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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 fixed factor (labour) can be taxed.

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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. 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 and public good provision 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-Mieskowski (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.

In this 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, as the after-tax price of capital decreases and the wage is fixed by the level of inelastically supplied savings.

[1] Other, more recent contributions are discussed in Section 6.

[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.

With capital mobility, instead, the entire burden of the tax is shifted to owners of the immobile factor of production (labour), as each country takes the world interest rate as given, and the wage depends on the net flow of capital. Then, by the tax incidence effect, the median voter in the closed economy case is the owner of the median share of the capital endowment relative to his valuation of public good (the *preference-adjusted capital endowment*) whereas the median voter in the open economy case is the owner of the median share of the labour endowment relative to his valuation of public good (the *preference-adjusted labour endowment*) [4]

So, other things equal, if the median voter's share of the preference-adjusted capital endowment is high, and his share of the preference-adjusted labour endowment is low, 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 supply of capital, 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.

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 tax rates *rise*, 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 shares does not have to be large to result in a rise in capital taxes.[5]

Our paper is related to three literatures. 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. These contributions are all discussed in more detail in Section 6.

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 Basinger (1998), (2001), Devereux, Lockwood, and Redoano(2002), Garrett(1998), Quinn(1997) Rodrik(1997), Swank and Steinmo(2002)) find rather mixed effects of relaxation of exchange controls on the capital

[4]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.

[5]Of course, the logic of the above argument is that a necessary condition for this to occur is that the preference-adjusted endowments of the fixed factor are more unequally distributed than those of the mobile factor. Note however, that this may not be inconsistent with the empirical regularity that that labour income is less unequally distributed than capital income (see for instance Goodman et. al. (1997)). We return to this issue below.

account on corporate tax rates. Our paper provides one possible explanation for this. Some of the evidence, and a review of competing explanations, including our own, is presented in Section 5.

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 constrained to be zero. Section 4 does the same in the general case. In Section 5 we discuss some empirical evidence on the effects of CMI on capital taxes. 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, each of which can be sold to firms as an input. Let $\sum_{i \in N} k_i = 1$, $\sum_{i \in N} l_i = 1$. 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 income generated by the use of capital and labour inputs. Capital income is taxed on a source basis.

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.

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

$$c_i = rk_i + (w - \tau_w)l_i \tag{2}$$

where r and w are prices of the capital and labour inputs respectively, r is understood to be the price net of tax, and τ_w is the tax on labour income. Substituting the personal budget constraint (2) into

(1), we get:

$$u_i = rk_i + (w - \tau_w)l_i + \gamma_i v(g) \tag{3}$$

Now consider the behaviour of firms. These are assumed competitive, i.e. they take factor prices as given. Due to the assumed constant returns to scale, and $\sum_{i \in N} l_i = 1$, we can suppose that there is only one firm in each country, with a production function in intensive form of $F(k)$, where k is the amount of capital employed by the firm in a typical country. $F(.)$ has the standard properties, $F(0) = 0$, $F'(.) > 0, F''(.) < 0$. 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.

$$F'(1) = r_c + \tau_r \tag{4}$$

where τ_r is the tax on capital income. In the open economy case, the demand for capital by the firm is implicitly given by

$$F'(k) = r_o + \tau_r \tag{5}$$

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

$$w(k) = F(k) - kF'(k) \tag{6}$$

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

Turning now to the determination of the taxes, the government budget constraint is $g = \tau_r k + \tau_w$ where $k = 1$ in the closed economy case. So, substituting the government budget constraint and (4) into (3), and dividing by γ_i, the overall payoff to i, up to a constant, is

$$u_i = \begin{cases} (F'(1) - \tau_r)\alpha_i + (w(1) - \tau_w)\beta_i \ + v(\tau_r + \tau_w) & \text{(closed)} \\ r_o\alpha_i + (w(k) - \tau_w)\beta_i \ + v(\tau_r k + \tau_w) & \text{(open)} \end{cases} \tag{7}$$

where $\frac{k_i}{\gamma_i} = \alpha_i$, $\frac{l_i}{\gamma_i} = \beta_i$. 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 endowments, and perferences), effective heterogeneity is two-dimensional.

Then, (τ_w, τ_r) 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[6] (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 (5), given tax τ_r. Also, taxes must be feasible in the sense that they generate non-negative revenue (as $g \geq 0$) and also imply non-negative post-tax prices for labour and capital.

As these feasibility constraints play an important role in what follows, it is helpful to state them formally. Non-negative revenue requires that $\tau_w + k\tau_r \geq 0$. From (6), a non-negative wage requires

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

$\tau_w \leq w(k)$. From (4), in the closed economy, a non-negative price of capital $r_c \geq 0$ requires $\tau_r \leq F'(1)$. In the open economy case, as r_o is exogenous, there is no upper bound on τ_r. So, in the closed economy case, recalling $k = 1$, the feasible set of taxes is

$$S_c = \{(\tau_w, \tau_r) \,|\tau_w + \tau_r \geq 0,\ \tau_w \leq w(1),\ \tau_r \leq F'(1)\}$$

In the open-economy case, taking r_o as given, and recalling $k = k(r_o + \tau_r)$, the feasible set of taxes is

$$S_o = \{(\tau_w, \tau_r) \,|\tau_w + k(r_o + \tau_r)\tau_r \geq 0,\ \tau_w \leq w(k(r_o + \tau_r))\}$$

Note that we have allowed the taxes to be individually negative i.e. we allow for a wage or capital subsidy. The reason for doing so is discussed in Section 4 below.

Note that if $\tau_w = 0$, so that only the mobile factor is taxed, then the model is effectively the well-known model of Zodrow and Mieszkowski (1986) and Wilson(1986) (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 somewhat involved, because the policy space (τ_w, τ_r) is two-dimensional in each country. Consequently, with unrestricted 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 the fixed factor is untaxed i.e. $\tau_w = 0$. In this case, from S_c, S_o, the feasibility constraints on the capital tax are simply $0 \leq \tau_r \leq F'(1)$ in the closed economy, and $\tau_r \geq 0$ in the open economy.

3 Capital Market Integration and Tax Competition with an Untaxed Fixed Factor

3.1 Majority Voting Equilibrium in Closed and Open Economies

First consider the closed economy. Recall that $\tau_w = 0$ by assumption, and set $\tau_r = \tau$. Then, from (7), the payoff of agent $i \in N$ in any country is

$$u_i(\tau) = (F'(1) - \tau)\alpha_i + w(1)\beta_i \ + v(\tau) \tag{8}$$

It is clear from (8) that *only the weights* α_i *given by preference-adjusted capital endowments* will affect voter preferences over τ. Note that t $u_i(\tau)$ 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 (8) subject to the feasibility constraint that $\tau \in [0, F'(1)]$. For an interior solution, this is given by the condition

$$v'(\tau_i^c) = \alpha_i \tag{9}$$

That is, the marginal benefit of the public good is equal to type $i's$ preference-adjusted share of the capital stock. This is because the tax is borne entirely by immobile capital; α_i is also $i's$ share of the cost of the public good. Note also that if $\alpha_i > v'(0)$, then we have a corner solution with $\tau_i^c = 0$, and if $\alpha_i < v'(F'(1))$, then we have a corner solution with $\tau_i^c = F'(1)$.

Now, let $p \in N$ be the agent with the median preference-adjusted capital endowment.[7] It follows from the fact that τ_i^c is decreasing in α_i that the voter with the median ideal tax is just the median voter with respect to the preference-adjusted capital endowment. 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 $v'(0) \geq \alpha_p \geq v'(F'(1))$. Then, in the closed economy case, the equilibrium tax in each country is $\tau^c = \tau_p^c$, where τ_p^c solves (9) above with $i = p$.*

Now consider the open economy case. Here, as each country is small, voters take r_o as fixed and thus from (5), they perceive that $k = k(r_o + \tau)$, with $dk/d\tau = 1/F''(k)$. So, from (7), the pay-off of agent i in any country, is

$$u_i(\tau, r_o) \equiv r_o\alpha_i + w(k(r_o + \tau))\beta_i \; + v(\tau k(r_o + \tau)). \tag{10}$$

It is now clear from (10) 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 a type i agent. This maximises (10) subject to the constraint that the tax be feasible i.e. that $\tau \in [0, \infty)$. Assuming an interior solution, after simple manipulation, we see that τ_i^o satisfies the simple condition:

$$v'(\tau_i^o k(r_o + \tau_i^o)) = \mu(\tau_i^o, k(r_o + \tau_i^o))\beta_i \tag{11}$$

where

$$\mu(\tau, k) = \frac{1}{\left(1 + \frac{\tau}{kF''(k)}\right)}$$

is the marginal cost of public funds (MCPF) in the open economy, evaluated at any τ, for a fixed r_o. If $\beta_i > v'(0)$, then we have a corner solution with $\tau_i^o = 0$.

From (11), the marginal cost of a unit of the public good to i is now his preference-adjusted share β_i of labour, the immobile factor (as the tax now falls entirely on the immobile factor), times the marginal cost of public funds. Given the assumptions made so far, it can be shown straightforwardly[8] that the higher the cost share β_i, the lower the ideal tax τ_i^o at a given interest rate r_o.

[7]Formally, for any i, let $A_i = \{j \in N \,|\alpha_j \leq \alpha_i\}$, and $a_i = \#A_i/n$. Then, p is the value of the index for which $a_{p-1} < 0.5 < a_p$

[8]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 $v'(\tau_i^o k(r^o + \tau_i^o))/\mu(\tau_i^o, r^o)$ is strictly decreasing with τ_i^o for any β_i. Hence, we can see directly from (11) that the higher β_i, the lower τ_i^o, as long as τ_i^o is interior.

Now let $q \in N$ be the agent with the median preference-adjusted labour endowment.[9] So, it follows that in the open economy case, the voter with the median ideal tax is now just the median voter with respect to the preference-adjusted labour endowment. Then, the outcome of majority voting over τ will be that voter q will prevail. Note that in the open economy case, 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 $k(r_o + \tau_q^o) = 1$. If $q's$ ideal tax is interior, it will therefore satisfy

$$v'(\tau_q^o) = \mu(\tau_q^o, 1)\beta_q \tag{12}$$

As in the closed economy case, we wish, for simplicity, to restrict attention to interior equilibrium taxes i.e. those satisfying (12). This requires $v'(0) \geq \beta_q$. Also, as in equilibrium $r^o = F'(1) - \tau_q^o$, we must restrict attention to equilibrium taxes $\tau_q^o \leq F'(1)$ which imply a non-negative world interest rate. This requires $\beta_q \geq v'(F'(1))/\mu(F'(1), 1)$. So, we have proved:

Proposition 2. *Assume $v'(0) \geq \beta_q \geq v'(F'(1))/\mu(F'(1), 1)$. Then, in the open economy case, the equilibrium tax in each country is $\tau^o = \tau_q^o$, where τ_q^o solves (12) above.*

3.2 Capital Market Integration and Tax Competition

Following CMI, three things will happen. First, for any positive tax lower than the revenue-maximising tax, 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 change i.e. $p \neq q$, which we call *the shifting median voter effect*. In general, a necessary condition for the existence of the shifting median voter effect is that the preference-adjusted endowments are not perfectly positively or negatively rank-correlated, i.e. that it is not possible to label citizens so that $\alpha_1 \leq \alpha_2 \leq ...\alpha_n$ and either $\beta_1 \leq \beta_2 \leq ..\beta_n$ or $\beta_n \leq \beta_{n-1} \leq ...\beta_1$.

Second, whether or not there is a shifting median voter, if the median preference-adjusted capital share is not equal to the median preference-adjusted labour share (i.e. $\alpha_p \neq \beta_q$), other things equal, the median voter's choice of tax rate will change. This is clear as from (9), the equilibrium tax in the closed economy case is determined by α_p, but from (12), 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 entirely borne by capital, whereas in the open economy case, it is borne by labour. So, we say that there is an *incidence effect* when $\alpha_p \neq \beta_q$.

To understand the importance of these two effects, our first benchmark result describes what happens if both effects are absent.[10] This occurs, for instance, when the preference-adjusted capital

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

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

share of any i is equal to her preference-adjusted labour share i.e. $\alpha_i = \beta_i = \lambda_i$, all $i \in N$. Then, we can rank agents by this common share i.e. $\lambda_1 \leq \lambda_2 \leq ...\lambda_n$. In this case, the median voter in both closed and open economies is $m = (n+1)/2$ i.e. in our notation, $p = q = m$.

Proposition 3. *If there is no incidence effect or shifting median voter effect i.e. if* $p = q = m$ *and* $\alpha_m = \beta_m = \lambda_m$, *then* $\tau^c > \tau^o$.

Proof. If $\alpha_p = \beta_q = \lambda_m$, then the conditions defining τ^c, τ^o become

$$v'(\tau^c) = \lambda_m, \; v'(\tau^o) = \mu(\tau^o, 1)\lambda_m$$

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[11] that CMI will reduce the equilibrium tax, because capital mobility leads to a higher cost of public funds.

Now we show how this "standard" result can be overturned by the incidence effect. This happens in a very simple and striking way. The general idea is illustrated in Figure 1 below.

Figure 1 in here

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 (α_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 preference-adjusted capital share, and thus desires a low level of g and thus a low tax, but the median voter in the open economy has a low preference-adjusted labour share, and thus desires a higher level of g and thus a higher tax. This effect more than offsets the reduction in the tax due to an increase in the marginal cost of public funds generated by capital mobility i.e. the fact that μ is increasing in g.

Of course, the Figure merely illustrates a possibility: the following example shows that this possibility can actually occur. This example is also 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 (see for instance Goodman et. al. (1997)). But, by choice of $\{\gamma_i\}_{i \in N}$, the preference-adjusted capital endowment is *less* unequally distributed than the corresponding labour endowment, which is what is needed for $\tau_o > \tau_c$.

Example. Assume quadratic preferences and technology i.e. $v(g) = (g - \zeta g^2)/2$, $\zeta > 0$, and $F(k) = k - \phi k^2/2$, $1 > \phi > 0$. The constraints on ϕ ensure that $F(k)$ has the standard properties in the neighborhood of the Nash equilibrium i.e. $F'(1) = 1 - \phi > 0$, $F''(1) = -\phi < 0$. We also need to assume that v' is positive at all feasible taxes, which, from concavity, requires only that $v'(F'(1)) = \frac{1}{2} - \zeta(1 - \phi) > 0$.

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

So, by Proposition 1, the equilibrium tax in the closed economy will be zero if $\alpha_p \geq v'(0) = 0.5$. Moreover, by Proposition 2, the equilibrium tax in the open economy will be strictly positive if $\beta_q < v'(0) < 0.5$.

We construct α_p, β_q as follows. Assume $n = 3$. Now choose $(k_1, k_2, k_3) = (0, 0.1, 0.9)$, $(l_1, l_2, l_3) = (0, 0.3, 0.7)$. Note that $k_2 < l_2 < 1/3$. So, endowments are unequally distributed (the distributions of endowments are left-skewed), with capital income being more unequally distributed than labour income. Suppose also that $\gamma_1 = 2$, $\gamma_3 = 1.8$ and $\gamma_2 = 0.2$. These imply that $(a_1, a_2, a_3) = (0, 1/2, 1/2)$ and $(\beta_1, \beta_2, \beta_3) = (0, 3/2, 7/18)$. So, $p = q = 3$, and $a_p = 1/2 > 7/18 = \beta_q$, implying that $\tau^c = 0$, $\tau^o > 0$ as required. $\|$

In the above example, the citizen with the larger than the median labour endowment has a high 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: it fact it is sufficeintly 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, the ditsribution of valuations for public need not be positively or negatively related to the distributions of endowment. In fact, 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 preference-augmented capital endowment. The following more general construction demonstrates. Suppose that capital and labour endowments are not perfectly-rank correlated. In particular, assume that $k_1 < ... < k_m < ... < k_n$ and $l_1 < ... < l_{m-1} < l_{m+1} < l_m < l_{m+2} < ... < l_n$, 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 $\gamma_1 = ... = \gamma_m = 1$. Then, if $k_{m+1} \geq \frac{n-1}{2} k_m > l_n$ we have that there is a distribution of relative valuations for public good over citizens $m+1$, $m+2, ..., n$ so that $a_p > \beta_q$. To see this, note first that $n - m = \frac{n-1}{2}$ is the number of citizens with larger than the median capital endowments. Notice then, due also to $\sum_{i \in N} \gamma_i = n$, 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 $j = m+2, ..., n$. It follows then directly that any distribution of relative valuations for public good $\{\gamma_j\}_{j=m+1}^{j=n}$ with $\gamma_{m+1} = 1$, $\sum_{j=m+1}^{j=n} \gamma_j = n - m$, $\gamma_j \leq l_j/l_{m-1}$ and $\gamma_s > l_s/k_m$ for some $s \geq m+2$ leads to $q \geq m+2$ and $\beta_q < \alpha_p$ (as $\beta_j \geq \beta_{m-1} = l_{m-1}$ and $\beta_s = l_s/\gamma_s < k_m < l_{m+1} = \beta_{m+1}$).

The final and important question then arises as to "how big" the incidence effect (i.e. difference between α_p and β_q) needs to be to get a reversal of the standard result. To answer this question, note that if the median voters in closed and open economies have preference-adjusted capital and labour shares $\alpha_p, \beta_q > 0$ respectively, then they will choose the same taxes in closed and open economy cases if

$$\alpha_p = \mu(\tau(\alpha_p), 1)\beta_q \equiv \psi(\alpha_p, \beta_q)$$

where $\tau(\alpha_p) = v'^{-1}(\alpha_p)$ is the tax chosen by the median voter in the closed economy. Moreover, it is clear from (9),(12) that if $\alpha > \psi(\alpha, \beta)$, $\tau^o > \tau^c$, and vice versa. Formally, we have:

Proposition 4. *τ^o is greater, equal to, or less than τ^cas $\alpha_p > \psi(\alpha_p, \beta_q)$, $\alpha_p = \psi(\alpha_p, \beta_q)$, or $\alpha_p < \psi(\alpha_p, \beta_q)$ respectively.*

Note, due to $\mu > 1$, that $\psi(\alpha, \beta) > l$. So, the quantity

$$\eta = \left(\frac{\psi(\alpha_p, \beta_q)}{\beta_q} - 1\right) \times 100\% > 0$$

is the minimum percentage by which the median preference-adjusted capital endowment must exceed the median preference-adjusted labour endowment in order to get a reversal of the standard result that the equilibrium tax falls following CMI. Example A1 in the Appendix shows, for appropriate choice of parameter values, that η can be small: indeed, it is possible to choose parameters so that η can be arbitrarily close to zero. The intuition is that for appropriate choice of parameters, the marginal cost of public funds μ can be made arbitrarily close to one around $\tau(\alpha_p)$.

Before leaving this Section, note that in Proposition 3, we have assumed also that median voter does not shift. However, the inspection of the proof of this proposition makes it clear that non-shifting is not required (the result goes though as long as $\alpha_p = \beta_q$, even if $p \neq q$). In other words, shifting median voter effect *in itself* has no effect at all on equilibrium taxes[12], 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 changes following the opening of the economy.

4 Capital Market Integration and Tax Competition: the General Case

This main result above has been derived for the case where labour income is not taxed, but the same basic effect will be at work if both labour and capital can be taxed at different rates. There are complications, however: in particular, as the policy space is then multi-dimensional, some restrictions on the joint distribution of capital and labour endowments are required to ensure a well-defined median voter and thus a Condorcet Winner. Our main finding is that when the median voter has a relatively larger capital than labour endowment, he will choose a capital subsidy in the closed economy, but the capital tax in the open economy is zero. So, our basic finding is robust to the taxation of labour.

[12]Another way of seeing this is to take an initial situation where the median voter does not shift ($p = q$), and then consider a permutation of the labour endowments across individuals. So, now there is a shifting median voter. But, the share of the median voter with respect to preference-adjusted labour endowments, and thereby the incidence effect, has not changed. So neither τ^o nor τ^c change.

4.1 Majority Voting Equilibrium in Closed and Open Economies

First consider the closed economy. From (7), the payoff of agent $i \in N$ in any country is

$$u_i(\tau_w, \tau_r) = (F'(1) - \tau_r)\alpha_i + (w(1) - \tau_w)\beta_i \; + v(\tau_r + \tau_w) \tag{13}$$

It is now clear from (13) that *both the preference-adjusted capital endowment* α_i *and the preference-adjusted labour endowment* β_i will affect voter preferences over (τ_r, τ_w). So, generally, there is multidimensionality in the preference parameters, as well as in the policy space, and indeed, it is possible to show that generally, there will be no Condorcet winner. Our approach, following Persson-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-Tabellini(2000), Definition 4), and so a Condorcet winner exists. Specifically, we assume that $\alpha_i = a + b\beta_i$, and $a = (1-b)/n$ to ensure that the conditions $\sum_{i \in N} \alpha_i = \sum_{i \in N} \beta_i = 1$ are satisfied. Then (13) becomes

$$u_i(\tau_w, \tau_r) = (F'(1)b + w(1))\beta_i - (\tau_r b + \tau_w)\beta_i + (F'(1) - \tau_r)\left(\frac{1-b}{n}\right) \; + v(\tau_r + \tau_w) \tag{14}$$

Note from (14) that the ideal taxes of agent i only depend on his preference-adjusted labour endowment (and the constant $(1-b)/n$). With these preferences, there exists a unique Condorcet Winner $(\tau_w, \tau_r) \in S_c$, which is the ideal tax vector of the individual with the median preference-adjusted labour endowment. Above, we defined this individual as q : here, for convenience, we label this voter m, where m denotes the median preference-adjusted labour endowment. So, the equilibrium taxes (τ_w^c, τ_r^c) maximise $u_m(\tau_w, \tau_r)$, as defined in (13), subject to the constraint that $(\tau_w, \tau_r) \in S_c$. The following proposition characterises these taxes:

Proposition 5. *(i) Assume* $\beta_m < \alpha_m$, $v'(0) > \alpha_m > v'(F(1))$. *Then* $\tau_w^c = w(1)$, *and* $v'(w(1) + \tau_r) = \alpha_m$. *(ii) Assume* $\beta_m > \alpha_m$, $v'(0) > \beta_m > v'(F(1))$. *Then* $\tau_r^c = F'(1)$, *and* $v'(F'(1) + \tau_w) = \beta_m$.

Proof. The proof is standard, given the objective function (13), the constraints $(\tau_w, \tau_r) \in S_c$, and the strict concavity of v. □

Part (i) of this Proposition[13] is illustrated below in Figure 2. As is clear in that figure, the opportunity cost of the public good for the median voter is α_m. If demand 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.

Figure 2 in here

Now consider the open economy case. Here, as each country is small, voters take r_o as fixed and

[13]Note that the condition $v'(0) > \max\{\alpha_m, \beta_m\} > v'(F(1))$ ensures positive provision and positive private consumption.

thus from (5), they perceive that $k = k(r_o + \tau_r)$. So, from (7), the pay-off of agent i in any country, is

$$u_i(\tau_w, \tau_r, r_o) \equiv r_o\alpha_i + (w(k(r_o + \tau_r)) - \tau_w)\beta_i \ + v(\tau_w + \tau_r k(r_o + \tau_r)). \tag{15}$$

Now note that *only the weights β_i given by the preference-adjusted labour endowment* will affect voter preferences over (τ_w, τ_r). So, the relevant preference space is unidimensional and the intermediate preference condition in Persson-Tabellini(2000) is automatically satisfied, *whatever* the relationship between the labour and capital endowments. So, the voter with the median preference-adjusted labour endowment, m, is the median voter, and consequently, the Condorcet-winning taxes (τ_w^o, τ_r^o) in the open economy maximise $u_m(\tau_w, \tau_r, r_o)$ subject to the feasibility constraints on taxes that $(\tau_w, \tau_r) \in S_o$. Note that in the open economy case, (τ_w^o, τ_r^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 $k(r_o + \tau_r^o) = 1$. These facts imply the following characterization of equilibrium taxes in the open economy:

Proposition 6. *Assume $v'(0) > \beta_m$. If $v'(w(1)) \leq \beta_m$, $\tau_r^o = 0$ and τ_w^o solves $v'(\tau_w) = \beta_m$. If $v'(w(1)) > \beta_m$, $\tau_r^o = 0$, and $\tau_w^c = w(1)$.*

Proof. The proof is given in the Appendix.□

Thus the capital tax is set to zero, whatever the labour and capital endowments of the median voter. This result is reminiscent of the well-known finding that under non-cooperation, countries that satisfy the assumptions of the aggregate production efficiency theorem of Diamond and Mirrlees (1971) find it optimal not to tax capital at source.[14] These assumptions are satisfied here, as returns from investment are certain, there is free capital mobility, all commodities (including labour) can be taxed, and producers are perfectly competitive.

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_r^c to zero. So, whenever $\tau_r^c > 0$ we have confirmation of the "standard" kind of result that international tax competition lowers capital taxes. On the other hand, if $\tau_r^c < 0$, we have the opposite. It then follows immediately from Propositions 5 and 6 that:

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

To interpret this condition, note that what is required is that both (i) the median voter is a "capitalist" i.e. $\beta_m < \alpha_m$ 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.

[14] See, for instance, Gordon (1986) and Razin and Sadka (1991).

Note that this comparison is rather simpler than in the case with no labour income tax. However, this simplicity has been purchased at the cost of making a rather strong assumption about the joint distribution of labour and capital endowments. The extent to which this assumption can be relaxed is discussed in Section 4.3.

Before leaving this Section we also discuss briefly the case of non-negative taxes. If subsidies were ruled out then, as it is obvious from the proof of Proposition 6, the ideal policy mix of the median voter under CMI would still be given by Proposition 6 i.e. $\tau_r^o = 0$. Accordingly, if either $\alpha_m < \beta_m$ or $v'(w(1))$ $> \alpha_m > \beta_m$ CMI would lead to a decrease in capital taxes, as Proposition 5 implies that $\tau_r^c > 0$. If, on the other hand, $\alpha_m > \beta_m$ and $\alpha_m \geq v'(w(1))$ the median voter's ideal capital tax under a closed economy is at the corner, i.e. $\tau_r^c = 0$. So, in the absence of subsidies, if the median voter is a capitalist and does not value the public good highly, capital is not taxed whether the economy is closed or open. Clearly, then, if subsidies cannot be deployed CMI cannot lead to higher capital taxes.

4.3 Relaxing the Intermediate Preference Assumption

One strong assumption made in Section 4 was that the endowments of capital and labour were linearly related. This was done in order to demonstrate the existence of Condorcet winner in the closed economy, when both labour and capital taxes could be set separately. Here, we briefly argue that this assumption can be relaxed if some minimal assumptions are made on the voting agenda over the set of alternatives S_c.

Assume that $\{\alpha_i\}_{i\in N}, \{\beta_i\}_{i\in N}$ are perfectly rank-correlated, either positively or negatively. This is equivalent to saying that $\alpha_i = f(\beta_i)$, where f is either a strictly increasing or a strictly decreasing function. This clearly weakens the assumption that $\alpha_i = a + b\beta_i$ made in Section 4.1. With this weaker assumption, a Condorcet Winner will generally not exist in S_c. But suppose that we impose *issue-by-issue voting* i.e. majority voting on either τ_r, followed by τ_w, or vice versa. Generally, as $u_i(\tau_w, \tau_r)$ is not additively separable in τ_w, τ_r, the order of items on the agenda will matter. In particular, this will occur when the median voter over τ_w is not the median voter over τ_r (see, for instance, Ordeshook(1986) and Muller(1989)). In this case, issue-by-issue voting will give two possible outcomes, depending on the agenda.

On the other hand, when endowments are perfectly (positively or negatively) rank-correlated, then clearly voter $m = (n+1)/2$ is the median voter over both τ_w, τ_r. In that case, *whatever* the order, m is effectively dictator, so issue-by-issue majority voting will lead to a choice of (τ_w, τ_r) that maximise $u_m(\tau_w, \tau_r)$ over the set of feasible taxes. Then, Proposition 5 - and therefore Proposition 7 - continues to apply.

5 Capital Controls and Capital Taxes: Some Evidence

Here we briefly discuss the evidence on the relationship between capital controls and taxes on capital, to justify our assertion that the relationship between financial liberalization and reductions in taxes on capital is weak. The usual way of measuring financial liberalization is to construct some coding of the legal restrictions on capital movements in or out of country.

One widely used coding[15], originally due to Grilli and Milesi-Ferretti (1995) is a binary one, with a value of 1 indicating significant restrictions on the capital account. This coding also has three binary variables indicating the presence of restrictions on the current account: multiple exchange rates, restrictions on current account transactions, and surrender of export proceeds. Quinn (1997) offers a more sophisticated coding that also measures the intensity of capital controls[16]. Both of these authors also construct a coding of joint restrictions on the capital and current account, which we also use[17]. All of these variables are normalized between 0 and 1 with a higher value indicating fewer restrictions, with Quinn's and Milesi-Ferretti's variables denotes CQ, EXQ, CMF, EXMF in obvious notation.

As for taxes on capital, in practice, these are both personal and corporate. We focus on corporate taxes, and in particular on the marginal tax rate on incremental investment, the so-called effective marginal tax rate, or EMTR. Of the various emprical measures of corporate tax, this corresponds most closely to the tax studied in the Zodrow-Mieskowski model, which is the canonical model in the literature, and the one we use in our analysis. We use a forward-looking measure of the EMTR, further discussed in Devereux, Lockwood and Redoano(2003), available for a panel of 21 OECD countries over the period 1983-1999.

Table 1 below shows regressions using this panel data set. The dependent variable is the EMTR, $T_{i,t}$. Explanatory variables are: the lagged dependent variable (included because there is considresable persistence in taxes), the capital control dummy D_{it}, and various control variables that might plausibly affect tax-setting[18]. There are four different regressions, each one corresponding to a different measure of

[15] The main source for researchers on legal restrictions is the information in the International Monetary Fund's Exchange Arrangements and Exchange Restrictions annual.

[16] For 56 countries over the period 1950 to 1997, and an additional eight countries starting in 1954, Quinn distinguishes seven categories of statutory measures. Four are current account restrictions, two are capital account restrictions, and one denotes membership of international organizations, such as the OECD, which may constrain the ability of a country to restrict exchange and capital flows. The capital account restrictions are coded on a 0-4 scale, the current account restrictions on a 0-8 scale, and membership on a 0-2 scale with half-point increments. In every case, a higher number denotes a weaker restriction.

[17] Some have the view that there is fungibility between accounts, i.e. "where capital controls do exist, they can be avoided through current account transactions, and, as such, consideration of restrictions on the current account and other restrictions is necessary to measure the effectiveness of controls" (Mody and Murshid (2002)).

[18] These are the proportion of the population over 65 (POPOLD), the top rate of personal income tax (TOPINC),

capital or excahnge controls CQ, EXQ, CMF, EXMF. All regresions also pass standard mis-specification tests for serial and spatial correaltion of the errors.

It is clear from Table 1 that all measures of the relaxation of capital and exchange controls have an insignificant and numerically small effect on the EMTR. In the case of CMF, EXMF, this effect is in fact positive. This is broadly consistent with the findings of Quinn(1997) and Rodrik(1997): Garrett(1998) and Swank and Steinmo(2002) who simply find that capital controls have no significant effect.

Table 1 in here

These findings are certrainly consistent with our model. As remarked in the introduction, and discussed in more detail below, thery are also consistent with versions of the ZMW model with either (i) partial foreign ownership of the fixed factor, or (ii) where the government supplies an infrastructure public good. With (i), CMI enables "tax exporting" to the foreign owner of the fixed factor, and with (ii), CMI causes "amenity competiion" which may drive up the tax rate. Howover, the current state of knowledge does not allow us to say which of these models (if any) best explains the empricval finding that CMI seems to mave little effect on capital taxes. Alsthough there is a growing empirical literature on tax competition (see e.g. Brueckner(2003)), there is (to our knowledge) no emprical work on amenity competition. Also, observed levels of foreign ownership of equities are low (Bailey et al. (1999)): whether they are high enough to explain the findings above is an open quesion.

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.[19]

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 interest rate 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 interest rate i.e. 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

country size as measured by GDP relative to the US (SIZE), the unemployment rate (UNEMPL), and the debt-to-GDP ratio (DEBT). For precise data definitions and sources, see Devereux, Lockwood, and Redoano(2004).

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

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.[20] 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 good. If, at Nash equilibrium, the degree of complementarity between capital and the infrastructure input is sufficiently large,[21] 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*

[20] 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.

[21] 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.

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 in the Introduction, 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. Kessler et. al. (2003)'s model 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.[22] 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[23].

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: 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.

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

[23] 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.

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A Appendix

Example A1. Preferences and technology are the same as in Example 1. Also, $n = 3$. We first write down conditions that hold on α_2, β_2, the preference-adjusted endowments of the median voter. Thus, as $n = 3$, the median voter cannot own more than half the endowment of any asset, i.e. $\alpha_p, \beta_q \leq 0.5$. Combining this with A1, we get:

$$1/2 \geq \alpha_P \geq \frac{1}{2} - \zeta(1 - \phi).$$

Note that, due to $\zeta > 0$ and $0 < \phi < 1$, this set of parameter values is non-empty.

Again, combining $\beta_2 \leq 0.5$ with A2, we get:

$$1/2 \geq \beta_2 \geq [\frac{1}{2} - \zeta(1 - \phi)](\frac{2\phi - 1}{\phi})$$

As $\zeta(1 - \phi) \in (0, 1/2)$ and $\frac{2\phi-1}{\phi} < 1$, we have that this set as well is non-empty.

Also, recall that

$$\zeta < \frac{1}{2} + \phi\zeta \tag{16}$$

from $v'(F'(1)) > 0$. So, together, (**??**),(**??**),(16) with $\phi \in (0, 1)$ and $\zeta > 0$ define a feasible set for ϕ, ζ. Next, note that in this example,

$$\begin{aligned}
\eta &= \frac{\psi}{\beta} - 1 \\
&= \mu(\tau(\alpha_p), 1) - 1 \\
&= \frac{1}{1 + \tau(\alpha_p)/F''(1)} - 1 \\
&= \frac{1}{1 - (\frac{1}{2} - \alpha_p)/\zeta\phi} - 1 \\
&= \frac{(\frac{1}{2} - \alpha_{p2})}{c - (\frac{1}{2} - \alpha_p)} \\
&\leq \frac{1/2}{c - \frac{1}{2}}
\end{aligned}$$

where $c = \zeta\phi$. So, it is clear that as $c \to \infty$, then $\eta \to 0$. Finally, it is possible to show that we can choose feasible ζ, ϕ such that $c = \phi\zeta$ for any $c > 0$.[24] So, we can choose parameter values such that $\eta \simeq 0$ to any desired approximation. □

P**roof of Proposition 6.** The equilibrium taxes maximise (15) subject to $\tau_w \leq w(k(r_o + \tau_r))$, $0 \leq \tau_r k + t_w$. Ignoring the latter constraint, the first-order conditions are:

$$\begin{aligned}
-\beta_m + v'(\tau_w + k\tau_r) - \xi &= 0 \\
-k\beta_m + v'(\tau_w + k\tau_r)[k + \tau_r k'] - \xi k &= 0
\end{aligned}$$

[24] In particular, for any $c > 0$ the admissible set is given by $\zeta \in (c, c + \frac{1}{2})$ and $\phi \in (0, 1)$.

So, if the constraint $\tau_w \leq w(k(r_o + \tau_r))$ is not binding, $\xi = 0$, and we have

$$\begin{aligned} -\beta_m + v'(\tau_w + k\tau_r) &= 0 \\ -k\beta_m + v'(\tau_w + k\tau_r)[k + \tau_r k'] &= 0 \end{aligned}$$

At equilibrium, $k = 1$, and so

$$\begin{aligned} -\beta_m + v'(\tau_w + \tau_r) &= 0 \\ -\beta_m + v'(\tau_w + \tau_r)[1 + \tau_r k'] &= 0 \end{aligned}$$

The unique solution to these equations is $\tau_r = 0,\ \beta_m = v'(\tau_w)$. Given $v'(0) > \beta_m$ we have that $\tau_w > 0$ and thereby positive provision. For the constraint $\tau_w \leq w(k(r_o+\tau_r))$ not to be binding at this solution, we require $\tau_w \leq w(1)$, and thus $\beta_m \geq v'(w(1))$.

If the constraint $\tau_w \leq w(k(r_o + \tau_r))$ is binding, $\xi > 0$ and we have $\tau_w = w(k(r_o + \tau_r)) = w(1)$ in equilibrium. Also, in equilibrium, as $k = 1$, τ_r and ξ solve

$$\begin{aligned} -\beta_m + v'(w(1) + \tau_r) - \xi &= 0 \\ -\beta_m + v'(w(1) + \tau_r)[1 + \tau_r k'] - \xi &= 0. \end{aligned}$$

and hence $\tau_r = 0$, and $\xi = v'(w(1)) - \beta_m$. As $\tau_r = 0$ and $\tau_w = w(1)$, provision is positive. For the constraint $\tau_w \leq w(k(r_o+\tau_r))$ to be binding at this solution, we require $\xi > 0$ and thus $\beta_m < v'(w(1))$. □

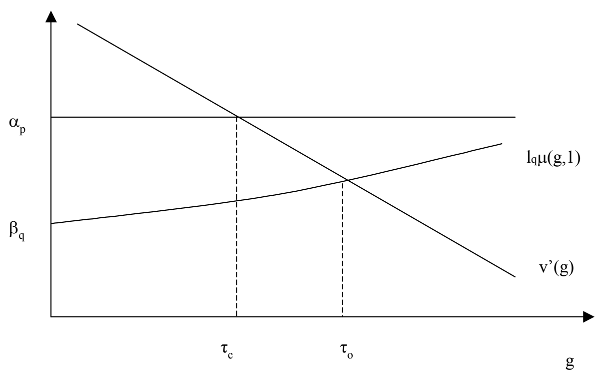

Figure 1:

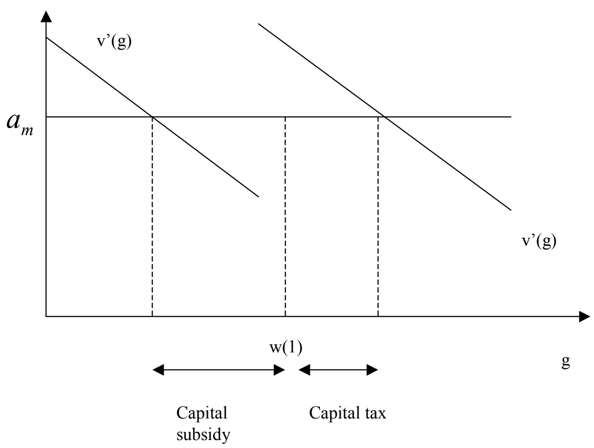

Figure 2:

Table 1

Dependent Variable: EMTR				
	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.783*** (0.045)	0.788*** (0.044)	0.781*** (0.043)	0.781*** (0.043)
D_{it}	0.009 (0.004)	0.015 (0.013)	-0.011 (0.020)	-0.012 (0.020)
POPOLD	-0.314 (0.332)	-0.322 (0.362)	-0.096 (0.309)	-0.074 (0.304)
TOPINC	0.090** (0.040)	0.0890* (0.040)	0.068* (0.036)	0.069* (0.038)
SIZE	-0.475 (0.298)	-0.457 (0.308)	-0.517** (0.250)	-0.520** (0.251)
UNEMPL	-0.270* (0.145)	-0.226* (0.134)	-0.129 (0.119)	-0.135 (0.116)
DEBT	0.035* (0.021)	0.033 (0.021)	0.025 (0.019)	-0.025 (0.018)
Country Dummies	yes	yes	yes	yes
R^2	0.91	0.91	0.91	0.90
*LM serial**	2.013	1.785	0.567	0.583
*LM spatial***	0.0008	0.0007	0.0007	0.0007
Obs	250	250	290	290

Robust t-statistics in parentheses.
* Tests for first –order serial correlation in the error term: distributed as χ^2 (1)
* * Tests for spatial correlation in the error term: distributed as χ^2 (1)