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Tax incidence, majority voting and capital market integration

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Abstract

We re-examine, from a political economy perspective, the standard view that higher capital mobility results in lower capital taxes — a view, in fact, that is not confirmed by the available empirical evidence. We show that when a small economy is opened to capital mobility, the change of incidence of a tax on capital–from capital owners to owners of the immobile factor–may interact in such a way with political decision-making so as to cause a *rise* in the equilibrium tax. This can happen whether or not the immobile factor (labour) can be taxed, and whether or not savings can be subsided under capital mobility.

Keywords: Capital tax competition; Capital market integration; Majority voting; Tax incidence

1. Introduction

In spite of the now large literature on capital tax competition, there have been relatively few systematic analyses of the interaction between the level of tax competition and the political process by which taxes are chosen. An early and important exception[1] is Persson and Tabellini (1992) – henceforth PT – who stress that with tax competition, voters in a country generally vote strategically by choosing a candidate who, once in office, will tax capital more than the median voter would. In their model, such a candidate has less than the median endowment of capital i.e.

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[1] Other, more recent contributions are discussed in Section 5.

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is poorer. Via this strategic delegation, the voters precommit to a higher tax rate, thus counteracting the ex post incentive of the policy-maker, once in office, to under-tax capital. So, intensification of tax competition, due to increased capital mobility (capital market integration, CMI), will also induce a change in to a more pro-tax candidate.

In this paper, we identify a rather different interaction between changes in CMI and the political process. This works through the impact that CMI has on the *incidence* of the tax on capital. Unlike PT, this effect does not require representative democracy or strategic behavior by countries. Indeed, in our model, countries are small and democracy is direct. Nevertheless, the effect of this interaction is quite striking: under empirically quite plausible conditions, the equilibrium tax on capital can *rise* following CMI, in contrast to the standard conclusion that taxes are lower in economies open to capital mobility.[2]

The key feature of our model is that (unlike PT) there are two factors of production in every country, one internationally immobile (labour) and one possibly internationally mobile (capital), and the before-tax prices of factors are not fixed. Indeed, our model is simply the standard Zodrow and Mieszkowski (1986) one, but where agents in any country are allowed to be completely heterogeneous in their labour and capital endowments, and also their preferences over the public good.[3] Decisions over tax rates are made by majority voting.

Consider the simplest case, where the only tax instrument is a capital tax and all voters value the public good equally. Then, in our model, following capital market integration, the *incidence of the capital tax changes*: the burden of the tax shifts from owners of capital to owners of labour. As agents within a given country are heterogenous, the change in the incidence of the capital tax, following CMI, will generally cause a change in the attitude of the median voter toward taxation (and may also change the identity of the median voter—but this is not crucial).

Specifically, without capital mobility, owners of capital bear the entire burden of the tax; the after-tax price of capital decreases by the full amount of the tax, while the wage is fixed by the level of inelastically supplied capital.[4] So, any voter's marginal contribution to the cost of public good provision is proportional to his *capital* endowment. This implies that the median voter in the closed economy (i.e., the voter whose ideal tax and level of public good provision is the median one in the population) is the owner of the median capital endowment. So, in the closed economy, in equilibrium, the tax will be determined by the size of the median capital endowment.

With capital mobility, instead, the entire burden of the tax is shifted to owners of the immobile factor of production (labour), as each country is small and takes the after-tax price of capital as given. So, now, any voter's marginal contribution to the cost of public good provision is proportional to his *labour* endowment. So, the median voter in the open economy case is the owner of the median labour endowment, and the equilibrium tax is thus determined by the size of the median labour endowment.[5]

[2] It is worth noting that in the PT model, although the strategic delegation effect works in to raise taxes following CMI, in the symmetric equilibrium that they analyse, it never fully offsets the basic economic effect of CMI which is to lower the equilibrium tax.

[3] Our results therefore also extend in various ways (fully explained in Section 6) the many papers that use this model.

[4] The case where capital endowments are determined by an endogenous savings decision and thus may be price-elastic is considered in Section 5 below.

[5] Note that these may in fact be different agents, so we may have a shifting median voter. However, as argued below, the shifting median voter per se does not drive our results.

So, other things equal, if the median capital endowment is high (relative to the average capital endowment), and the median labour endowment is low (relative to the average labour endowment), the median voter's demand for the public good (and therefore the tax) will be low in the closed economy, and high in the open economy. Call this the *tax incidence* effect of capital market integration. Of course, following capital market integration, other things are not equal: from the point of view of the median voter in a given country, the elasticity of capital employed in that country with respect to the capital tax, formerly zero, is now positive, and so the marginal cost of public funds rises from unity to a value greater than unity, causing the policy-maker to choose a lower tax. Call this latter effect the *tax competition* effect. In a model with a representative household, or with a benevolent policy-maker that maximises the sum of utilities, *only* the tax competition effect will be at work, and this leads to the classic result that the tax on capital falls in response to CMI.

However – and this is the main result of our paper – in our model, it is perfectly possible for the tax incidence effect to outweigh the tax competition effect, so that equilibrium capital tax rate *rises*, following capital market integration. Indeed, under some conditions (basically, when the marginal cost of public funds is close to unity in the open economy) the difference in the median endowments does not have to be large to result in a rise in capital taxes. Some basic calibrations imply that in practice, the relevant marginal cost of public funds is not too far from unity.

Of course, this basic result is open to the objection that in practice, income from capital is more unequally distributed than income from labour (see for instance Goodman et al. (1997)), implying that the more likely scenario is that the median capital endowment – relative to the average – is *lower* than the median labour endowment, implying that the tax incidence effect would work in the same direction as the tax competition effect. As shown in detail below, this difficulty can be overcome by allowing voter preferences over the public good to differ. Then, equilibrium taxes are determined by the preference-adjusted capital and labour endowments in the closed and open economy cases, and then it is quite possible for the tax incidence effect to offset and dominate the tax competition effect even while the median capital endowment is lower than the median labour share (see Example 1 below).

A second question is whether our result is robust to allowing the government to have access to taxes other than the capital tax. We show fairly comprehensively that our result extends to this more realistic case, given that conditions are assumed that are sufficient to ensure an equilibrium outcome with majority voting i.e., a Condorcet winner (with multiple taxes, the policy space is multi-dimensional, and so a Condorcet winner does not exist without further restrictions). Specifically, in Section 3, we first assume that the government has a labour tax, as well as a capital tax, but the two taxes are proportional to each other, thus making the policy space one-dimensional. This is realistic for some countries such as the UK, where the personal tax rates on both kinds of income are in fact equal.[6] Second, in Section 4, we allow the government access to unrestricted labour and capital taxes, and also a savings subsidy.[7] In this case, we make the intermediate preference assumption (Persson and Tabellini (2000)), by assuming that preference-adjusted labor and capital shares are linearly related, which is again sufficient to ensure a Condorcet winner. In both cases, the basic argument presented above generalizes quite straightforwardly.

[6] Some countries, however, notably the Nordic countries and Austria operate a system of dual income taxation, where income from capital is taxes at a flat rate which is lower than the higher marginal rates of tax on labour income.

[7] Following most of the tax competition literature, we suppose that a positive savings tax is infeasible due to enforcement problems.

Our paper is related to three literatures, the first of which is discussed in more detail below in Section 6. First, there are some papers which show that equilibrium taxes may rise in some or all countries following CMI (for instance, DePater and Myers (1994), Wilson (1987), Huizinga and Nielsen (1997), Noiset (1995) and Wooders, Zissimos and Dhillon (2001)). However, in these models, the rise in taxes is generated by some modification of the economic environment relative to the standard tax competition model, rather than any interaction between tax incidence and the political process. Second, there is a growing body of empirical evidence that CMI has not clearly led to cuts in corporate tax rates, at least for OECD countries. Specifically, recent studies by Hallerberg and Bassinger (1998, 2001), Devereux, Lockwood, and Redoano (2003), Garrett (1998), Quinn (1997), Rodrik (1997), Swank and Steinmo (2002)) find rather mixed effects of relaxation of exchange controls on the capital account on corporate tax rates. Our paper provides one possible explanation for this.

Finally, there is a view in the political economy literature that (at least when preferences are single-peaked) models of direct democracy are observationally very similar to models with benevolent dictators who maximise (for example) the sum of utilities. Indicative of this view are the models and discussions in Persson and Tabellini (2000) pp. 319, 331 and Besley and Smart (2001). Our analysis shows that this is not always the case: the comparative statics of our model when CMI changes is qualitatively different with a median voter and a benevolent dictator.

The organization of the paper is the following. Section 2 describes the model. Section 3 characterizes the equilibria with and without capital mobility when labour taxes are allowed, but are assumed to be proportional to capital taxes. Section 4 does the same in the general case of no restrictions on taxes, but with the intermediate preference assumption. Section 5 discusses the extension to the case of elastic savings and labour supply. Section 6 discusses related literature in some depth and finally, Section 7 concludes the paper.

2. The model

There are a large number of identical countries. Each country is populated by a number of agents $i \in N = \{1, ..n\}$, where n is odd. Agent i in any country is endowed with k_i units of capital and l_i units of labour time, each of which can be sold to firms as an input. For convenience, let $\sum_{i \epsilon N} k_i = 1, \sum_{i \epsilon N} l_i = 1$. There is a number of identical firms in each country, which transform the two inputs into the consumption good using a constant-returns technology. The labour input is internationally immobile, but the capital input may be internationally mobile or not. The government in any country provides a public good by taxing the use of capital and labour inputs. The timing of events is as follows. First, the taxes are determined by majority voting at the beginning of the period. Then, firms choose their capital and labour inputs, and the prices of the factors are determined. Finally, production and consumption take place.

In more detail, the utility of agent i in any country is

$$u_i = c_i + \gamma_i v(g) \tag{1}$$

where c_i is the level of the consumption good, g is the level of public good provision and γ_i measures i's relative preference for the public good $v(.)$ is assumed to have the standard properties that $v'(.)>0$ and $v''(.)<0$ for all non-negative g and also $\lim_{g \to 0} v'(g) = \infty$. Note that agent i does not value leisure so that labour time l_i will always be inelastically supplied. The personal budget constraint is therefore

$$c_i = (r - \tau_s)k_i + (w - \tau_l)l_i \tag{2}$$

where r and w are market prices of the capital and labour inputs, respectively, τ_s is the residence-based tax on "savings[8]" i.e., on the capital endowment k_i and τ_l is the tax on labour. So, we are assuming for simplicity, and following the literature, that these taxes are specific, rather than ad valorem, but this does not make a qualitative difference to our results. Substituting the personal budget constraint (2) into Eq. (1), we get:

$$u_i = (r - \tau_s)k_i + (w - \tau_l)l_i + \gamma_i v(g). \tag{3}$$

Now consider the behavior of firms. These are assumed competitive, i.e., they take factor prices as given. Due to the assumed constant returns to scale, we can suppose that there is only one firm in each country, with output of $f(k)$, where k is the amount of capital employed by the firm in a typical country. The production function $f(.)$ has the standard properties, $f(0)=0, f'(.)>0, f''(.)<0$. The firm is price-taking, and so employs capital up to the point where

$$f'(k) = r + \tau_k \tag{4}$$

where τ_k is the source-based tax on capital.

Factor prices are then determined as follows. In the closed economy case, the price of the capital input adjusts to the point where it is optimal for the firm to use the country's aggregate endowment of capital i.e., from Eq. (4)

$$r_c = f'(1) - \tau_k. \tag{5}$$

So clearly, the suppliers of capital bear the full burden of the tax i.e., $dr_c/d\tau_k = -1$. In the open economy case, r is fixed at r_o, so the amount of capital employed by the firm is given explicitly by inverting Eq. (4) to get

$$k = k(r_o + \tau_k),\ k' = \frac{1}{f''}. \tag{6}$$

Finally, the wage adjusts to the point where it is optimal for the firm to employ one unit of labour, so the wage is

$$w(k) = f(k) - kf'(k) \tag{7}$$

noting that if the economy is closed then $k=1$.

Turning now to the determination of the taxes, the government budget constraint is $g=\tau_k k+\tau_l+\tau_s$ where $k=1$ in the closed economy case. So, substituting the government budget constraint and Eq. (5) into Eq. (3), and dividing by γ_i, preferences over taxes for i in closed and open economies can be written

$$u_i = \begin{cases} (f'(1) - \tau_k - \tau_s)\alpha_i + (w(1) - \tau_l)\beta_i + v(\tau_k + \tau_l + \tau_s) \text{ (closed)} \\ (r_o - \tau_s)\alpha_i + (w(k) - \tau_l)\beta_i + v(\tau_k k + \tau_l + \tau_s) \text{ (open)} \end{cases} \tag{8}$$

where $k_i/\gamma_i=\alpha_i$, $l_i/\gamma_i=\beta_i$. We will call α_i, β_i the *preference-adjusted* capital and labour endowments. Note that although heterogeneity is three-dimensional (agents can differ in both types of endowments, and preferences), effective heterogeneity is two-dimensional.

[8] In Section 5, there is discussion of an extension of the model where savings and labour supply are endogenously determined.

Then, (τ_s, τ_l, τ_k) are determined simultaneously in each country by majority voting as described in the following sections. In particular, in the open-economy case, the voters in each country are assumed to take r_o as given[9] (i.e., each country is assumed small relative to the international market for the capital input), in which case they rationally anticipate that the capital employed in that country will be determined by Eq. (6), given tax τ_k.

Moreover, we will focus on the case when a positive tax on savings is not available in an open economy because of enforcement problems. In practice it is difficult to tax capital income on a residence basis, due to administrative and tax compliance problems associated with taxing foreign-source income.[10] So, in the open economy case we impose $\tau_s \leq 0$. Moreover, in the closed economy case the distinction between a savings and a capital tax is not important as they both have the same tax base, as $k=1$. Therefore, to simplify exposition, we assume hereafter that in the closed economy case $\tau_s=0$.

Finally, taxes must be feasible[11] in the sense that they imply non-negative post-tax equilibrium prices of labour and capital inputs. Consider the closed economy first. A non-negative post-tax wage requires $\tau_l \leq w(1)$. Also, from Eq. (5), a non-negative after-tax price of capital requires $\tau_k \leq f'(1)$. So, in the closed economy case, the feasible set of taxes is

$$S_c = \{(\tau_l, \tau_k, \tau_s) | \tau_l \leq w(1), \tau_k \leq f'(1), \tau_s = 0\}.$$

In the open economy case, a non-negative net wage requires $\tau_l \leq w(k)$, and a non-negative after-tax price of capital requires $\tau_s \leq r^o$, which is in fact implied by $\tau_s \leq 0$, given $r_o \geq 0$. So, recalling $k=k(r_o+\tau_k)$, the feasible set of taxes facing a given country is

$$S_o = \{(\tau_l, \tau_k, \tau_s) | \tau_l \leq w(k(r_o + \tau_k)), \tau_s \leq 0\}.$$

Note that if $\tau_l=\tau_s=0$, so that only capital is taxed, then the model is effectively the well-known model of Zodrow and Mieszkowski (1986) and Wilson (1986) – the ZMW model henceforth – extended to allow (completely generally) for heterogeneity in the ownership of factors of production and in preferences.

Finally, we note that an analysis of the model as it stands is difficult, because the policy space (τ_l, τ_k, τ_s) is multi-dimensional in each country. Consequently, with *both* unrestricted taxes and distributions of preference-adjusted capital and labour endowments $\{\alpha_i\}_{i\in N}$, $\{\beta_i\}_{i\in N}$, voting cycles will generally arise. So, we begin in the next section, Section 3, by illustrating the tax incidence effect, and obtaining our key results in the special setting where there are enough restrictions on the tax instruments to ensure a Condorcet winner. Specifically, we assume that savings taxes are not available, even in the open economy case, i.e., $\tau_s=0$, and the labour tax is proportional[12] to the capital tax, i.e., $\tau_l=d\tau_k$ with $d \geq 0$ a fixed scalar,

[9] Implicitly, they also take the taxes in other countries as given, but these taxes only affect citizens' payoffs though r_o.

[10] For a model where the degree of information sharing between tax authorities is endogenously determined to be zero, which in turn implies that residents do not, in effect, face a tax on their capital income upon repatriation, i.e., a tax on their savings, see Makris (2003).

[11] Taxes must also generate non-negative revenue, because $g \geq 0$: however, due to the assumption $\lim_{g\to 0} v'(g) = \infty$, this constraint will never be binding in equilibrium, and so can be ignored.

[12] Allowing for $\tau_w = \bar{\tau}_w + d\tau_r$ where $\bar{\tau}_w$ is a fixed scalar would only complicate exposition, without affecting the qualitative nature of our results. The only difference would be that the capital tax could also be negative if $\bar{\tau}_w > 0$ and the public good was not valued enough.

so that the policy space is one-dimensional. In this case, the feasibility constraint on the capital tax is simply

$$\tau_k \leq \min\left\{ f'(1), \frac{w(1)}{d} \right\} \equiv \bar{\tau}, \tau_k \leq \bar{\tau}(r_o) \tag{9}$$

in the closed and open economy respectively, where $\bar{\tau}(r_o)$ is the unique solution of $\tau = \frac{w(k(r_o+\tau))}{d}$.

3. Capital market integration and tax competition with no savings tax and a restricted factor tax

3.1. Majority voting equilibrium in closed and open economies

First consider the closed economy. Recall that $\tau_s=0$, $\tau_l=d\tau_k$ by assumption, and set $\tau_k=\tau$. Then, from Eq. (8), the payoff of agent $i \in N$ in any country is

$$u_i(\tau) = (f'(1) - \tau)\alpha_i + (w(1) - d\tau)\beta_i + v(\tau(1+d)). \tag{10}$$

It is clear from Eq. (10) that *only the weights* $\alpha_i + d\beta_i$ will affect voter preferences over τ. Note that $u_i(\tau)$ is strictly concave in τ as v is assumed strictly concave. So, preferences over τ are single-peaked for all $i \in N$. Let τ_i^c be the *ideal tax* of agent i i.e., the tax that maximises Eq. (10) subject to the feasibility constraint that $\tau \leq \bar{\tau}$, where $\bar{\tau}$ is defined in Eq. (9). For an interior solution, this is given by the condition

$$v'(\tau_i^c) = \frac{\alpha_i + d\beta_i}{1+d} \equiv \sigma_i. \tag{11}$$

That is, the marginal benefit of the public good is set equal to σ_i,where σ_i is i's share of the cost of the public good. This is because one extra unit of public good requires a tax increase of $1/(1+d)$, and the tax is borne by both immobile capital and the fixed factor, labour, with the costs to i of α_i and $d\beta_i$, respectively; Note also that if $\sigma_i < v'(\bar{\tau}(1+d))$, then we have a corner solution with $\tau_i^c = \bar{\tau}$.

It follows from the fact that τ_i^c is decreasing in σ_i that the voter with the median ideal tax is just the voter with the median[13] σ_i-say voter p. Then, the outcome of majority voting over τ will be that τ_p^c is chosen. In what follows, we will assume that τ_p^c is interior. So we have proved:

Proposition 1. Assume $\sigma_p \geq v'(\bar{\tau}(1+d))$. Then, in the closed economy case, the equilibrium tax in each country is $\tau^c = \tau_p^c$, where τ_p^c solves Eq. (11) above with $i=p$.

Now consider the open economy case. Here, as each country is small, voters take r_o as fixed and thus perceive the negative relationship between τ and k in Eq. (6). So, from Eq. (8), the payoff of agent i in any country, is

$$u_i(\tau, r_o) \equiv r_o\alpha_i + (w(k(r_o+\tau)) - d\tau)\beta_i + v(\tau(k(r_o+\tau)+d)). \tag{12}$$

It is now clear from Eq. (12) that *only the weights* β_i *given by the preference-adjusted labour endowments* will affect voter preferences over τ. We will assume that the above function is strictly quasi-concave with respect to τ for any β_i and any r_o, which is sufficient to ensure that preferences over τ are single-peaked for all $i \in N$, given r_o fixed. Let τ_i^o be the ideal tax of voter i.

[13] Formally, for any i, let $A_i = \{j \in |N| \sigma \leq \sigma_i\}$, and $s_i = \#A_i/n$. Then, p is the value of the index for which $s_{p-1} < 0.5 < s_p$.

This maximises Eq. (12) subject to the constraint that the tax be feasible i.e., that $\tau \leq \bar{\tau}(r^o)$. Assuming an interior solution, after simple manipulation, we see that τ_i^o satisfies the condition:

$$v'\left(\tau_i^o\left(k\left(r_o+\tau_i^o\right)+d\right)\right)=\mu\left(\tau_i^o, k\left(r_o+\tau_i^o\right)\right)\beta_i \tag{13}$$

where

$$\mu(\tau,k)=\frac{k+d}{\left(k+d+\frac{\tau}{f''(k)}\right)} \tag{14}$$

is the marginal cost of public funds (MCPF) in the open economy, evaluated at any fixed τ, k. From Eq. (13), the marginal cost of a unit of the public good to i is now his preference-adjusted share β_i of labour (as the tax now falls entirely on the immobile factor) times the marginal cost of public funds μ, which is now greater than unity as capital is mobile.

Given the assumptions made so far, it can be shown straightforwardly[14] that the higher the cost share β_i, the lower the ideal tax τ_i^o at a given r_o. In the open economy case, the voter with the median ideal tax is now the voter with the median[15] preference-adjusted labour endowment β_i-say voter q. Then, the outcome of majority voting over τ will be that τ_q^o is chosen, where τ_q^o solves Eq. (13). From Eq. (13), τ_q^o depends on r_o, but as all countries are identical, the only possible equilibrium is where taxes are the same in all countries, and hence r_o is such that $k(r_o+\tau_q^o)=1$. So, if the equilibrium tax is interior i.e. $\tau_q^o \leq \bar{\tau}(r^o)$, from Eq. (9), it will therefore satisfy

$$v'\left(\tau_q^o(1+d)\right)=\mu\left(\tau_q^o, 1\right)\beta_q. \tag{15}$$

As in the closed economy case, we wish, for simplicity, to restrict attention to interior equilibrium taxes. For an interior equilibrium, it can be shown[16] that β_q must lie in the range stated in the following Proposition. So we have:

Proposition 2. Assume $\beta_q \geq v'(\bar{\tau}(1+d))/\mu(\bar{\tau},1)$. Then, in the open economy case, the equilibrium tax in each country is $\tau^o=\tau_q^o$, where τ_q^o solves Eq. (15) above.

Note two special cases. When $d=0$ a labour tax is not available and the above model reduces to the ZMW model with heterogenous ownership of factors of production. In this case, i's share of the cost of the public good in the closed economy is just equal to α_i, the preference-adjusted capital endowment. The reason is that in the absence of a labour tax the capital tax is borne entirely by immobile capital. When, on the other hand, $d=1$, the model features a uniform tax on capital and labour, and $\sigma_i=(\alpha_i+\beta_i)/2$. Also, note that the equilibrium public good provision is

[14] Strict quasi-concavity of $u_i(\tau, r^o)$ with respect to τ for any β_i and any r^o implies that $\partial^2 u_i(\tau_i^o, r^o)/\partial\tau^2<0$. This in turn implies directly that the ratio $v'(\tau_i^o(k(r^o+\tau_i^o)+d))/\mu(\tau_i^o, r^o)$ is strictly decreasing with τ_i^o for any β_i. Hence, we can see directly from Eq. (13) that the higher β_i, the lower τ_i^o, as long as τ_i^o is interior.

[15] Formally, let $B_i=\{j\in N|\beta_j\leq B_i\}$, and $b_i=\#B_i/n$. Then $q\in N$ is the value of the index for which $b_{q-1}<0.5<b_q$.

[16] An interior tax requires $\beta_q \geq \frac{v'(\frac{w(1)}{d}(1+d))}{\mu(\frac{w(1)}{d},1)}$. To see this, note that in equilibrium $k(r^o+\tau)=1$ and so the constraint $\tau\leq+(r_o)$, i.e., $d\tau\leq w(k(r^o+\tau))$, becomes $d\tau\leq w(1)$. This constraint is binding for the median voter in equilibrium if $d>0$ and $v'(\tau(1+d))>\mu(\tau,1)\beta_q$ when evaluated at $\tau=w(1)/d$. Also, as in equilibrium $r^o=f'(1)-\tau_q^o$, for $r^o\geq 0$, we need $\tau_q^o\leq f'(1)$. Given that strict quasi-concavity implies that $v'(\tau(1+d))/\mu(\tau,1)$ is decreasing with τ, having $\tau_q^o\leq f'(1)$ in an interior equilibrium requires $\beta_q\geq v'(f'(1)(1+d))/\mu(f'(1),1)$. So, focusing on an interior equilibrium with $r^o\geq 0$ requires $\beta_q\geq\max\left\{\frac{v'(\frac{w(1)}{d}(1+d))}{\mu(\frac{w(1)}{d},1)}, \frac{v'(f'(1)(1+d))}{\mu(f'(1),1)}\right\}$. Simplifying, by recalling that $\bar{\tau}=\min\left\{f'(1), \frac{w(1)}{d}\right\}$ and using the quasi-concavity of $v'(\tau(1+d))/\mu(\tau,1)$, we get $\beta_q\geq v'(\bar{\tau}(1+d))/\mu(\bar{\tau},1)$.

proportional to the capital tax τ, with $(1+d)$ the factor of proportionality. Therefore, any ranking between τ_p^c and τ_q^o implies the same ranking for levels of public good, for any $d \geq 0$.

3.2. Capital market integration and tax competition

Following CMI, three things will happen. First, the marginal cost of public funds rises from unity to $\mu > 1$, as the supply of capital is now no longer fixed in each country. Other things equal, this will lower the equilibrium tax, a well-known and standard result.

However, with heterogenous agents, there are two other effects of CMI. First, the identity of the median voter may[17] change i.e., $p \neq q$, which we call *the shifting median voter* effect. Second, whether or not there is a shifting median voter, if the median weighted preference-adjusted endowment is not equal to the median preference-adjusted labour share (i.e. $\sigma_p \neq \beta_q$), other things equal, the median voter's choice of tax rate will change. This is clear as from Eq. (11), the equilibrium tax in the closed economy case is determined by σ_p, but from Eq. (15), the equilibrium tax in the open economy case is determined by β_q. As already remarked, this is due to the fact that in the closed economy, the tax burden is partly borne by capital, whereas in the open economy case, it is entirely borne by labour. So, we say that there is a *tax incidence effect* when $\sigma_p \neq \beta_q$.

To understand the importance of these two effects, our first benchmark result describes what happens if the tax incidence effect is absent.[18]

Proposition 3. If there is no incidence effect i.e. if $\sigma_p = \beta_q$, then $\tau^c > \tau^o$.

Proof. If $\sigma_p = \beta_q = \lambda$, then the conditions (11) and (15) defining τ^c, τ^o become $v'(\tau^c) = \lambda$, $v'(\tau^o) = \mu(\tau^o, 1)\lambda$. So, as $f'' < 0$ and $\tau^o > 0$, $\mu(\tau^o, 1) > 1$, we have $v'(\tau^o) > v'(\tau^c)$. But then by strict concavity of v, $\tau^o < \tau^c$. □

That is, we have the standard result[19] that CMI will reduce the equilibrium tax, because capital mobility leads to a higher cost of public funds. So, the shifting median voter effect per se has no effect at all on equilibrium taxes, and thus on the relationship between τ^c and τ^o. It is, nevertheless interesting (and not noted in the literature, to our knowledge) that the identity of the median voter can change following CMI.

Now we show how this "standard" result $\tau^c > \tau^o$ can be overturned by the incidence effect. This happens in a very simple and striking way. The general idea is illustrated in Fig. 1 below. The figure graphs the marginal benefit of the public good, g, i.e., $v'(g)$, and also the marginal cost to the relevant median voter of providing that level of the public good (σ_p in the closed economy, and $\beta_q\ \mu(g, 1)$ in the open economy). In the Figure, the median voter in the closed economy has a high weighted preference-adjusted endowment σ_p, and thus desires a low level of g and hence a low tax, but the median voter in the open economy has a low preference-adjusted labour endowment β_q, and thus desires a higher level of g and hence a higher tax. As the Figure is drawn, this tax incidence effect *more than offsets* the reduction in the tax due to an increase in the marginal cost of public funds generated by capital mobility.

The important question then arises as to "how big" the incidence effect (i.e., difference between σ_p and β_q) needs to be to get a reversal of the standard result. To answer this question, note that

[17] In general, a necessary condition for the existence of the shifting median voter effect is that it is not possible to label citizens so that $\sigma_1 \leq \sigma_2 \leq \ldots \sigma_n$ and either $\beta_1 \leq \beta_2 \leq .. \beta_n$ or $\beta_n \leq \beta_{n-1} \leq \ldots \beta_1$.

[18] In all following results, we assume that the conditions in Propositions 1 and 2 hold.

[19] Note that the classic results of Zodrow and Mieszkowski (1986), Wilson (1986) follow from Proposition 3, because if all agents are identical, i.e., $k_i = l_i = \frac{1}{n}, \gamma_i = \gamma$, all $i \in N$, the hypotheses of Proposition 3 are clearly satisfied.

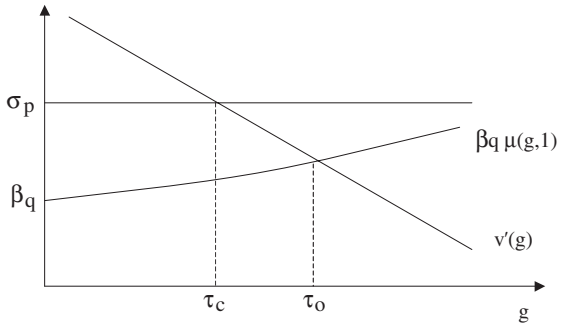

Fig. 1. Higher taxes with capital market integration.

because the median voters in closed and open economies have preference-adjusted shares σ_p, $\beta_q > 0$, respectively, then they will choose the same taxes in closed and open economy cases if

$$\frac{\sigma_p}{\beta_q} = \mu\left(\tau(\sigma_p), 1\right) \tag{16}$$

where $\tau(\sigma_p) = v'^{-1}(\sigma_p)$ is the tax chosen by the median voter in the closed economy. Moreover, it is clear from Eqs. (11) and (15) that if $\frac{\sigma_p}{\beta_q} > \mu\left(\tau(\sigma_p), 1\right)$, $\tau^o > \tau^c$, and vice versa. So, we have:

Proposition 4. τ^o is greater or less than τ^c as $\sigma_p/\beta_q > \mu(\tau(\sigma_p), 1)$, or $\sigma_p/\beta_q < \mu(\tau(\sigma_p), 1)$, respectively.

We will shortly discuss some numbers below to get a feel for what restriction on σ_p/β_q is required to have $\tau^o > \tau^c$ in practice. First, we show formally that $\sigma_p/\beta_q > \mu(\tau(\sigma_p), 1)$ is a theoretical possibility via a numerical example. This example is constructed so that the actual distribution of endowments has capital *more* unequally distributed than labour, consistently with the available evidence which suggests that wage income is less unequally distributed than non-wage income (Goodman et al. (1997)).

Example 1. Assume $d = 0$, quadratic preferences and technology i.e., $v(g) = (g - \zeta g^2)/2$, $\zeta > 0$, and $f(k) = k - \phi k^2/2$, $1 > \phi > 0$. First, we construct α_p, β_q as follows. Assume $n = 3$. Now choose endowments $(k_1, k_2, k_3) = (0, 0.1, 0.9)$, $(l_1, l_2, l_3) = (0, 0.3, 0.7)$. Note that $k_2 < l_2 < 1/3$. So, endowments are unequally distributed (the distributions of endowments are left-skewed), with the additional (realistic) assumption that capital income is more unequally distributed than labour income. Suppose also that $\gamma_1 = 1$, $\gamma_3 = 1.8$ and $\gamma_2 = 0.2$. These imply that $(\alpha_1, \alpha_2, \alpha_3) = (0, 1/2, 1/2)$ and $(\beta_1, \beta_2, \beta_3) = (0, 3/2, 7/18)$. So, voter 3 is the median voter in both closed and open economies i.e. $p = q = 3$, and $\alpha_p = 1/2 > 7/18 = \beta_q$. Now, by Proposition 1, the equilibrium tax in the closed economy solves $\alpha_p = v'(\tau^c)$, or $0.5 = 0.5 - \zeta\tau^c$, so $\tau^c = 0$. So, in this case, using Eq. (14), we have $\mu(\tau(\alpha_p), 1) = 1$. Thus, by Proposition 4, the equilibrium tax in the open economy will be strictly positive, because of $\beta_q < \alpha_p$. We have thus shown that $\tau_o > \tau_c$.||

In the above example, the citizen with the larger than the median labour endowment has a valuation for public good sufficiently high to make him the median voter when voters are ranked by preference-adjusted endowments. This citizen also has a larger preference-adjusted capital endowment than labour endowment: in fact it is sufficiently larger to ensure that the tax rate will rise following CMI. The example highlights the fact that, in order to have a tax increase following CMI when wage income is less unequally distributed than non-wage income, all that

is needed is that some citizen who is richer than the citizen with the median labour endowment has a sufficiently high valuation of public good so that she possesses the median preference-augmented labour endowment, with the latter also being sufficiently lower than the median weighted preference-augmented endowment.[20]

When might the condition in Proposition 4 for the non-standard result that $\tau^o > \tau^c$ hold in practice? Note that from Eq. (14), we have

$$\mu(\tau,1) \equiv \frac{1}{\left(1-\frac{k}{k+d}\frac{\tau}{\tau+r}\varepsilon\right)}$$

where $\varepsilon = -\frac{r+\tau}{k}\frac{1}{f''}$ is the elasticity of capital with respect to the user-cost of capital. This is estimated at 0.25 by Chirinko et al. (1999) for the US. Also, following Keen and Kotsogiannis (2002), we take the tax-inclusive tax rate on capital $\tau/(r+\tau)$ in the US to be 0.2. Finally, assume that capital and labour income is taxed at the same average rate, i.e., $d=1$. Then $k/(k+1)$ is interpreted simply as the share of capital in national income, which for the US is stable at about 0.7. This gives a value of $\mu=1.036$. So, for $\tau^o > \tau^c$, we would need σ_p only to be 4% or so larger than β_q. The above discussion, we hope, establishes that this is at least a possibility. To be more precise about this would require empirical data on the joint distribution of $\{k_i, l_i, \gamma_i\}$ which we do not have.

4. Capital market integration and tax competition: the general case

The main result above has been derived for the case of a restricted set of tax instruments i.e., where savings are not taxed and the labour tax is proportional to the capital tax. In this section, we show that the same basic effect will be at work if a savings subsidy is available and all taxes/subsidies are related to each other only through the budget constraint. In this case, as already mentioned, as the policy space is then multi-dimensional, some restriction on the joint distribution of capital and labour endowments is required to ensure a well-defined median voter and thus a Condorcet Winner. When imposing this restriction – the intermediate preference assumption of Grandmont – we find that our basic result is robust: when the median voter has a relatively larger preference-adjusted capital than labour endowment CMI will result in higher capital taxes.

4.1. Majority voting equilibrium in closed and open economies

First consider the closed economy. Recall that $\tau_s=0$, by assumption. From Eq. (8), the payoff of agent $i \in N$ in any country is

$$u_i(\tau_l,\tau_k) = (f'(1)-\tau_k)\alpha_i + (w(1)-\tau_l)\beta_i + v(\tau_k+\tau_l). \tag{17}$$

[20] The following is a more general class of examples with this feature. Suppose that $\sum_{i\in N}\gamma_i = n$. Suppose also that capital and labour endowments are not perfectly-rank correlated. In particular, assume that $k_1<\ldots<k_m<\ldots<k_n$ and $l_1<\ldots<l_{m-1}<l_{m+1}<l_m<l_{m+2}<\ldots<l_n$, with $m=(n+1)/2$. Thus, m is the median capital endowment and $m+1$ is the median labour endowment. Suppose also that $k_m<l_{m+1}$ and $\gamma_1=\ldots=\gamma_m=1$. Then, if $k_{m+1}\frac{n-1}{2}k_m>l_n$ we have that there is a distribution of relative valuations for public good over citizens $m+1, m+2,\ldots,n$ so that $\alpha_p>\beta_q$. To see this, note first that $n-m=\frac{n-1}{2}$, that the smallest preference-adjusted capital endowment on the part of the citizens who are richer in capital than the median capitalist m is $k_m+1/(n-m)$. Thus, $p=m$ and $\alpha_p=k_m$. Notice also, due to $k_m<l_m+1$ and $l_n/(n-m)<k_m$, that $n-m>l_j/k_m>1$ for any $j=m+2,\ldots,n$. It follows then directly that any distribution of relative valuations for public good $\{\gamma_j\}_{j=m+1}^{j=n}$ with $\gamma_{m+1}=1$, $\sum_{j=m+1}^{j=n}\gamma_j = n-m, \gamma_j \le l_j/l_{m-1}$, and $\gamma_s > l_s/k_m$ for some $s+m+2$ leads to $q+m+2$ and $\beta_q<\alpha_p$ (as $\beta_j+\beta_{m-1}=l_{m-1}$ and $\beta_s=l_s/\gamma_s<k_m<l_{m+1}=\beta_{m+1}$).

It is now clear from Eq. (17) that both the preference-adjusted capital endowment α_i and the preference-adjusted labour endowment β_i will affect voter preferences over (τ_k, τ_l). So, generally, there is multi-dimensionality in the preference parameters, as well as in the policy space, and in this case, generally, there will be no Condorcet winner. Our approach in this section, following Persson and Tabellini (2000) Ch 12, is to impose a linear restriction on the relationship between the labour and capital endowments of any agent. This is sufficient to ensure that voters have intermediate preferences (Persson and Tabellini (2000), Definition 4), and so a Condorcet winner exists.

Specifically, we assume that $\alpha_i = a + b\beta_i$. Note from Eq. (17) that with this restriction, the ideal taxes of agent i only depend on his preference-adjusted labour endowment (and the constant a). With these preferences, there exists a unique Condorcet Winner $(\tau_l, \tau_k) \in S_c$, which is the ideal tax vector of the individual with the median preference-adjusted labour endowment β_i. Above, we defined this individual as q: here, we label this voter m. So, the equilibrium taxes (τ_l, τ_k) maximise $u_m(\tau_l, \tau_k)$, as defined in Eq. (17) with $i = m$, subject to the constraint that $(\tau_l, \tau_k) \in S_c$.

Notice that the marginal benefit from each tax is the same for m at $v'(g)$. We would thus expect the median voter to first use the tax that is less costly for her, and then the tax that is more costly. This is exactly what we find. Specifically, assuming for expositional simplicity an interior solution i.e., that the valuation of the public good is not so high that m wishes to tax both savings and labour at 100% (which requires max $\{\alpha_m, \beta_m\} \geq v'(f(1))$, we have:

Proposition 5. Assume max $\{\alpha_m, \beta_m\} \geq v'(f(1))$. If $\beta_m < \alpha_m$, then $\tau_l^c = w(1)$, and $\tau_k^c = v'^{-1}(\alpha_m) - w(1)$. If $\beta_m > \alpha_m$, then $\tau_k^c = f'(1)$, and $\tau_l^c = v'^{-1}(\beta_m) - f'(1)$.

Proof. The proof is standard, given the objective function (17) with $i = m$, the constraints $(\tau_l, \tau_k) \in S_c$, and the strict concavity of v. □

Part (i) of this Proposition is illustrated below in Fig. 2. As is clear in that figure, the opportunity cost of the public good for the median voter is α_m. If the marginal willingness to pay for the public good at this cost is below $w(1)$ – the maximum labour tax–the maximum labour tax is employed, and the remainder of the tax revenue is used to subsidise capital. If demand for the public good at this cost is above $w(1)$, the maximum labour tax is employed, and the additional revenue is raised though taxing capital. Part (ii) has a similar interpretation, with the roles of labour and capital taxes reversed.

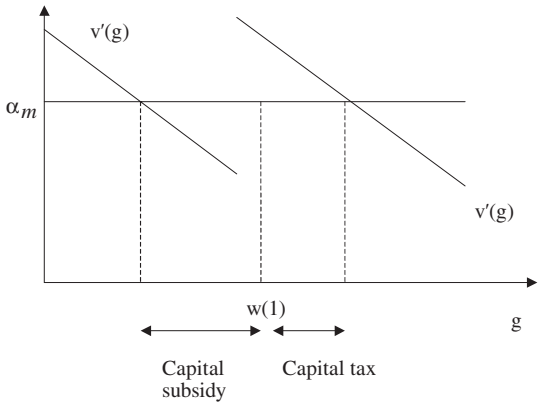

Fig. 2. The closed economy tax mix.

Now consider the open economy case. Here, as each country is small, voters take r_o as fixed and thus from Eq. (6), they perceive that $k=k(r^o+\tau_k)$. So, from Eq. (8), the pay-off of agent i in any country, is

$$u_i(\tau_l,\tau_k,\tau_s,r_o)\equiv(r_o-\tau_s)\alpha_i+(w(k(r_o+\tau_k))-\tau_l)\beta_i+v(\tau_l+\tau_k k(r_o+\tau_k)+\tau_s). \quad (18)$$

Again, we make the same intermediate preference assumption as above. Note that, again, the ideal taxes of agent i only depend on his preference-adjusted labour endowment (and the constant a). With these preferences, there exists a unique Condorcet Winner $(\tau_l,\ \tau_k,\ \tau_s)\in S_o$, which is the ideal tax vector of the individual with the median preference-adjusted labour endowment β_i. So, the equilibrium[21] taxes $(\tau_l^o,\ \tau_k^o,\ \tau_s^o)$ maximise $u_m\ (\tau_l,\ \tau_k,\ \tau_s,\ r_o)$, in Eq. (18) above, subject to the constraint that $(\tau_l,\ \tau_k,\ \tau_s)\in S_o$. Assuming, again for convenience, an interior solution, we have the following characterization of equilibrium taxes in the open economy:

Proposition 6. Assume max $\{\alpha_m,\beta_m\}\geq v'(f(1))$. (i) Whatever the restrictions on the savings tax, $\tau_k^o=0$. (ii) If there is no savings tax $(\tau_s\equiv 0)$, then $\tau_l^o=\min\ \{w(1),\ v'^{-1}\ (\beta_m)\}$. (iii) If only a savings subsidy $(\tau_s\leq 0)$ is permitted, (a) if $\beta_m<\alpha_m$, then $\tau_l^o=w(1)$ and $w(1)+\tau_s=\min\ \{w(1),\ v'^{-1}\ (\alpha_m)\}$, while (b) if $\beta_m>\alpha_m$ then $\tau_s=0$ and $\tau_l^o=\min\{w(1),\ v'^{-1}\ (\beta_m)\}$.

Proof of Proposition 6. The equilibrium capital and labour taxes maximise Eq. (18) with $i=m$, subject to $\tau_l\leq w(k(r_o+\tau_k))$, $\tau_s\leq T$. The first-order conditions with respect to τ_l, τ_k, τ_s, respectively, evaluated at equilibrium where $k=1$ are:

$$-\beta_m+v'(\tau_l+\tau_k+\tau_s)-\xi=0 \quad (19)$$

$$-\beta_m+v'(\tau_l+\tau_k+\tau_s)[1+\tau_k k']-\xi=0 \quad (20)$$

$$-\alpha_m+v'(\tau_l+\tau_k+\tau_s)-\theta=0 \quad (21)$$

where ξ, θ are the constraints on $\tau_l\leq w(k(r_o+\tau_k))$, $\tau_s\leq T$, respectively. First, note that from Eqs. (19) and (20), we have $v'\tau_k k'=0$, which implies $\tau_k=0$, proving (i).

Now suppose that $\tau_s\equiv 0$. Then only Eq. (19) applies i.e., $-\beta_m+v'(\tau_l)-\xi=0$. Then, there are two possibilities. If $v'(w(1))\leq\beta_m$, then the constraint on τ_l is not binding and $v'(\tau_l)=\beta_m$. Or, if $v'(w(1))>\beta_m$, then the constraint on τ_l is binding and $\tau_l=w(1)$. This proves (ii).

Now suppose that only savings subsidies are allowed, i.e., $T=0$ and hence $\tau_s\leq 0$. Then both Eqs. (19) and (21) apply, i.e., $-\beta_m+v'(\tau_l+\tau_s)-\xi=0$ and $\beta_m+\xi=\alpha_m+\theta$. Then, there are the following possibilities. If $\beta_m>\alpha_m$ then $\theta>0$ and thereby $\tau_s=0$. As above, then, If $v'(w(1))\leq\beta_m$, then the constraint on τ_l is not binding and $v'(\tau_l)=\beta_m$, while if $v'(w(1))>\beta_m$, then the constraint on τ_l is binding and $\tau_l=w(1)$. If on the other hand $\alpha_m>\beta_m$ then $\xi>0$ and hence $\tau_l=w(1)$. Also, given $\beta_m+\xi=\alpha_m+\theta$, we have $-\alpha_m+v'(w(1)+\tau_s)-\theta=0$. Then, there are two possibilities. If $v'(w(1))\leq\alpha_m$, then the constraint on τ_s is not binding and $v'(w(1)+\tau_s)=\alpha_m$. Or, if $v'(w(1))>\alpha_m$, then the constraint on τ_s is binding and $\tau_s=0$. This proves (iii). □

Part (i) says that the capital tax is set to zero, whatever the labour and capital endowments of the median voter. This result is an extension, to a political economy setting, of the well-known finding that a small open economy with a representative household does not wish to impose a

[21] Note that in the open economy case, $(\tau_w^o,\ \tau_r^o,\ \tau_s^o)$ depends on r_o, but as all countries are identical, the only possible equilibrium is where taxes are the same in all countries, and hence r_o is such that $k(r_o+\tau_r^o)=1$.

source-based tax on capital (the mobile factor) when a tax on labour (the fixed factor) is available.[22] As is well-known, this result is an application of the aggregate production efficiency theorem of Diamond and Mirrlees (1971). Part (ii) simply says that the median voter chooses either an interior or corner solution for its only tax instrument, the labour tax. Part (iii) says that a savings subsidy will be used only if the median voter's benefit from the subsidy is greater than the median voter's cost from providing it, i.e., $\alpha_m > \beta_m$. This is analogous[23] to the closed economy case (Proposition 5).

4.2. Capital market integration and tax competition

Comparing Propositions 5 and 6, the consequences of CMI for taxation of capital are clear. Generally, the tax on capital changes from τ_k^c to zero. So, whenever $\tau_k^c > 0$ we have confirmation of the "standard" kind of result that international tax competition lowers capital taxes. On the other hand, if $\tau_k^c < 0$, we have the opposite. It then follows immediately from Propositions 5 and 6 that:

Proposition 7. International tax competition raises capital taxes, i.e. $\tau_k^c < \tau_k^c = 0$, iff $\alpha_m > \max\{\beta_m, v'(w(1))\}$, and (weakly) lowers capital taxes otherwise.

To interpret this condition, note that for CMI to cause an increase in capital taxation, what is required is that both (i) the median voter is a "capitalist" i.e., has a greater share of the aggregate capital endowment of the economy than he does of the labour endowment ($\beta_m < \alpha_m$ or equivalently, $l_m < k_m$) and (ii) he does not value the public good too highly i.e., $\alpha_m > v'(w(1))$. The first condition ensures, in equilibrium, the tax on labour is always at a maximum, and the second ensures that not all of the tax revenue from the labour tax is used to fund the public good, leaving some excess to fund a capital subsidy in the closed economy.

Note that Proposition 7 is subject to the qualification that in the closed economy, the distinction between the source-based capital tax and residence-based savings tax is arbitrary. We have assumed that in the closed-economy case, $\tau_s = 0$, but this is not the only possibility. The other extreme assumption would be to set $\tau_k = 0$, in which case, it is immediate from Propositions 5 and 6 that the capital tax is left unchanged (at zero) following CMI. But more generally, we can say that if – possibly for reasons of evasion with a residence-based tax, or fraud with a residence-based subsidy – the government wishes to tax or subsidise capital partly on a source basis, i.e., where the tax or subsidy is formally incident on the firm, then Proposition 7 continues to apply. In other words, if we introduced enforcement problems with a residence-based tax/subsidy explicitly into the model, then in the closed economy τ_s, τ_k would be uniquely defined, and we would predict an increase in τ_k following CMI under the conditions specified in Proposition 7.

Finally, note also that any particular ranking between capital taxes before and after CMI is not necessarily informative about the size of local public good provision, as provision is also financed through the use of labour taxes. To see the effect of CMI on provision levels, note that the provision levels in the closed and open economies are $g^c \equiv \tau_k^c + \tau_l^c$ and $g^o \equiv \tau_k^o + \tau_l^o + \tau_s^o$, respectively. If only a savings subsidy is allowed, then note that Propositions 5 and 6 imply that $g^c = \min\{v'^{-1}(\alpha_m), v'^{-1}(\beta_m)\}$ and $g^o = \min\{v'^{-1}(\alpha_m), v'^{-1}(\beta_m), w(1)\}$. Clearly then if the public good is not sufficiently valued by the median voter, i.e., $\max\{\alpha_m, \beta_m\} \geq v'(w(1))$, we have that provision levels are unaffected by CMI. If, however, the median voter does not value much

[22] This result was first established by Gordon (1986) and Razin and Sadka (1991).

[23] We would like to thank an anonymous referee for bringing this into our attention.

the public good, i.e. max $\{\alpha_m, \beta_m\} < v'(w(1))$ then CMI leads to lower provision. Finally, if no savings tax/subsidy is used, i.e., $\tau_s \equiv 0$, then from Propositions 5 and 6 we have that $g^c = \min\{v'^{-1}(\alpha_m), v'^{-1}(\beta_m)\}$ and $g^o = \min\{v'^{-1}(\beta_m), w(1)\}$. Clearly then, depending on the demand for public good and the endowments of the median voter, CMI can leave unaffected, decrease or even increase provision. For instance, if $\alpha_m > \beta_m \geq v'(w(1))$ we have that $g^c = v'^{-1}(\alpha_m) < g^o = v'^{-1}(\beta_m) \leq w(1)$.

5. Endogenous savings and labour supply

Our results have all been obtained under the assumption that both labour supply and the stock of the capital endowment are fixed. Here, we sketch an extension to the case of endogenous labour supply and savings. A detailed version of this extension, including all algebraic derivations, is available from the authors. Assume explicitly that there are two periods, with a consumption/savings decision taking place in the first period, and all other activity in the second. Voter i in any country has preferences[24] over first and second-period consumption, second-period labour supply z_i, and the public good. This voter also has a first-period endowment k_i of the consumption good, which can be consumed in the first period or saved, generating savings s_i. This voter also has a second-period endowment of leisure time l_i which can be consumed or sold to firms. In this situation, both savings and labour supply are generally elastic i.e. depend on factor prices net of taxes $w - \tau_l$, $r - \tau_s$. Finally, in each country i, a single competitive firm produces output in the second period via a constant-returns production function $f(k, l)$ where $l \equiv \sum_{i=1}^{n} z_i$, and $k = \sum_{i=1}^{n} s_i$ by definition in the closed economy, and at equilibrium in the open economy. The model discussed so far is obviously a special case where voters do not value first-period consumption or leisure, so actual savings and labour supply are k_i, l_i, respectively. Also, in this discussion, it is convenient[25] to set $\gamma_i = 1$, all i.

In this more general model, one can take the approach of either Section 3 or Section 4, i.e., impose restrictions on either tax instruments or on preferences sufficient to ensure a Condorcet winner. Taking the approach of Section 3, and imposing $\tau_l = d\tau_k$, $\tau_k = \tau$, $\tau_s = 0$, we see that the analysis of the equilibrium tax in the open economy is conceptually the same as above, i.e., only l_i determines i's ideal tax, as the burden of the tax is borne entirely by labour (given r fixed). On the other hand, in the closed economy, as long as the supply of savings (and therefore the supply of capital) is somewhat interest-elastic, the burden of the tax will be shared between labour and capital. In the special case when $d = 0$, it can be shown that the ideal tax of voter i in the closed economy is determined by the weighted average of k_i and l_i, where the weight on k_i is simply the share of the burden of the capital tax borne by capital i.e., the fall in r as a percentage of an increase in τ_k.

The problem is that this weight is endogenous, i.e., varies with τ, so this makes it difficult to identify the median voter in terms of the underlying parameters of the model. But if individual preferences over τ are assumed single-peaked (i.e., strictly quasi-concave), the results are qualitatively the same as before: that is, CMI will cause the preferences of the median voter for public good provision to change, via a tax incidence effect. Specifically, in the open economy, the marginal cost of the public good to the median voter, q, is proportional to his share of total labour supply, z_p / l, whereas in the closed economy, the marginal cost of the public good to the

[24] We assume that utility is additively separable in all variables, and linear in second-period consumption.
[25] Formally, it is no longer true that i's ideal tax is just determined by the ratios k_i/γ_i, $l_i/\gamma i$.

median voter, p, is proportional to a weighted combination of his share of total labour supply, z_q/l and his share of total savings, s_q/k. So, if z_p/l is less than the weighted average of z_q/l and s_q/k then following CMI, the tax incidence effect will still work in the opposite direction to the rise in the MCPF, so $\tau^o > \tau^c$ is still possible.

The approach of Section 4, where the intermediate preference assumption is made to guarantee a Condorcet winner, generalizes very easily to this case. As before, the capital endowment is assumed to be a linear function of the labour endowment, so the voter with the median labour endowment is the median voter. Even with endogenous saving and labour supply, it is still true that the optimal capital tax for this median voter is zero. So, as in Section 4, to show that the capital tax may rise following CMI, all that is needed is to show that a capital subsidy can be optimal in the closed economy. As in Section 4, this can occur when $v'(g)$ is relatively low.

6. Related literature

Apart from the seminal work of PT, our paper is related to two parts of the now vast literature on capital tax competition. First, and most importantly, there are papers that have explicitly or implicitly derived conditions under which Nash equilibrium taxes rise in some or all countries following capital market integration.[26]

The relevant work can be subdivided in two. First, there are contributions that study asymmetries *between countries*. For example, DePater and Myers (1994) study a version of the ZMW model but allow for asymmetric countries that do not take the world price of capital as fixed. In that model, if a country is a sufficiently large capital importer it will set a higher tax when capital becomes more mobile. This is intuitive as a tax on capital lowers the price of capital and thus the cost of capital to an importing country. In a well-known paper, Wilson (1987) considers a model with trade in goods as well as capital: specifically, two goods, one labour-intensive and one capital-intensive. In that model, even if countries are symmetric ex ante, in equilibrium, one set of countries produces the capital-intensive good and set low tax rates (these countries import capital), and the other set of countries produce the labour-intensive good and set high tax rates (these countries export capital). In the first group of countries taxes are lower under perfect capital mobility. This can be thought of as a model of *endogenous* asymmetry across countries. Of course, the results of these papers are weaker than ours, in the sense that in equilibrium, only a *subset* of the countries raise their taxes following capital market integration.

Second, some recent papers present symmetric models where under certain conditions, taxes in all countries rise following capital market integration. The first, Huizinga and Nielsen (1997) relies on a *tax-exporting argument*. They allow agents in one country to own a share of the immobile factor (land) in the other countries. So, following capital market integration, the capital tax set in any country i is partially shifted to owners of land in other countries. If the level of foreign ownership is large enough, taxes in all countries rise following capital market liberalization.[27] Noiset (1995) and Wooders, Zissimos and Dhillon (2001) consider a second variant of the ZMW model where the tax funds a public infrastructure good, rather than a final

[26] For some excellent surveys of the literature on capital tax competition see Wilson (2000) and Wilson and Wildasin (2004).

[27] A further paper that fits this category is Keen and Kotsogiannis (2002), where tax jurisdictions are identical, but there is a federal government which taxes capital as well. This feature introduces a vertical tax externality: countries do not take into account the erosion of the federal tax base which results from an increase in local capital tax. If this vertical externality is large relative to the standard horizontal tax externalities, then over-taxation will result.

good. If, at Nash equilibrium, the degree of complementarity between capital and the infrastructure input is sufficiently large,[28] taxes with capital mobility will be inefficiently high. The intuition is simply that with strong complementarity, countries have an incentive to overinvest in infrastructure.

Our distinctive contribution to this literature is that we show that a tax rise following CMI is possible when the political process is modelled realistically, not because of some economic modification or elaboration of the ZMW model. Specifically, in our model, a benevolent (i.e. welfare maximizing) dictator would always choose lower taxes in the open economy: higher taxes arise because of the interaction of the "dictatorship" of the median voter with the tax incidence effect.

A final related paper here is Kessler, Lulfesmann and Myers (2002). In that model, agents differ only with respect to their capital endowment, and capital taxes fund a lump-sum transfer to all residents. Moreover, capital is perfectly mobile, and labour is imperfectly mobile (there are migration costs). Their main result is that in this setting, a reduction in migration costs (further integration of the labour market) leads to an increase in the capital tax when countries are symmetric. The intuition is the following: "*The integration of labour markets reduces the incentives for voters to attract foreign capital through lowering national tax rates because it at the same time causes an inflow of labour, which is detrimental to a majority*" (Kessler, Lulfesmann and Myers (2002)). So, both the result and the reasoning behind it are rather different to our paper. More broadly, however, both their paper and this one indicate that the under-taxation results of the classic Zodrow–Mieskowski model are not robust to apparently quite minor changes.

The second related literature comprises several papers that have studied choice of taxes via majority voting in variants of the ZMW and related models. Apart from the work of Kessler et al. (2002) we have mentioned above, Grazzini and van Ypersele (1999) have asymmetric countries and also heterogeneity of capital endowments. They study Nash equilibrium taxes in the open economy with majority voting in each country, but do not study the closed economy equilibrium (their focus is on when a proposal for a minimum tax on capital will be unanimously accepted). Consequently, they do not identify the incidence and shifting median voter effects. The model of Kessler et al. (2003) is very similar to Grazzini and van Ypersele (1999): heterogenous countries, and also agents within a country differing with respect to capital (but not labour) endowments.[29] They study Nash equilibria with majority voting in both countries both with and without capital mobility. However, their additional assumptions ensure that in any country, the equilibrium tax is *always* lower with capital mobility than without.[30]

7. Conclusions

This paper provides one possible explanation for why taxes on capital may not fall, but rise, following capital market integration. Our explanation is based on three simple ingredients:

[28] Specifically, the cross-partial derivative of output with respect to capital and infrastructure must be sufficiently large at Nash equilibrium. An assumption sufficient to rule this out was made by Zodrow and Mieszkowski (1986) in their original paper, so they also found under-taxation with an infrastructure public good.

[29] In fact, they just allow for two groups, rich and poor.

[30] Specifically, in their model, tax revenue is not spent on a public good but is returned in the form of a grant to every agent. This can be formally captured in our model by writing $\gamma_i=1$ and $v(g)=g$. Then, it is clear that in the closed economy case, the median voter p will choose the maximum feasible tax because $v'(g)=1>k_p$, and indeed, that is their result. So, the open-economy tax cannot be higher than the closed-economy tax.

equilibrium tax-shifting in the ZMW model, heterogeneity between agents within countries, and decision-making through a political process such as majority voting, rather than benevolent dictatorship. These interact to produce the incidence effect on equilibrium taxes following capital market integration. If the differences between the median preference-adjusted endowments of the mobile factor (capital), and the fixed factor (land) are large enough, the incidence effect may more than offset the usual effects of tax competition, and cause equilibrium taxes to rise. We also show that the same logic applies to the case where capital and labour can be taxed separately.

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