of labor. The government maximizes a utility function that depends on

public spending and on the after-tax national income per inhabitant. The novelty of the model is to highlight the cross effects of the mobility of one factor on the taxation of the other factor. Furthermore, our setting allows us to contrast the impact of factor mobility depending on whether the economy is a net exporter or importer of capital.

2.1 Production and incomes

Production is achieved using two internationally mobile factors, capital and labor, denoted K and L respectively. The production function is written as $F(K, hL)$, where $F(.,.)$ satisfies constant returns-to-scale and is increasing and concave in each arguments and where $h > 0$ is an exogenous scaling parameter. We assume that capital and labor are taxed at the source at rates τ_K and τ_L, respectively. We denote by r^* and w^* the international remuneration of capital and labor, respectively, and by r and w the domestic after-tax return of each factor such that $r := F'_K(.,.) - \tau_K$ and $w := F'_L(.,.) - \tau_L$.

We assume that two types of agents are living in the considered economy: (mobile) workers, assumed to be equal to the labor force L, and (immobile) pensioners of mass D.[10] Both have the same capital endowment, denoted $\bar{k}$,[11] and thus the total capital available in the economy depends on the total number of residents: $K = (L + D)\bar{k}$. Both workers (who are supposed to live in the same country where they work) an pensioners can invest their capital endowment in a different country. Capital income is the sum of the domestic capital income rK and of the revenue of the net investment position $(L+D)\bar{k} - K$. Importantly, a positive net investment position yields the foreign after-tax return r^*, whereas a negative net investment position costs the domestic after-tax return r, as part of the domestic capital income is channeled towards foreign investors. The rest of the earnings is made of an (after-tax) wage w, for workers and of an exogenous pension, denoted p, for pensioners. Hence, the private incomes (or disposable incomes) of each

[10] The importance of featuring pensioners in the model will appear clear in the econometric section of the paper.

[11] We do not study specific results that could arise from heterogenous capital between natives and migrants (Razin and Sadka, 2012) nor from different productivities (Bucovetsky, 2003).

worker and pensioner, denoted y_L and y_D, respectively, are given by:

$$y_L = \left| \begin{array}{l} rk + r^* \left(\bar{k} - k\right) + w \text{ if } \bar{k} \geq k, \\ rk + r \left(\bar{k} - k\right) + w \text{ if } \bar{k} \leq k, \end{array} \right. \tag{1}$$

and:

$$y_D = \left| \begin{array}{l} rk + r^* \left(\bar{k} - k\right) + p \text{ if } \bar{k} \geq k, \\ rk + r \left(\bar{k} - k\right) + p \text{ if } \bar{k} \leq k, \end{array} \right. \tag{2}$$

where $k := K/(L+D)$ is the capital per resident.[12] Notice that, in our model, workers relocate with their capital endowment, or stay home and invest their endowment overseas. Hence there is an asymmetry between capital and labor: attracting a new worker will automatically attract a new capital endowment, whereas attracting new capital will attract new workers only through the induced rise in the marginal productivity of labor.[13] We now turn to the conditions that provide the wedge between the domestic and the international remunerations of both factors.

2.2 No-arbitrage conditions with imperfect factor mobility

In contrast to the existing literature on tax competition, we assume that both capital and labor are imperfectly mobile, and that the extent of mobility may differ for capital and labor. In macroeconomic models, frictions in the international capital market are typically modelled as departures from the uncovered interest parity depending on the net foreign asset position of the country (see e.g. Lindé and Pescatori, 2017, Itskhoki and Mukhin, 2019). Consistently, we assume that the stock of productive capital in the domestic economy depends on the domestic endowment and on the gap between the domestic after-tax return on capital and the international remuneration of capital, which influences the international allocation of capital endowments:[14]

$$K = \left[\bar{k} + \phi_K \left(r - r^*\right)\right](L+D), \tag{3}$$

[12] If $\bar{k} = k$, then the alternative expressions of y_L and y_D are equivalent since $r = r^*$, see next sub-section.

[13] Such asymmetry could be erased if workers were allowed to work and live in two different countries. Existing models of international tax competition generally disregard this possibility, but things could change with the expansion of cross-border telecommuting (see Baldwin, 2016).

[14] For simplicity, we consider the depreciation rate of capital to be equal to its price variation over one period, so that the user cost of capital is equal to its gross marginal return.

where $\phi_K \geq 0$ represents the degree of capital mobility. Hence, a country can enjoy productive capital in excess of its domestic endowment (i.e. $K > (L+D)\bar{k}$) if its after-tax return is greater than the international return.[15] In the limit case such that $\phi_K = 0$, capital is immobile and we have $K = (L+D)\bar{k}$. Conversely, when $\phi_K \to \infty$, an infinitely small excess return is required to attract foreign capital, so at equilibrium the domestic after-tax return is equal to the international return: $r = r^*$. For intermediate values of ϕ_K, the domestic after-tax return satisfies:

$$r = r^* + \frac{k - \bar{k}}{\phi_K}. \tag{4}$$

The literature on international migrations has also modelled the remuneration wedge between host and origin countries as a function of market frictions, here migration costs (see Borjas, 1989). By analogy with capital, we assume that the quantity of labor in the domestic economy depends on an exogenous labor endowment, denoted $\bar{L}$, and on the gap between the after-tax labor return and the international remuneration of labor:

$$L = \bar{L} + \phi_L \left(w - w^*\right) L, \tag{5}$$

where $\phi_L \geq 0$ represents the international mobility of labor. Like for capital mobility, this parameter is scaled by the size of the economy, here L. For $\phi_L = 0$, we have $L = \bar{L}$, while $\phi_L \to \infty$ corresponds to perfect labor mobility that implies $w = w^*$. For intermediate values of ϕ_L, there is a wedge between the domestic after-tax wage and its international remuneration:

$$w = w^* + \frac{1 - \frac{\bar{L}}{L}}{\phi_L}. \tag{6}$$

For given K and L, the absolute size of the wedge in conditions (4) and (6) declines for higher factor mobility. For instance, higher capital mobility makes it easier for a net capital importer to attract foreign capital: the premium needed to attract foreign investors is reduced, and the capacity to tax is increased. By replacing r by $F'_K(.,.) - \tau_K$ in (4) we indeed obtain that:

$$\left.\frac{\partial \tau_K}{\partial \phi_K}\right|_{K,L \text{ given}} = \frac{k - \bar{k}}{\phi_K^2}. \tag{7}$$

[15] Symmetrically, $K < (L+D)\bar{k}$ is consistent with $r < r^*$.

For a given level of capital and labor, partial derivative (7) suggests that the tax rate on capital should increase with capital mobility for a net capital importer, and decrease for a net capital exporter. The same reasoning applies to labor, except that it is the difference between L and $\bar{L}$ that is relevant. However, capital and labor will adjust to a change in factor mobility, so the model needs to be solved before it is possible to conclude.

By replacing the no-arbitrage conditions (4) and (6) in the equations that define private incomes, i.e. (1) and (2), we obtain:

$$y_L = \left| \begin{array}{l} w^* + \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L} + r^*\bar{k} + \left(\frac{k-\bar{k}}{\phi_K}\right) k \text{ if } \bar{k} \geq k, \\ w^* + \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L} + r^*\bar{k} + \left(\frac{k-\bar{k}}{\phi_K}\right) \bar{k} \text{ if } \bar{k} \leq k. \end{array} \right. \tag{8}$$

and:

$$y_D = \left| \begin{array}{l} p + r^*\bar{k} + \left(\frac{k-\bar{k}}{\phi_K}\right) k \text{ if } \bar{k} \geq k, \\ p + r^*\bar{k} + \left(\frac{k-\bar{k}}{\phi_K}\right) \bar{k} \text{ if } \bar{k} \leq k. \end{array} \right. \tag{9}$$

For a given L, we see that the income is always larger in a capital importing country than in a capital exporting one. The reason is that the after-tax return on capital is higher and overcompensates for the loss induced by the outflow benefiting to foreign investors. Incomes per capita are independent from L when labor mobility is infinite and from k when capital mobility is infinite.

2.3 Tax rates

The government maximizes a social welfare function that depends on private incomes and on average public spending net of transfers, denoted G, divided by the size of the population $L + D$.[16] Private incomes, y_L and y_D, are weighted using the demographic weight of each type of agents, $L/(L+D)$ for workers and $D/(L+D)$ for pensioners, and a parameter $\gamma > 0$ that reflects the relative weight of each pensioner to a worker, which can be justified e.g. by different participation rates to the elections. The social welfare

[16] Hence, public spending is not subjet to returns to scale. It refers to e.g. education or healthcare rather than to e.g. military spending. By doing so, we do not want to introduce an incentive for the government to increase the size of the economy.

function of the government is given by:

$$U\left(\frac{L}{L+D}y_L+\gamma\frac{D}{L+D}y_D,\frac{G}{L+D}\right) \tag{10}$$

where U is an increasing and concave function in both arguments. Both partial derivatives, denoted $U_Y(.,.)$ and $U_G(.,.)$, are assumed to be infinite when the argument equals zero. Finally, we assume that the budget is balanced and, consequently, that the public spending net of transfers is equal to total tax revenues:

$$G=\tau_K K+\tau_L L-pD. \tag{11}$$

The government's problem then is to set τ_K and τ_L so as to maximize its utility function (10) subject to conditions (4), (6), (1), (2), and (11). The resolution of the model is presented in Appendix A. In particular, we can show that the optimal tax rate on capital satisfies:

$$\tau_K=\left|\begin{array}{l}\frac{1}{\phi_k}\left[(1-\eta)\,k+\eta\left(\bar{k}-k\right)\right]\ \text{ if } \bar{k}\geq k,\\ \frac{1}{\phi_k}\left[\left(k-\bar{k}\right)+(1-\eta)\,\bar{k}\right]\ \text{ if } \bar{k}\leq k.\end{array}\right. \quad \text{where: } \eta:=\frac{U'_Y(.,.)}{U'_G(.,.)}\frac{L+\gamma D}{L+D}. \tag{12}$$

In the case of an equal weight to each inhabitant in the utility function (i.e. for $\gamma=1$), it can be shown (see Appendix A) that there is an underprovision of public goods, i.e. that partial derivative of the social welfare function satisfy $U'_Y(.,.)<U'_G(.,.)$, which implies that $\eta<1$. Using the expressions (12), we thus immediately conclude that the tax on capital is positive. It tends to zero for infinite capital mobility. For imperfect capital mobility, the tax rate depends on an endogenous parameter. We first solve the model in the particular case where $D=0$ before moving to simulations for $D>0$.

For $D=0$, it can be shown (see Appendix A) that marginal utilities of public and private goods are equal, i.e. $U'_Y(.,.)=U'_G(.,.)$, which permit to conclude that $\eta=1$. Using (12), the optimal tax on capital is thus:

$$\tau_K|_{D=0}=\left|\begin{array}{l}\frac{\left(\bar{k}-k\right)}{\phi_k}\ \text{if } \bar{k}\geq k,\\ \frac{\left(k-\bar{k}\right)}{\phi_k}\ \text{if } \bar{k}\leq k,\end{array}\right. \tag{13}$$

where k is obtained, using (4), as the solution of the following equations:

$$\begin{aligned} F'_K(k,h) &= r^* \text{ if } \bar{k} \geq k, \\ F'_K(k,h) &= r^* + \tfrac{2(k-\bar{k})}{\phi_K} \text{ if } \bar{k} \leq k. \end{aligned} \tag{14}$$

Equations (14) state that the level of capital per worker k is obtained by equalizing the marginal productivity to the world's capital return r^* if the country is a net exporter of capital. Conversely, we see that the marginal productivity is larger than r^* if the country is a net importer of capital. This asymmetry is a direct consequence on the assumption we made on the differential remunerations of the net investment position. Computing the effect of a change in the degree of mobility on the tax rate is then straightforward and gives:

$$\frac{\partial \tau_K|_{D=0}}{\partial \phi_K} = \left| \begin{array}{l} -\frac{(\bar{k}-k)}{\phi_k^2} \text{ if } \bar{k} \geq k, \\ -\frac{1}{\phi_K^2}\left(k-\bar{k}\right)\left[\frac{F''_{KK}(k,h)}{F''_{KK}(k,h)-\frac{2}{\phi_K}}\right] \text{ if } \bar{k} \leq k. \end{array} \right. \tag{15}$$

In both cases, an increase in the capital mobility reduces the tax rate on capital (it triggers a "race to the bottom"), but the derivative (in absolute value) is larger for a capital exporting country than for an importing one. This is due to the fact that in the latter case, mobility increases the capital per worker, hence increases the tax base and reduces the after-tax return premium. This key theoretical result is supported by the empirical analysis we present in Section 5. Concerning the effect of the capital mobility on the tax rate on labor, we have (provided that the social welfare function is additively separable, see the Appendix A):

$$\frac{\partial \tau_L|_{D=0}}{\partial \phi_K} = \frac{k\left(\bar{k}-k\right)}{\phi_K^2} \text{ if } \bar{k} \geq k. \tag{16}$$

For a capital exporting country, capital mobility increases the tax rate on labor. This "burden shifting" effect can be explained by the fact that the additional capital outflow triggered by higher capital mobility will come along with an outflow of labor, since capital per worker (determined by r^*, see Equation (14)) stays constant *ex post*. Hence the labor tax base is reduced. For a capital importing country, higher capital mobility triggers an inflow of capital that exceeds the inflow of labor (since capital per worker k increases, see

Equation (14)). The net impact on labor taxation is ambiguous as it depends on how k reacts to higher capital mobility. We conclude that the burden shifting effect should be less apparent in capital importing countries than in capital exporting ones.

3 Model simulations

Now we come back to the complete model with $D > 0$, that we calibrate in order to simulate the impact of capital and labor mobility on tax rates. We first need to choose functional forms for the production and utility functions. We rely on a standard Cobb-Douglas production function:

$$Y = F(K, hL) = K^{\alpha}(hL)^{1-\alpha}, \tag{17}$$

where $0 \leq \alpha \leq 1$ and $h > 0$. In turn, we assume a log-linear utility function:

$$U = ln\left((1-\delta)\frac{R_L}{L} + \gamma\delta\frac{R_D}{D}\right) + \theta ln\left(\frac{G}{L+D}\right), \tag{18}$$

where $\theta > 0$ represents the relative weight of the public good.

3.1 Calibration

We calibrate the model on the four largest economies of the euro area: Germany, France, Italy and Spain, over 1997-2017. All four countries have fully liberalized capital flows in the early 1990s and their participation in the euro means that the frictions on capital markets related to exchange-rate volatility are similar. Furthermore, they have liberalized intra-EU labor flows over the 2000s, although not the flows with the rest of the world. For each variable, we take the country average over 1997-2017 and then the average over the four countries, weighted by GDP.

The old dependency ratio ($d = D/L$) is taken from the World Bank, Health Nutrition and Population Statistics. It is set to 27%. Hence, the share of the pensioners in the population is $\delta = \frac{D}{L+D} = 0.21$.[17]

Gross disposable income of households (when aggregating workers and pensioners) is

[17] Since L is endogenous, we set d and δ in terms of the labor endowment $\bar{L}$.

calibrated at 65% of GDP, based on the Ameco database of the European Commission. From the same database, we calculate that public pensions represent 13% of GDP whereas public expenditure other than inter-personnal transfers represents 35% of GDP: $\frac{pD}{Y} = 0.13$, $\frac{G}{Y} = 0.35$.

Exogenous foreign factor returns r^* and w^* are calibrated based on the returns observed over the period for the four countries. According to Jordà et al. (2019), p. 1293, the post-1980 real return on wealth averaged 6.29% in Germany, 4.72% in France, 5.01% in Italy and 5.34% in Spain. We set $r^* = 0.05$. From Ameco, we get a net worth per household of around 160,000 euros. We divide by 10,000 and set $\bar{k} = 16$. We then recover w^* based on the 0.7 labor share we get from Ameco and using: $\frac{r^*\bar{k}(1+d)}{w^*} = \frac{0.3}{0.7}$, which gives $w^* = 2.4$.

From Ameco, the ratio of public pensions to labor compensations is 0.27, i.e. $\frac{pD}{wL} = 0.27$. Since $D/L = 0.27$, we get $p = w$: our simulation should yield a similar value for unit pension and unit wage.

Implicit tax rates are recovered from the European Commission's Taxation Trends database. Labor taxes represent 21% of GDP whereas the share of corporate tax revenues is 2.7% of GDP. In our model, there are no other taxes. Since the budget constraint imposes that $\frac{\tau_K K + \tau_L L}{Y} = \frac{G+pD}{Y} = 0.48$, we target $\frac{\tau_K K}{Y} = 0.055$ and $\frac{\tau_L L}{Y} = 0.425$.

Finally, the size of the workforce can be set at any level since it will just determine the size of the economy. We set $\bar{L} = 100$.

The first line of Table 1 provides the values of the exogenous variables $\bar{L}$, $D = d\bar{L}$, r^*, w^*. In the second line, we report the target ratios that are used to calibrate the parameters of the model: α, h, γ, p, θ, ϕ_K, ϕ_L. The third line provides two parameters that can be set without model simulations: α and γ. As already mentioned, the labor share is 0.7 in our sample, hence we have $\alpha = 0.3$. In our benchmark calibration, we also assume that the weight of the pensioners in the utility function is no higher than their share in the population of households: $\gamma = 1$. The next line reports the other parameters that are set so as the model solution is close to our five target ratios.

The second part of Table 1 reports the results of the simulated model in two different cases: the benchmark case, which corresponds to high capital endowment ($\bar{k} = 16$), and a variant with low capital endowment ($\bar{k} = 13$). The endogenous ratios are close to their targets. The ratio of pensions to GDP is a bit small, but rising p would make the unit

pension exceed the unit wage. As for labor taxation, it is slightly too small, but rising it would make G/Y exceed its target.

Table 1: Calibration

	(1)	(2)	(3)	(4)	(5)
Exogenous variables	$\bar{L} = 100$	$D = 27$	$r^* = 0.05$	$w^* = 2.4$	
Targets ratios	$\frac{p}{w} = 1$	$\frac{G}{Y} = 0.35$	$\frac{pD}{Y} = 0.13$	$\frac{\tau_K K}{Y} = 0.055$	$\frac{\tau_L L}{Y} = 0.425$
Preset parameters	$\alpha = 0.3$	$\gamma = 1$			
Calibrated parameters	$h = 2$	$p = 1.3$	$\theta = 0.57$	$\phi_K = 100$	$\phi_L = 0.1$
Benchmark: high capital endowment ($\bar{k} = 16$)					
Endogenous ratios	$\frac{p}{w} = 1.04$	$\frac{G}{Y} = 0.3510$	$\frac{pD}{Y} = 0.010$	$\frac{\tau_K K}{Y} = 0.061$	$\frac{\tau_L L}{Y} = 0.387$
Production factors	$k = 15.7$	$L = 89.7$			
Variant: low capital endowment ($\bar{k} = 13$)					
Endogenous ratios	$\frac{p}{w} = 1.12$	$\frac{G}{Y} = 0.3472$	$\frac{pD}{Y} = 0.1029$	$\frac{\tau_K K}{Y} = 0.0524$	$\frac{\tau_L L}{Y} = 0.3976$
Production factors	$k = 13.4$	$L = 89.0$			

In this benchmark, high endowment case, we get $k < \bar{k}$, hence we are in the case of a net capital exporting country. Conversely, the low endowment case yields $k > \bar{k}$, hence we are in the case of a net capital importer.

3.2 The impact of factor mobility on tax rates

We can now simulate the model with different coefficients of capital mobility, ϕ_K and labor mobility, ϕ_L. In each case, we successively simulate the model with $D = 27$ and $\gamma = 1$ (their calibrated values) and with a higher weight of pensioners either demographically (D) or politically (γ).

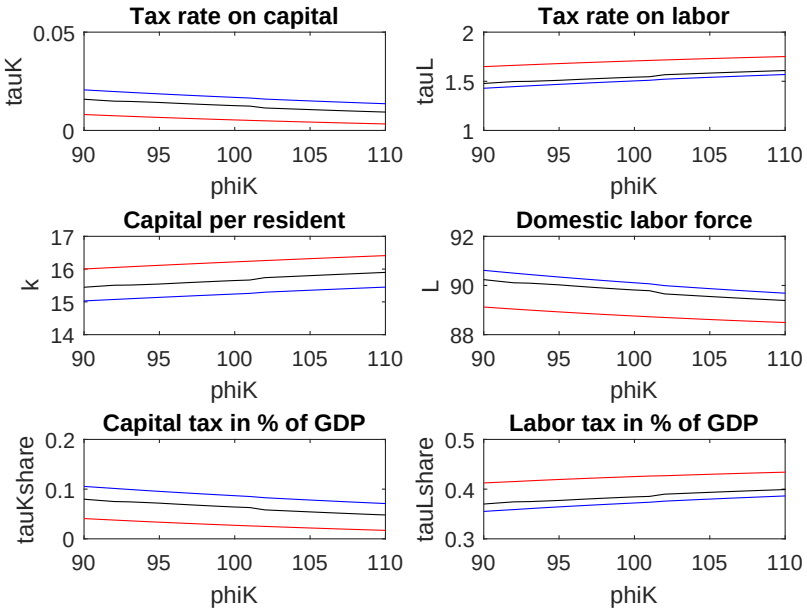
Capital mobility

In this first group of simulations, we keep the exogenous variables and parameters of Table 1 except for ϕ_K that is allowed to change by $\pm 10\%$. We then study how population ageing affects the results through a variant where $D = 30$ instead of 27. We also study how the results are affected when pensioners have more say than the workers in public decisions (we set $\gamma = 1.05$ instead of 1 in this case). The results are presented in Figure 4

in the case of a net capital exporter ($\bar{k} = 16$) and in Figure 5 for the case of a net capital importer ($\bar{k} = 13$). In each case, we plot the evolution of the tax rates τ_K and τ_L as a function of ϕ_K, the evolution of capital per person k and the workforce L, and finally the share of capital taxation and of labor taxation in GDP.

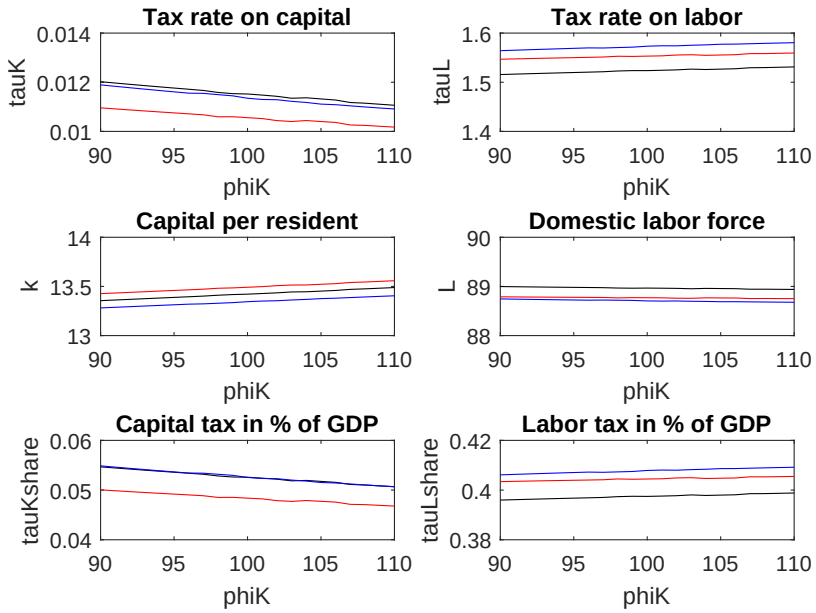
The case with $D = 27$ and $\gamma = 1$ is depicted through black lines. Figure 4 (capital exporter) illustrates the standard result where higher capital mobility triggers a reduction in capital taxation and a shift of the tax burden on to labor. Consistently, the labor force falls when the labor tax is raised, whereas the capital per resident increases. In the case of a net capital importer (Figure 5), more capital mobility also triggers a reduction in capital taxation and rise in labor taxation, but to a much lesser extent. When ϕ_K rises from 90 to 100, capital taxation falls from 7.97% of GDP to 6.4% in the case of a capital exporter but only from 5.47 to 5.26% in the case of a capital importer. Simultaneously, the share of labor taxation rises from 37% to 38.4% in the former case, but only from 39.6 to 39.75% in the latter case.

Figure 4: Impact of capital mobility on taxation: net capital exporter ($\bar{k} = 16$)



Notes: black lines are for $D = 27$, $\gamma = 1$; blue lines for higher dependence ($D = 30$, $\gamma = 1$), red lines for higher political weight of pensioners ($D = 27$, $\gamma = 1.05$).

Figure 5: Impact of capital mobility on taxation: net capital importer ($\bar{k} = 13$)



Notes: black lines are for $D = 27$, $\gamma = 1$; blue lines for higher dependence ($D = 30$, $\gamma = 1$), red lines for higher political weight of pensioners ($D = 27$, $\gamma = 1.05$).

Interestingly, the two types of countries differ in their reaction to ageing (blue lines). A capital importing country reacts to a higher dependence ratio by increasing the tax rate on labor, whereas a capital exporting country reacts by lowering the taxation of labor (and increasing the tax rate on capital). In both cases, the rising number of pensioners requires additional tax revenues. It also reduces the share of workers in the utility function of the government. In a capital importing country, though, the return on capital is higher than in the rest of the world, so the capital outflow following an increase in the tax rate on capital is relatively costly: it is better not to increase capital taxation. For a capital exporter, the priority is rather to attract foreign workers through lower labor taxation. The rise in capital taxation reduces domestic capital per resident, but the loss in terms of income is limited by the fact that the after-tax remuneration of capital is already less than in the rest of the world.

Hence, the impact of population ageing in our model is either a rise in capital taxation (in a capital exporting country) or a very limited decrease (for a capital importer): in our

model, the benevolent government of a net capital exporting country had better cut labor taxation than capital taxation to finance additional pensions. The result is different when ageing comes along increased political weight of the pensioners. This is shown by the red lines in in Figures 4 and 5, where D is kept at its baseline level of 27 but γ is raised to 1.05: in both types of countries, more powerful pensioners will put downward pressure in capital taxation, at the expense of the workers. Hence, in our model, it is the political economy rather than just the demography that explains while ageing countries tend to cut capital taxation and shift the tax burden on to labor.[18]

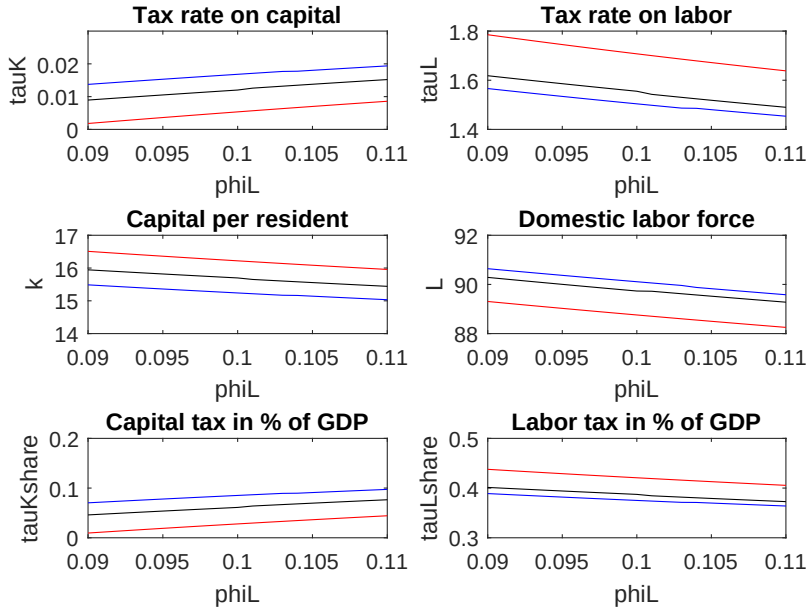
Labor mobility

We now study the impact of labor mobility by varying ϕ_L by $\pm 10\%$. The results are reported in Figure 6 for a capital exporter and Figure 7 for a capital importer. In both cases, more labor mobility puts downward pressure on labor taxation while shifting the tax burden on to capital. Like for capital mobility, though, the reaction of tax rates is much less in a capital importing country than in a capital exporting one. In the former case, the private revenue loss related to an increase in capital taxation is more important than in the latter case.

Again, population ageing leads the capital exporter to lower labor taxation and increase capital taxation, while more political weight of the pensioners has the reverse impact.

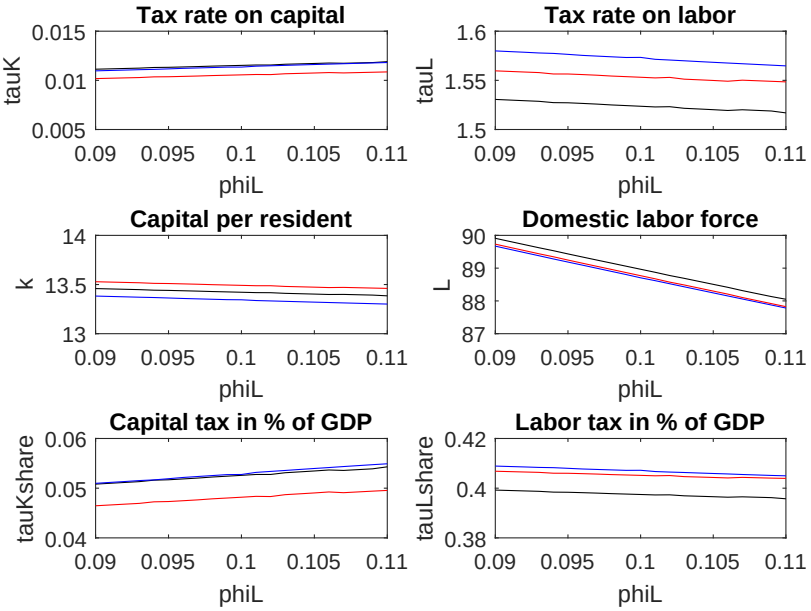
[18] In our model, workers and pensioners have the same capital endowment. Alternatively, with higher capital endowment for the pensioners, population ageing could change the status of the country from capital importer to capital exporter, with a negative impact on the capital tax rate.

Figure 6: Impact of labor mobility on taxation: net capital exporter ($\bar{k} = 16$)



Notes: black lines are for $D = 27$, $\gamma = 1$; blue lines for higher dependence ($D = 30$, $\gamma = 1$), red lines for higher political weight of pensioners ($D = 27$, $\gamma = 1.05$).

Figure 7: Impact of labor mobility on taxation: net capital importer ($\bar{k} = 16$)



Notes: black lines are for $D = 27$, $\gamma = 1$; blue lines for higher dependence ($D = 30$, $\gamma = 1$), red lines for higher political weight of pensioners ($D = 27$, $\gamma = 1.05$).

In all the simulations presented here, we have considered a net labor exporting country ($L < \bar{L}$). For a net labor importing country, we also find that increasing labor mobility puts downward pressure on labor taxation, with a burden shifting on to capital.[19] Hence we do not find the same asymmetry between labor exporters and labor importers as for capital exporters and capital importers. The reason is that labor cannot move without its capital endowment whereas capital can move without its labor endowment: when labor becomes more mobile, it is extremely important for the country to keep its labor force (through cutting the labor tax) whatever the net position in terms of labor, because capital will move together with labor.

4 Empirical strategy

Our empirical methodology is close to Adam and Kammas (2007) who estimate the impact of globalization on effective tax rates on capital and on labor, for 17 OECD countries over 1970-1997. They find trade openness to have a negative impact on capital taxation ("efficiency effect") but a positive impact on labor taxation ("compensation effect"). However, they only study the impact of trade openness, not capital nor labor mobility, and their sample stops before the steep increase in capital mobility.[20] We nevertheless follow their general methodology consisting in panel estimations with country and time fixed effects, and a range of control variables that includes ageing, public spending, GDP and the political orientation of the government. Contrasting with Adam and Kammas (2007), though, we consider trade openness as a control rather than a variable of interest, and we use specific measures of capital and labor mobility.

Our panel covers 28 OECD countries[21] over the period 1997-2014. The empirical specification is the following:

$$KTAX_{it} = a_1 KMOB_{it} + a_2 LMOB_{it} + a_3 X_{it} + FE_i + FE_t + u_{it}, \tag{19}$$

[19] We calibrate this case by assuming $w^* = 1$ instead of 2.4. The economy is then close to balance in terms of capital. The figures can be found in Appendix B.

[20] The time sample is especially important in our case. Indeed, Adam et al. (2013) show that studies incorporating more recent years tend to find more negative impact of globalization on capital taxation.

[21] Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States.

$$LTAX_{it} = b_1 LMOB_{it} + b_2 KMOB_{it} + b_3 X_{it} + FE_i + FE_t + v_{it}, \tag{20}$$

where $KTAX_{it}$ is the tax rate on capital for country i in year t, $LTAX_{it}$ the tax rate on labor, $KMOB_{it}$ is the mobility of capital, $LMOB_{it}$ is the mobility of labor, X_{it} is a vector of control variables, FE_i, FE_t are country and time fixed effects, respectively, and u_{it}, v_{it} are the residuals. Based on the existing theoretical literature, we expect $a_1, b_1 < 0$ ("race-to-the-bottom" effect for capital and labor taxation, respectively) and $a_2, b_2 > 0$ (compensation effect). However, we have shown theoretically that these effects may be influenced by the net international position of a country. In a second stage, we interact capital mobility and labor mobility with proxies of factor endowments.

We now briefly describe the data sources used in the analysis, with special attention to tax rates and to the variables used to capture factor mobility.[22]

4.1 Tax rates

Consistent with theoretical models of tax competition that focus on source taxes, the empirical literature on international tax competition has generally focused on the corporate income tax and relied on the Effective Average Tax Rate (EATR) which accounts for tax allowances differing across countries (see Devereux and Griffith, 1998). Adam et al. (2013) note that studies based on implicit tax rates (e.g. corporate income tax revenues divided by GDP or gross operating surplus) tend to find a positive relationship with globalization, but they are plagued with endogeneity problems.

We use EATRs from the 2016 update of the Oxford University Centre for Business Taxation Tax Database developed by Bilicka and Devereux (2012). The EATR is calculated as the ratio of post-tax to pre-tax net present value of a composite investment yielding a 20% pre-tax return financed through a combination of debt, equity and auto-financing.

As for the taxation of labor, we use the average tax wedge for a single individual with no children, and earning a gross income representing 167% of average earnings. The tax wedge includes both the income tax and social security contributions paid, and therefore offers a more complete picture of labour taxation than the statutory personal income tax rate. We choose to work on the tax rate applied on relatively high wages because labor

[22] The list of variables and data sources is summarized in Appendix C.

mobility concerns mainly skilled labor across OECD countries. The data are taken from the comparative tables of the OECD taxing wages database.

4.2 Measures of factor mobility

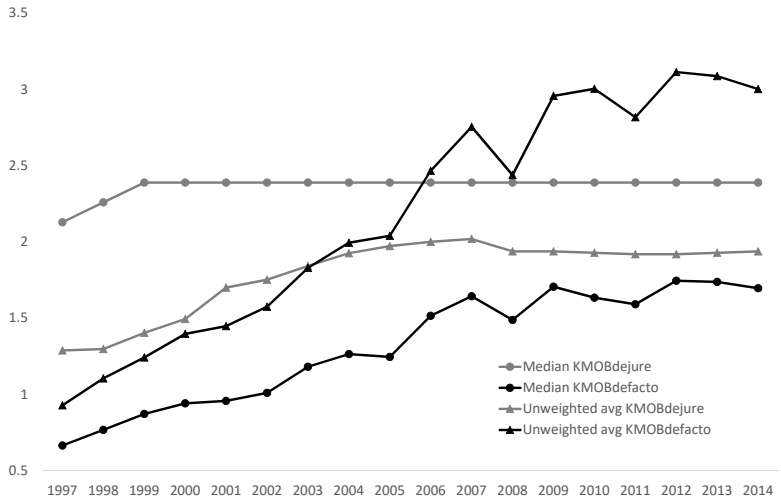
In their meta-analysis, Adam et al. (2013) highlight the importance of how globalization is measured for the estimation of its impact on capital taxation. Some studies have used trade openness or broader measures of globalization that also cover political and social aspects (Dreher, 2006). Other studies have focused specifically on international capital mobility. In the latter case, two categories of measures have been used: *de jure* (based on existing restrictions to capital flows as reported by the International Monetary Fund), or *de facto* (based on actual cross-border capital flows or stocks).

Figure 8 compares the evolution of *de jure* and *de facto* capital mobility for our sample of 28 OECD countries, over 1997-2014. The *de jure* measure is the index constructed by Chinn and Ito (2006), and regularly updated, based on the Annual IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. For *de facto* capital mobility, we calculate the sum of gross external assets and gross external liabilities based on Lane and Milesi-Ferretti (2007) (updated) and divide by GDP in current dollar (World Bank database). The graph shows that on average our countries reach high de jure mobility very soon in our time sample, so the median and average of the de jure measure are almost flat. In contrast, the *de facto* measure shows a clear upward trend that only stabilizes after the global financial crisis. Since we intend to estimate the model in the within dimension, we select the *de facto* measure (denoted by KMOB), which offers the additional advantage of being more consistent with our measure of labor mobility, which is also *de facto* (see *infra*).[23]

For labor mobility, there is no available *de jure* measure. The Migrant Integration Policy Index (MIPEX) developed by Huddleston et al. (2015) is a notable exception. Unfortunately, the index covers only a few years between 2004 and 2014, and only a few OECD countries. We rely on a de facto measure (LMOB), namely the sum of inflows

[23] We also used a Feldstein-Horioka measure of capital mobility, namely the absolute value of gross domestic savings (GDP net of final consumption expenditures) minus gross fixed capital formation as a percentage of GDP. We do not report the results with this proxy as they turned out to be always non-significant.

Figure 8: *De jure* and *de facto* capital mobility: 28 OECD countries



Note: Countries: see Figure 1.
Source: Lane and Milesi-Ferretti (2007) and Chinn and Ito (2006) databases.

and outflows of non-nationals from and to other OECD countries, divided by the total population of the country. Limiting our measure to intra-OECD gross flows allows us to focus on relatively more skilled labor mobility. The data are taken from the OECD International Migration Database.

4.3 Control variables

Our first control variable is trade openness denoted by TRADE, which is the sum of exports and imports over twice the GDP, all variables being defined in current US dollar (CEPII and World Bank databases). The square of TRADE is also introduced in order to capture a possible non-linear impact of trade openness, consistent with the economic geography literature (Baldwin et al, 2003).

In advanced economies, financial integration has been concommittant to population ageing, which, as highlighted in our theoretical section, may affect capital and labor taxation is an ambiguous way. We control for the share of the population aged 65+ in total population (65+) using data from OECD population statistics. We also control for political cycles by adding a dummy variable RIGHT for a right-wing executive (World Bank

Database of Political Institutions).[24]

In order to control for a possible "compensation effect" of globalization, we control for general government spending in percent of GDP, GOVSPEND (IMF World Economic Outlook database).[25] We also include the lagged debt-to-GDP ratio in order to capture a debt brake effect.

4.4 Factor endowments

Whether a country is a net capital importer or exporter can be observed through its net position in terms of Foreign Direct Investment - FDI (the difference between FDI assets and liabilities, hence a positive figure for a net capital exporter). The data is from the Lane and Milesi-Ferretti database.[26] Because net FDI may be endogenous to taxation, we use the net stock in percent of GDP in the year before the beginning of the sample, hence at end 1996. The variable is labelled FDI1996.

An alternative strategy, already followed by Hays (2003), consists in using the level of capital per worker in a remote year as a proxy for the capital endowment. Consistently, we use the stock of capital per worker in 1990, labelled k1990 (Penn World Tables).[27] A country with relatively high capital per worker in 1990 is likely to export capital in the subsequent years.

For labor endowments, we follow a similar strategy. First, we retain the cumulated net migrations (inflows minus outflows) over 1983-87 and divide by the domestic population in 1990 (based on UN data). The variable is labelled MIGR1990. It is positive for countries lacking labor endowment (that need to import foreign labor). Alternatively, we use the ratio of workers to total population in 1990, from the Penn World Tables, L1990. The variable is higher the higher the labor endowment.

[24] Other political variables such as the share of seats in Parliament held by the government party did not show up significant.

[25] Adam et al. (2013) show that including a measure of government spending in the regression significantly reduces the coefficient on globalization. Hence it is especially important to control for government spending.

[26] Alternatively, we could use the net foreign asset position, but the latter includes sovereign assets and liabilities that do not fit our theoretical model which assumes budget balance.

[27] The data is not available for some of our countries before 1990.

5 Econometric results

5.1 Preliminary estimates

As a preliminary exercise, we regress capital and labor tax rates separately on trade integration (TRADE, TRADE2), capital mobility (KMOB) and labor mobility (LMOB), while controlling for government spending (GOVSPEND), lagged government debt (LDEBT), the share of the population aged 65+ (65+) and the presence of a right-wing government (RIGHT). Country and time fixed effects are also included. The results are reported in Table 2. Columns (1) to (3) are for capital taxation, while (4) to (6) correspond to the labor tax. Neither trade openness nor capital mobility seem to have any significant impact on both tax rates. Only labor mobility affects the capital tax negatively in this specification. Conversely, there is evidence that ageing exerts negative impact on the capital tax whereas the lagged public debt puts upward pressure on the labor tax.

Table 2: Preliminary results

	KTAX			LTAX		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	-0.351			-0.159		
	(0.223)			(0.137)		
TRADE2	0.299*			0.0739		
	(0.167)			(0.105)		
KMOB		-0.00114			-0.00259	
		(0.00418)			(0.00205)	
LMOB			-1.540**			-1.126
			(0.710)			(1.003)
GOVSPEND	0.0765	0.102	0.0941	0.130*	0.174**	0.130
	(0.0899)	(0.0972)	(0.0889)	(0.0711)	(0.0655)	(0.0808)
LDEBT	0.0318*	0.0291	0.0276*	0.0819***	0.0806***	0.0741***
	(0.0168)	(0.0183)	(0.0159)	(0.0117)	(0.0161)	(0.0128)
65+	-1.086**	-1.309**	-1.373**	0.523**	0.302	0.394
	(0.507)	(0.611)	(0.565)	(0.243)	(0.292)	(0.277)
RIGHT	-0.00800*	-0.00598	-0.00686	-0.00280	-0.00210	-0.00243
	(0.00466)	(0.00503)	(0.00493)	(0.00337)	(0.00386)	(0.00348)
Observations	478	479	462	484	485	465
R-squared	0.515	0.495	0.514	0.411	0.405	0.420
N. of countries	28	28	28	28	28	28

All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.2 Baseline results

We now introduce trade, capital mobility and labor mobility in a simultaneous way, and examine the impact of being a net capital exporter or importer. The results are presented in Table 3. Again, Columns (1) to (3) concern capital taxation, whereas Columns (4) to (6) are for labor taxation. In each case, we start with a specification that does not account for capital endowments (Columns (1) and (4)). Strikingly, only two variables appear significant when no interaction term is introduced: ageing puts downward pressure on the capital tax, while government spending increases the labor tax. Trade openness, capital mobility and labor mobility do not have any significant impact on both tax rates.

We then successively introduce our two measures of capital endowments: the net FDI position in 1996 (FDI1996) and the capital per worker in 1990 (k1990). Both variables are interacted with capital mobility. The interacted variable has a significant, negative impact on capital taxation, and positive impact on the labor tax: in a country with high capital endowment (hence, in a net capital exporting country), more capital mobility triggers a "race to the bottom" of the capital tax and a burden shifting to labor taxation. However, this is less the case for a country with low capital endowment (the non-interacted mobility has no significant impact).

The ageing variable continues to affect negatively the capital tax, whereas public spending and debt affect positively the labor tax. Hence, an ageing society tends to shift to labor the burden of additional public spending and debt. Labor mobility still has no significant impact on tax rates.

We now study how the impact of factor mobility on taxation reacts to labor endowments. In Table 4, Columns (1) and (4) reproduce the results obtained in Table 3 with only capital endowments (restricting their measure to FDI1996). In the other culumns, we interact labor mobility with our two measures of labor endowment, successively: MIGR1990 and L1990. There is now evidence of a negative impact of labor mobility on labor taxation, except in a country with high labor endowment (high L1990). However this result is not confirmed by the use of the other measure of labor endowments (MIGR1990), which appears insignificant. Additionally, labor mobility has no significant impact on capital taxation.

Table 3: Impact of factor mobility on capital and labor taxation: capital endowments

	KTAX			LTAX		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	-0.351	-0.372	-0.271	-0.196	-0.173	-0.244*
	(0.218)	(0.219)	(0.217)	(0.124)	(0.107)	(0.119)
TRADE2	0.301*	0.285*	0.239	0.0963	0.107	0.133
	(0.163)	(0.150)	(0.151)	(0.0998)	(0.0777)	(0.0876)
KMOB	-0.00153	0.0340	-0.000771	-0.00281	-0.0345***	-0.00325***
	(0.00378)	(0.0210)	(0.00177)	(0.00233)	(0.00955)	(0.00111)
KMOB*k1990		-1.25e-07*			1.12e-07***	
		(7.20e-08)			(3.24e-08)	
KMOB*FDI1996			-0.0522***			0.0314***
			(0.0153)			(0.00921)
LMOB	-1.190	-2.062*	-0.630	-0.748	0.00403	-1.089
	(0.843)	(1.065)	(0.693)	(0.975)	(0.828)	(0.777)
GOVSPEND	0.0962	0.0970	0.0831	0.154**	0.152**	0.162**
	(0.0976)	(0.101)	(0.0994)	(0.0713)	(0.0709)	(0.0697)
LDEBT	0.0373*	0.0227	0.0275	0.0888***	0.101***	0.0947***
	(0.0199)	(0.0177)	(0.0190)	(0.0168)	(0.0170)	(0.0167)
65+	-1.294**	-1.208**	-1.160**	0.342	0.271	0.262
	(0.566)	(0.554)	(0.558)	(0.269)	(0.256)	(0.227)
RIGHT	-0.00762	-0.00735	-0.00601	-0.000520	-0.000623	-0.00146
	(0.00462)	(0.00460)	(0.00433)	(0.00351)	(0.00329)	(0.00340)
Observations	461	461	461	464	464	464
R-squared	0.536	0.556	0.568	0.462	0.506	0.493
N of countries	28	28	28	28	28	28

All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 also evidences a negative impact of trade openness on labor taxation (but not on capital taxation), while the impact of the other control variables is similar as in Table 3.

Table 4: Impact of factor mobility on capital and labor taxation: labor endowments

	KTAX			LTAX		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	-0.271	-0.273	-0.273	-0.244*	-0.244*	-0.232**
	(0.217)	(0.216)	(0.218)	(0.119)	(0.119)	(0.111)
TRADE2	0.239	0.242	0.240	0.133	0.133	0.130
	(0.151)	(0.149)	(0.152)	(0.0876)	(0.0878)	(0.0844)
KMOB	-0.000771	0.000115	-0.000898	-0.00325***	-0.00313**	-0.00229**
	(0.00177)	(0.00195)	(0.00167)	(0.00111)	(0.00130)	(0.000998)
KMOB*FDI1996	-0.0522***	-0.0524***	-0.0513***	0.0314***	0.0314***	0.0241***
	(0.0153)	(0.0146)	(0.0179)	(0.00921)	(0.00922)	(0.00851)
LMOB	-0.630	0.199	-5.066	-1.089	-0.986	35.36***
	(0.693)	(1.033)	(24.65)	(0.777)	(0.942)	(7.476)
LMOB*MIGR1990		-262.1			-33.00	
		(195.1)			(207.0)	
LMOB*L1990			8.457			-69.47***
			(46.26)			(13.75)
GOVSPEND	0.0831	0.0691	0.0811	0.162**	0.160**	0.178***
	(0.0994)	(0.0977)	(0.106)	(0.0697)	(0.0684)	(0.0589)
LDEBT	0.0275	0.0244	0.0267	0.0947***	0.0942***	0.101***
	(0.0190)	(0.0193)	(0.0188)	(0.0167)	(0.0171)	(0.0147)
65+	-1.160**	-1.115**	-1.166**	0.262	0.268	0.294
	(0.558)	(0.542)	(0.553)	(0.227)	(0.220)	(0.215)
RIGHT	-0.00601	-0.00670	-0.00632	-0.00146	-0.00154	0.000964
	(0.00433)	(0.00443)	(0.00426)	(0.00340)	(0.00326)	(0.00329)
Observations	461	461	461	464	464	464
R-squared	0.568	0.572	0.568	0.493	0.493	0.550
N of countries	28	28	28	28	28	28

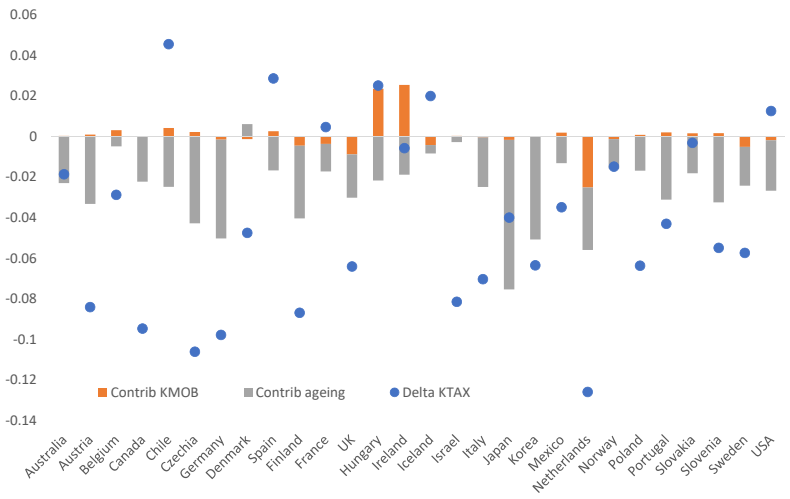
All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Based on the estimations presented in Table 3, Columns (3) and (6), we can calculate the contribution of the increased capital mobility in the evolution of both tax rates between 2003 and 2014.[28] The results are presented in Figures 9 and 10. In each case, the chart reports the variation in the tax rate between 2003 and 2014, the contribution of capital mobility and the contribution of the other significant variables: ageing for capital taxation, and government spending and debt for labor taxation. In both cases, the contribution of rising capital mobility in explaining the evolution of tax rates between 2003 and 2014 is modest, with the exception of Hungary and Ireland as net capital importers, and the Netherlands as a net capital exporter. In contrast, population ageing goes a long way

[28] Unfortunately, we are unable to start before 2003 because some tax rates are missing.

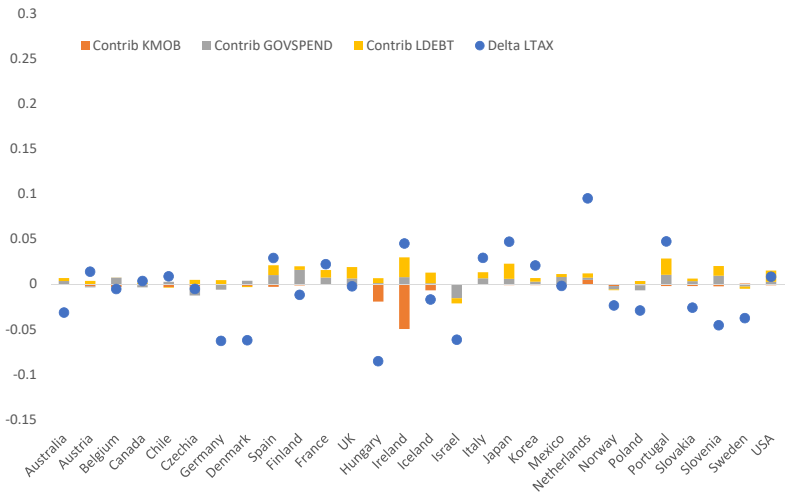
in explaining the fall in the capital tax, while rising government spending and debt have contributed positively to the increase in labor taxation.

Figure 9: Contribution of rising capital mobility to capital taxation, 2003-2014



Source: Own calculations based on Table 3, Column (3) .

Figure 10: Contribution of rising capital mobility to labor taxation, 2003-2014



Source: Own calculations based on Table 3, Column (6) .

5.3 Robustness

In this section, we successively perform three robustness tests. First, we control for possible endogeneity of factor mobility. Second, we check that our results are consistent with different tax convergence speeds between capital exporters and capital importers. Finally, we perform a placebo test on the value-added tax and on the taxation of low-skilled workers.

5.4 Endogeneity of factor mobility

Our measures of factor mobility are non-directional since they are sums of inward and outward stocks or flows. However, they are both *de facto* measures, hence one cannot exclude some endogeneity bias. For instance, one could perhaps argue that low taxation reduces cross-border frictions, hence encourages capital and labor mobility. To address this problem, we can instrument capital and labor mobility by their first lags.[29] Clemens and Hunt (2017) argue that lagging the migrant-to-population ratio leads to a "blunt

[29] Unfortunately, data limitations do not allow us to use remote lags.

instrument" problem because the denominator of this ratio (total population) is almost constant from one year to the next. This generates spurious correlation between labor mobility and its lagged value. They rather recommend to use the lagged value of the numerator (migrations) as an instrument. Hence we instrument labor mobility by lagged migrations. For capital mobility, we use the first lag of the variable itself, since both the numerator and the denominator evolve smoothly over time. The interacted variables are instrumented consistently.

The results are reported in Table 5, columns (1)-(3) for capital taxation and (4)-(6) for labor taxation. Since the model is exactly identified, we cannot test for the exogeneity of the instruments. The relevance of the instruments is tested through the Kleibergen-Paap rk LM statistics (where the null is no correlation between the excuded instruments and the endogenous variables) and the Kleibergen-Paap Wald rk F one (where the null is weak correlation). In the latter case, the critical values are not tabulated but the common usage is to require that $F > 10$. Both tests suggests that our instrumentation strategy is adequate in Table 5.

The various control variables bear similar signs and significance as in our baseline results, except for government debt (that now has positive impact on both tax rates) and for trade openess that now has a significant, non-linear impact on both taxes: negative for small deviations at country level, but positive for large deviations. Concerning the impact of capital mobility, the baseline results are confirmed, although the interaction between capital mobility and $k1990$ loses significance to explain the evolution of capital taxation. Finaly, labor mobility is not sgnificant, like in our baseline estimations.

Labor mobility has a negative impact on labor taxation, although not in the last specification.

Table 6 replicates the same instrumentation strategy for the impact of labor endowments. To facilitate comparisons, Columns (1) and (3) reproduce Columns (2) and (4) of Table 5. We then interact labor mobility and labor endowments. Although the coefficients on the interacted variables are significant, the Kleibergen-Paap Wald rk F statistics is well below 10, suggesting weak instruments. We conclude that there is no robust impact of labor endowments on how taxation reacts to labor mobility.[30]

[30] This conclusion is reinforced by the fact that $MIGR1990$ and $L1990$ should work in opposite direction:

Table 5: Impact of instrumented factor mobility on capital and labor tax rates: capital endowments

	KTAX			LTAX		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	-0.373***	-0.286**	-0.407***	-0.235***	-0.274***	-0.170**
	(0.120)	(0.123)	(0.115)	(0.0910)	(0.0827)	(0.0685)
TRADE2	0.312***	0.249***	0.314***	0.129*	0.158**	0.123**
	(0.0857)	(0.0869)	(0.0859)	(0.0668)	(0.0613)	(0.0518)
KMOB	-0.00416	-0.00375	0.0230	-0.00419**	-0.00439***	-0.0550***
	(0.00267)	(0.00236)	(0.0196)	(0.00167)	(0.00151)	(0.0126)
KMOB*FDI1996		-0.0713***			0.0316**	
		(0.0132)			(0.0124)	
KMOB*k1990			-9.74e-08			1.83e-07***
			(6.41e-08)			(4.35e-08)
LMOB	2.857	5.520	3.816	4.350	3.183	2.541
	(3.356)	(3.958)	(3.026)	(2.822)	(2.718)	(2.179)
GOVSPEND	0.130**	0.111*	0.131**	0.136**	0.144**	0.133***
	(0.0522)	(0.0645)	(0.0589)	(0.0635)	(0.0565)	(0.0488)
LDEBT	0.0623***	0.0543***	0.0568***	0.104***	0.108***	0.114***
	(0.0187)	(0.0199)	(0.0218)	(0.0149)	(0.0132)	(0.0137)
65+	-1.308***	-1.133***	-1.250***	0.299*	0.220	0.193
	(0.251)	(0.259)	(0.257)	(0.164)	(0.152)	(0.149)
RIGHT	-0.00597*	-0.00344	-0.00529	0.00171	0.000595	0.000510
	(0.00352)	(0.00392)	(0.00347)	(0.00249)	(0.00247)	(0.00199)
Observations	436	436	436	439	439	439
R-squared	0.493	0.475	0.479	0.231	0.323	0.429
Kleibergen-Paap rk LM	21.419***	17.717***	29.489***	21.560***	17.780***	29.059***
Kleibergen-Paap Wald rk F	28.068	15.529	19.054	27.835	15.335	18.643
N of countries	28	28	28	28	28	28

All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Impact of instrumented factor mobility on capital and labor tax rates: labor endowments

	KTAX			LTAX		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	-0.286**	-0.346**	-0.226*	-0.274***	-0.306***	-0.172**
	(0.123)	(0.151)	(0.118)	(0.0827)	(0.102)	(0.0780)
TRADE2	0.249***	0.298***	0.209**	0.158**	0.182**	0.0955*
	(0.0869)	(0.104)	(0.0860)	(0.0613)	(0.0743)	(0.0550)
KMOB	-0.00375	-0.00262	-0.00148	-0.00439***	-0.00352**	-0.000514
	(0.00236)	(0.00277)	(0.00211)	(0.00151)	(0.00168)	(0.00156)
KMOB*FDI1996	-0.0713***	-0.0798***	-0.0665***	0.0316**	0.0264**	0.0408***
	(0.0132)	(0.0140)	(0.0114)	(0.0124)	(0.0130)	(0.0121)
LMOB	5.520	12.96***	26.35**	3.183	7.639***	42.88***
	(3.958)	(3.739)	(12.95)	(2.718)	(2.792)	(7.503)
LMOB*MIGR1990		-813.2***			-494.2***	
		(174.0)			(124.0)	
LMOB*L1990			-49.37*			-93.56***
			(27.46)			(15.51)
GOVSPEND	0.111*	0.0631	0.133***	0.144**	0.114	0.189***
	(0.0645)	(0.107)	(0.0473)	(0.0565)	(0.0834)	(0.0567)
LDEBT	0.0543***	0.0610***	0.0414**	0.108***	0.110***	0.0863***
	(0.0199)	(0.0236)	(0.0168)	(0.0132)	(0.0158)	(0.0117)
65+	-1.133***	-0.980***	-1.088***	0.220	0.322*	0.275*
	(0.259)	(0.290)	(0.249)	(0.152)	(0.184)	(0.163)
RIGHT	-0.00344	-0.00356	-0.00406	0.000595	0.000616	-0.000724
	(0.00392)	(0.00424)	(0.00349)	(0.00247)	(0.00275)	(0.00208)
Observations	436	436	436	439	439	439
R-squared	0.475	0.252	0.543	0.323	0.039	0.339
Kleibergen-Paap rk LM	17.716***	26.871***	12.091***	17.780***	27.628***	12.751***
Kleibergen-Paap Wald rk F	15.529	8.802	8.025	15.335	8.643	8.253
N of countries	28	28	28	28	28	28

All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.5 Convergence speed

In our theoretical model, imperfect capital or labor mobility translate into wedges between domestic after-tax returns and their world levels. The wedge declines following an increase in factor mobility. Hence, after-tax return should converge over time to the world level when capital and/or labor mobility increases. Consistently, countries starting with higher tax rates on capital at the beginning of the sample period should see their rate decline more, especially when they are net capital exporters.

In order to test for this convergence hypothesis, we estimate the following dynamic model:

$$\Delta TAX_{it} = \beta TAX_{it-1} + FE_t + u_{it}, \tag{21}$$

where TAX stands for either the capital or the labor tax, Δ is the first-difference operator and FE_t are time fixed effects. We expect $\beta < 0$, meaning that higher tax rates tend to decline faster over time. Equation (21) can be estimated in the following form:

$$TAX_{it} = (1+\beta)TAX_{it-1} + FE_t + u_{it} \tag{22}$$

Equation (22) is estimated through a parcimonious difference GMM methodology where the first difference of the explanatory variable is instrumented by the second lag of its level.[31] Table 7 reports the results for the whole sample, for net capital importers (with negative FDI position in 1996) and for net capital exporters (with positive FDI position in 1996). Columns (1) to (3) concern capital taxation whereas Columns (4) to (6) are for labor taxation. The second-order auto-correlation test suggests that the set of 16 instruments is sufficient, while the Sargan test confirms the validity of the instruments for the whole sample (although it is les the case for net capital exporters due to the reduced number of countries).

For the whole sample and both tax rates, the autororrelation coefficient is less than unity but not significantly different from one. It is also the case for net capital importers.

a high $MIGR1990$ denotes low labor endowment whereas a high $L1990$ denotes a high labor endowment. Additonally, instrumenting labor mobility by its lagged value (instead of the lagged numerator of the ratio) provides insignificant results, and the instrument is found even weaker.

[31] See Roodman (2009).

For net capital exporters, however, the auto-regressive coefficient is significantly less than one: the (downward) convergence only comes from capital exporting countries, consistent with our theoretical results. These results are nevertheless fragile given the limited number of groups compared to the number of instruments. In Appendix D, we re-estimate Equation (22) through a panel with country and time fixed effects. All autoregressive coefficients are found significantly less than one. In the case of the capital tax, the auto-regressive coefficient is significanly lower for capital exporting countries than for capital importing ones.

Table 7: Simple auto-regressive model: difference GMM estimation

VARIABLES	KTAX			LTAX		
	All	Kimport	Kexport	All	Kimport	Kexport
	(1)	(2)	(3)	(4)	(5)	(6)
L.KTAX	0.883***	1.028***	0.620***			
	(0.0931)	(0.0971)	(0.162)			
χ^2 test coeff=1	1.58	0.09	5.48**			
L.LTAX				0.989***	1.077***	0.820***
				(0.0954)	(0.135)	(0.0417)
χ^2 test coeff=1				0.01	0.33	18.54***
Observations	432	240	192	436	244	192
No. of countries	28	16	12	28	16	12
Number of instr.	16	16	16	16	16	16
AR(1) test (p-value)	0.001	0.001	0.099	0.002	0.009	0.036
AR(2) test (p-value)	0.347	0.689	0.099	0.352	0.441	0.608
Sargan test (p-value)	0.100	0.216	0.028	0.545	0.824	0.013

All columns include time fixed effects. Std errors in parentheses.
Instruments used for first-differentiated equation: second lag of tax level.
*** p<0.01, ** p<0.05, * p<0.1.
Arellano-Bond (AR) test: H0: No auto-correlation of the residuals.
Sargan test: H0: Instruments are exogenous.

5.6 Placebo

Our last exercise is to test for the impact of capital and labor mobility on standard value-added tax (VAT) rates (or general sales tax) and on the tax wedge at low levels of income (minimum wage) - hence on two tax bases that are generally considered immobile. The results are presented in Table 8. Columns (1) to (3) present the results for the VAT while Columns (4) to (6) are for the taxation of low-skilled labor.

For the VAT, our model performs poorly, since only a right-wing government has weakly significant, positive impact on the VAT rate. For the taxation of low-skilled labor,

we find a positive impact of government debt and of labor mobility, consistent with what is expected for a relatively immobile tax base. Capital mobility seems to affect negatively the tax rate on low-skilled labor, but with limited significance and robustness.

In Appendix D, we show the same estimations while instrumenting capital and labor mobility as in Section 5.4. The results are mostly unchanged, except that government debt now exerts positive pressure on both tax rates while the impact of labor mobility is shifted to the VAT. Government spending also contributes to an increase in the tax rate on low-skilled labor.

On the whole, this "placebo" exercise suggests that the race-to-the-bottom with budren shifting found in the previous sections for net capital exporting countries is specific to the taxation of capital and high-skilled labor.

Table 8: Impact of factor mobility on VAT and on the taxation of lower wages

VARIABLES	VAT			LTAX low		
	(1)	(2)	(3)	(4)	(5)	(6)
TRADE	0.0982	0.100	0.0869	-0.168	-0.174	-0.136
	(0.0812)	(0.0802)	(0.0839)	(0.127)	(0.124)	(0.133)
TRADE2	-0.0830	-0.0767	-0.0748	0.0932	0.0904	0.0683
	(0.0509)	(0.0525)	(0.0527)	(0.0880)	(0.0881)	(0.0915)
KMOB	0.000803	-0.00980	0.000695	-0.00347**	0.00516	-0.00317**
	(0.00101)	(0.00585)	(0.000979)	(0.00149)	(0.0114)	(0.00131)
KMOB*k1990		3.73e-08*			-3.05e-08	
		(1.91e-08)			(3.99e-08)	
KMOB*FDI1996			0.00655			-0.0213**
			(0.00451)			(0.00856)
LMOB	0.272	0.552	0.205	1.719***	1.514**	1.950***
	(0.251)	(0.329)	(0.216)	(0.481)	(0.629)	(0.516)
GOVSPEND	0.00399	-0.000196	0.00507	0.107	0.108	0.102
	(0.0273)	(0.0298)	(0.0277)	(0.0708)	(0.0709)	(0.0700)
LDEBT	0.0184	0.0238	0.0200	0.0928***	0.0895***	0.0889***
	(0.0131)	(0.0143)	(0.0133)	(0.0174)	(0.0181)	(0.0172)
65+	0.0580	0.0215	0.0385	0.0180	0.0373	0.0720
	(0.185)	(0.190)	(0.191)	(0.264)	(0.252)	(0.256)
RIGHT	0.00387*	0.00375*	0.00364*	-0.00198	-0.00195	-0.00134
	(0.00209)	(0.00212)	(0.00209)	(0.00429)	(0.00425)	(0.00428)
Observations	441	441	441	464	464	464
R-squared	0.316	0.335	0.321	0.402	0.405	0.416
N of countries	28	28	28	28	28	28

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6 Conclusion

By relaxing the assumptions of perfect capital mobility and perfect labor immobility, we have shown theoretically that financial globalization does not necessarily lead to a race-to-the-bottom of capital tax rates, whereas labor mobility does matter for both capital and labor taxation. More specifically, both our simplified model and the simulations of our complete model show that only net capital exporting country wil feel a sharp downward pressure on its (source) capital tax rate and a pressure to shift the burden on to labor when capital mobility increases. Net capital exporters are also more sensitive to changes in labor mobility.

Our theoretical results are supported by the econometric estimations run on a panel of 28 OECD countries over 1997-2014. We find evidence that capital mobility has a negative impact on capital taxation and a positive impact on labor taxation, but essentially for net capital exporting countries. Conversely, we find that rising labor mobility has ambiguous effects on tax rates.

We conclude that the mixed results obtained in the literature concerning the link between international capital mobility and capital taxation may be related to improperly controlling for other factors, notably trade openness and ageing, failing to account for labor mobility, and especially to the extreme assumption of full capital mobility versus full labor immobility. Quantitatively, population ageing is found to have much more impact on capital tax rates than financial globalization over the period studied.

This paper may be extended in various ways. In particular, the game between countries could be studied through reaction functions. Additionally, the development of immaterial capital has offered new possibilities of tax optimization, with increased pressure on tax rates; and new technologies may offer new opportunities for households to live and work in different places. Finally, different scenarios of (partial) tax cooperation could be studied. These developments are left for future research.

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Appendix A: Derivation of the theoretical model

The Government's problem rewrites as the following optimization problem in (k, L) :

$$\max_{k,L} U\left(\frac{L}{L+D}y_L + \frac{\gamma D}{L+D}y_D, \frac{G}{L+D}\right)$$
$$s.t. \left| \begin{array}{l} \frac{L}{L+D}y_L + \frac{\gamma D}{L+D}y_D = \left| \begin{array}{l} \frac{L+\gamma D}{L+D}\left[\frac{k(k-\bar{k})}{\phi_K} + r^*\bar{k}\right] + \frac{L}{L+D}\left[w^* + \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L}\right] + \frac{\gamma D}{L+D}p \text{ if } \bar{k} \geq k, \\ \frac{L+\gamma D}{L+D}\left[\frac{\bar{k}(k-\bar{k})}{\phi_K} + r^*\bar{k}\right] + \frac{L}{L+D}\left[w^* + \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L}\right] + \frac{\gamma D}{L+D}p \text{ if } \bar{k} \leq k, \end{array} \right. \\ \frac{G}{L+D} = F\left(k, h\frac{L}{L+D}\right) - \left(r^* + \frac{(k-\bar{k})}{\phi_K}\right)k - \left(w^* + \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L}\right)\frac{L}{L+D} - p\frac{D}{L+D}. \end{array} \right. \tag{A.1}$$

The weighted average personal income is obtained from (8) and (9). The average spending is obtained by replacing the tax rates τ_K and τ_L in (11) by $F'_K - r$ and $F'_L - w$ and by using (4), (6). The equation is then rearranged using the homogeneity property of the production function. Moreover, the tax rates satisfy:

$$\begin{aligned} \tau_K &= F'_K\left(k, h\frac{L}{L+D}\right) - r^* - \frac{(k-\bar{k})}{\phi_K}, \\ \tau_L &= F'_L\left(k, h\frac{L}{L+D}\right) - w^* - \frac{\left(1-\frac{\bar{L}}{L}\right)}{\phi_L}. \end{aligned} \tag{A.2}$$

First order conditions are:

$$\begin{aligned} &U'_Y(.,.)\left[\frac{(2k-\bar{k})}{\phi_K}\frac{L+\gamma D}{L+D}\right] + U'_G(.,.)\left[F'_K(.,.) - r^* - \frac{(2k-\bar{k})}{\phi_K}\right] = 0 \text{ if } \bar{k} \geq k, \\ &U'_Y(.,.)\left[\frac{\bar{k}}{\phi_K}\frac{L+\gamma D}{L+D}\right] + U'_G(.,.)\left[F'_K(.,.) - r^* - \frac{(2k-\bar{k})}{\phi_K}\right] = 0 \text{ if } \bar{k} \leq k, \end{aligned} \tag{A.3}$$

and:

$$\begin{aligned} &U'_Y(.,.)\left[(1-\gamma)D\left(\frac{\bar{k}(k-\bar{k})}{\phi_K} + r^*\bar{k} + p\right) + D\left(w^* + \frac{1}{\phi_L} - p\right) + \frac{\bar{L}}{\phi_L}\right] \\ &+U'_G(.,.)\left[F'_L(.,.)D - D\left(w^* + \frac{1}{\phi_L} - p\right) - \frac{\bar{L}}{\phi_L}\right] = 0. \end{aligned} \tag{A.4}$$

One can rewrite (A.3) as follows:

$$\begin{aligned} F'_K(.,.) - r^* - \frac{(k-\bar{k})}{\phi_K} &= \frac{1}{\phi_k}\left[k - \frac{U'_Y(.,.)}{U'_G(.,.)}\frac{L+\gamma D}{L+D}\left(2k-\bar{k}\right)\right] \text{ if } \bar{k} \geq k, \\ F'_K(.,.) - r^* - \frac{(k-\bar{k})}{\phi_K} &= \frac{1}{\phi_k}\left[k - \frac{U'_Y(.,.)}{U'_G(.,.)}\frac{L+\gamma D}{L+D}\bar{k}\right] \text{ if } k \geq \bar{k}, \end{aligned} \tag{A.5}$$

Using the expression of τ_K in (A.2), we obtain (12).

One can rewrite (A.4) as follows:

$$\frac{U'_Y(.,.)}{U'_G(.,.)} = \frac{\left[D\left(w^* + \frac{1}{\phi_L} - p\right) + \frac{\bar{L}}{\phi_L} - F'_L(.,.)\,D\right]}{\left[D\left(w^* + \frac{1}{\phi_L} - p\right) + \frac{\bar{L}}{\phi_L} - (1-\gamma)\,D\left(\frac{\bar{k}(k-\bar{k})}{\phi_K} + r^*\bar{k} + p\right)\right]} \tag{A.6}$$

which implies:

$$\left.\frac{U'_Y(.,.)}{U'_G(.,.)}\right|_{\gamma=1, D>0} = 1 - \frac{F'_L(.,.)\,D}{\left[D\left(w^* + \frac{1}{\phi_L} - p\right) + \frac{\bar{L}}{\phi_L}\right]} < 1 \text{ and } \left.\frac{U'_Y(.,.)}{U'_G(.,.)}\right|_{D=0} = 1. \tag{A.7}$$

Note also that when $D = 0$, (A.5) reduces to:

$$\begin{aligned} F'_K(k,h) - r^* &= 0 \text{ if } \bar{k} \geq k, \\ F'_K(k,h) - r^* - \frac{2(k-\bar{k})}{\phi_K} &= 0 \text{ if } \bar{k} \leq k, \end{aligned} \tag{A.8}$$

and (A.4) to:

$$U'_Y(.,.) - U'_G(.,.) = 0. \tag{A.9}$$

If the Social Welfare function is additively separable and using (A.2), (A.9) can be written as:

$$U'_Y\left(\frac{k\left(k-\bar{k}\right)}{\phi_K} + r^*\bar{k} + F'_L(k,h) - \tau_L\right) - U'_G\left(F(k,h) - \left(r^* + \frac{\left(k-\bar{k}\right)}{\phi_K}\right)k - F'_L(k,h) + \tau_L\right) = 0, \tag{A.10}$$

if $\bar{k} \geq k$. Using the homogeneity property of the production function and (A.8), the latter

can be rewritten as:

$$U'_Y\left(\frac{k\left(k-\bar{k}\right)}{\phi_K}+r^*\bar{k}+F'_L\left(k,h\right)-\tau_L\right)-U'_G\left(-\frac{k\left(k-\bar{k}\right)}{\phi_K}+\tau_L\right)=0, \tag{A.11}$$

which used as an implicit function gives (16). Similarly, (A.9) can be written as:

$$U'_Y\left(\frac{\bar{k}\left(k-\bar{k}\right)}{\phi_K}+r^*\bar{k}+F'_L\left(k,h\right)-\tau_L\right)-U'_G\left(\frac{k\left(k-\bar{k}\right)}{\phi_K}+\tau_L\right)=0, \tag{A.12}$$

if $\bar{k}\leq k$. We obtain

$$\frac{\partial\tau_L}{\partial\phi_K}=\frac{-\frac{\bar{k}\left(k-\bar{k}\right)}{\phi_K^2}U''_{YY}+\frac{k\left(k-\bar{k}\right)}{\phi_K^2}U''_{GG}}{U''_{YY}+U''_{GG}}+\frac{U''_{YY}\left[\frac{\bar{k}}{\phi_K}+F''_{KL}\left(k,h\right)\right]-U''_{GG}\frac{2k-\bar{k}}{\phi_K}}{U''_{YY}+U''_{GG}}\frac{dk}{d\phi_K}, \tag{A.13}$$

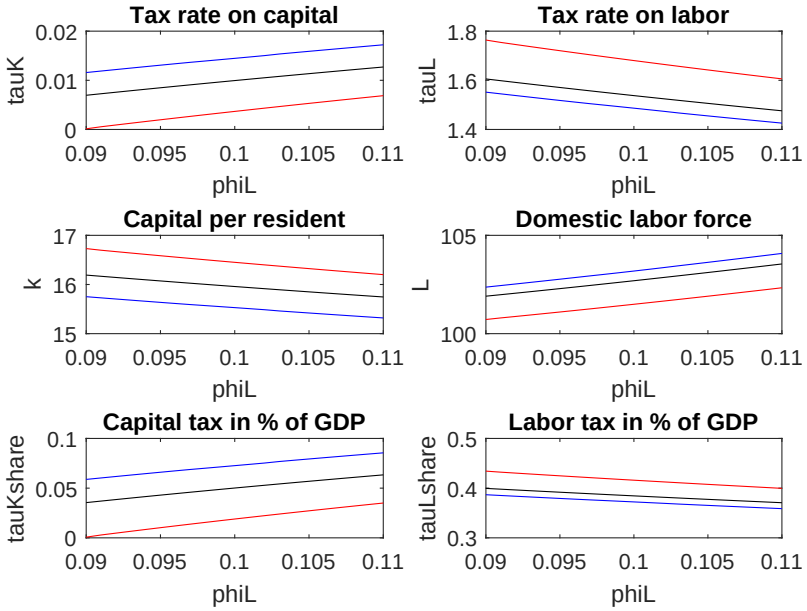
where:

$$\frac{dk}{d\phi_K}=\frac{\frac{2k}{\phi_K^2}}{F''_{KL}\left(k,h\right)+\frac{2k}{\phi_K}}>0. \tag{A.14}$$

The sign of is therefore ambiguous.

Appendix B: Impact of labor mobility on taxation: The case of a net labor importer

Figure 11: Impact of labor mobility on taxation: net labor importer ($w^* = 1$)



Notes: black lines are for $D = 27$, $\gamma = 1$; blue lines for higher dependence ($D = 30$, $\gamma = 1$), red lines for higher political weight of pensioners ($D = 27$, $\gamma = 1.05$.

Appendix C

Table 9: Variables definitions and data sources

Variable	Label	Definition	Source
Capital tax rate	KTAX	Effective average tax rate on corporate income	Oxford University
Labor tax rate	LTAX	Tax wedge on gross income representing 167% of gross earnings (single, no children)	OECD
Labor tax rate low	LTAX low	Tax wedge on gross income at the minimum wage	OECD
Capital mobility	KMOB	Gross external assets + liabilities /2GDP	Lane Milesi-Ferretti
Labor mobility	LMOB	Inflows+outflows of non-nationals from and to other OECD countries /total population	OECD
Trade openness	TRADE	Exports + Imports /2*GDP	CEPII, World Bank
Trade openness squared	TRADE2	Square of TRADE	CEPII, World Bank
Ageing	65+	Share of the population aged 65+	OECD
Right-wing executive	RIGHT	Dummy = 1 if right-wing executive	World Bank
Government spending	GOVSPEND	Gerneral government spending /GDP	IMF
Net FDI position	FDI1996	(FDI assets - FDI liabilities)/GDP	Lane Milesi-Ferretti
Capital endowment	k1990	Capital per worker in 1990 in USD mn of 2011	Penn World Tables
Net migration	MIGR1990	Cumulated net immigration 1983-97/residents	United Nations
Labor endowment	L1990	Employment to population in 1990	Penn World Tables

Appendix D: Additional regressions

Table 10: Simple panel auto-regressive model

VARIABLES	KTAX			LTAX		
	All	Kimport	Kexport	All	Kimport	Kexport
	(1)	(2)	(3)	(4)	(5)	(6)
L.KTAX	0.805***	0.859***	0.758***			
	(0.0342)	(0.0313)	(0.0575)			
F test coeff=1	32.37***	20.40***	17.69***			
L.LTAX				0.808***	0.818***	0.803***
				(0.0321)	(0.0418)	(0.0435)
F test coeff=1				35.57***	18.87***	20.59***
Observations	460	256	204	464	260	204
R-squared	0.841	0.860	0.844	0.731	0.754	0.717
No of countries	28	16	12	28	16	12

Country and time FE. Std errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Impact of factor mobility on VAT and on the taxation of low wages: instrumented mobility

VARIABLES	VAT			LTAX low		
TRADE	0.0661	0.0671	0.0782**	-0.154**	-0.111	-0.163**
	(0.0421)	(0.0414)	(0.0382)	(0.0742)	(0.0732)	(0.0724)
TRADE2	-0.0555*	-0.0562*	-0.0567*	0.0901*	0.0592	0.0909*
	(0.0308)	(0.0300)	(0.0294)	(0.0536)	(0.0514)	(0.0535)
KMOB	-8.63e-05	-8.13e-05	-0.00969	-0.00379***	-0.00358***	0.00335
	(0.000791)	(0.000789)	(0.00680)	(0.00138)	(0.00135)	(0.0102)
KMOB*FDI1996		-0.000846			-0.0342***	
		(0.00534)			(0.00986)	
KMOB*k1990			3.46e-08			-2.57e-08
			(2.29e-08)			(3.42e-08)
LMOB	2.232*	2.269*	1.814*	1.482	2.746	1.736
	(1.147)	(1.223)	(0.963)	(2.111)	(2.240)	(1.916)
GOVSPEND	-0.00446	-0.00472	-0.00586	0.103**	0.0936**	0.103**
	(0.0253)	(0.0258)	(0.0215)	(0.0415)	(0.0443)	(0.0418)
LDEBT	0.0274***	0.0273***	0.0295***	0.0902***	0.0862***	0.0888***
	(0.00782)	(0.00775)	(0.00822)	(0.0120)	(0.0118)	(0.0130)
65+	0.0124	0.0148	-0.0158	-0.0294	0.0562	-0.0146
	(0.0920)	(0.0920)	(0.0936)	(0.155)	(0.159)	(0.155)
RIGHT	0.00460***	0.00463***	0.00425***	-0.00144	-0.000238	-0.00128
	(0.00130)	(0.00135)	(0.00121)	(0.00212)	(0.00214)	(0.00205)
Observations	419	419	419	439	439	439
R-squared	0.317	0.324	0.341	0.379	0.400	0.382
N of countries	28	28	28	28	28	28
Kleibergen-Paap rk LM	18.098***	14.600***	26.415***	21.560***	17.780***	29.059***
Kleibergen-Paap Wald rk F	23.490	12.560	15.803	27.835	15.335	18.643

All columns include country and time fixed effects.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.