Darmstadt Discussion Papers in Economics

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Nr. 175

Arbeitspapiere
des Instituts für Volkswirtschaftslehre
Technische Universität Darmstadt

ISSN: 1438-2733

Economic Theory

Economic Growth and (Re-)Distributive Policies in a Non-Cooperative World

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July 11, 2006

Abstract

Many models show that redistribution is bad for growth. This paper argues that in a non-cooperative world optimizing, redistributing ('left-wing') governments mimic non-redistributing ('right-wing') policies for fear of capital loss if capital markets become highly integrated and the countries are technologically similar. 'Left-right' competition leads to more redistribution and lower GDP growth than 'left-left' competition. Efficiency differences allow for higher GDP growth *and* more redistribution than one's opponent. Irrespective of efficiency differences, however, 'left-wing' governments have higher GDP growth when competing with other 'left-wing' governments. The results may explain why one observes a positive correlation between redistribution and growth across countries, and why capital inflows and current account deficits may be good for relatively high growth.

KEYWORDS: Growth, Distribution, Tax Competition, Capital Mobility

JEL classification: O4, H21, D33, C72, F21

*This paper builds on research that I have conducted at the European University Institute in Florence. I would like to thank Tony Atkinson, James Mirrlees, Robert Waldmann and Robert K. v. Weizsäcker for helpful advice and stimulating suggestions. I have also benefited from comments by Cornelis Los and Thomas Werner as well as presentations at the EEA, T2M, NASM, DEGIT VII, Saarland University, and WIFO in Vienna. Furthermore, I am grateful for helpful comments by three anonymous referees. Of course, all errors are my own. Financial support by the Deutscher Akademischer Austauschdienst (DAAD), grant no. 522-012-516-3, is gratefully acknowledged.

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1 Introduction

Many theoretical models argue that redistribution causes low growth and/or capital outflows. See e.g. Perotti (1993), Bertola (1993), Alesina and Rodrik (1994), or Persson and Tabellini (1994). Yet despite globalization many countries redistribute a significant share of their GDP and have high growth. For instance, Easterly and Rebelo (1993), Perotti (1994) or Sala-i-Martin (1996) find a significantly positive relation between redistribution and growth across countries.

This empirical observation may be reconciled with theory by models along the lines of Galor and Zeira (1993), Saint-Paul and Verdier (1996), Lee and Roemer (1998), or Aghion, Caroli, and Garcia-Peñalosa (1999). However, they are usually set up for closed economies, and do not explicitly address the issue of what happens if the "cake" to be redistributed is mobile.[1]

This paper investigates precisely that issue by placing the equity-growth problem in an open economy framework. It is argued that long-run growth depends on policy in a non-cooperative world and that the growth-redistribution trade-off and with it the policy-growth-nexus crucially hinges on technological efficiency differences and the possibility of capital outflows in interdependent economies.

Usually it is shown that redistribution towards the non-accumulated factor of production causes lower growth in closed economies. That trade-off is extended here to a two-country, infinite-horizon world. The accumulated factor of production is identified with capital and the non-accumulated factor of production with (raw) labour. Building on Alesina and Rodrik, the governments are taken to tax the capital owners' wealth which is to be interpreted as a metaphor for many kinds of redistributive policies that transfer resources to the non-accumulated

[1] For surveys of the growth-redistribution literature see, for example, Bénabou (1996) or Bertola (1999). Growth in interdependent economies has e.g. been analyzed by Lucas (1990), Barro, Mankiw, and Sala-i-Martin (1995), or Ventura (1997).

factor of production while reducing the incentive to accumulate.[2]

It is commonly acknowledged that labour is less mobile across countries than capital. To capture that all agents are taken to be immobile in the paper. In contrast, capital can be transferred across countries and that is modelled as having a direct bearing on the productivity of capital employed in production. Wealth is taxed at *source* and it is shown that the capital owners optimally allocate their capital depending on the after-tax returns on capital in the economies.[3] In the market equilibrium with given policies domestic aggregates grow at a balanced but not necessarily steady rate. This is so because policy or technology differences imply capital allocations which have important intertemporal effects on the growth of the domestically operating but productively different capital stocks. The paper analyzes these differences by putting structure on policy first.

In the model governments are non-cooperative by engaging in tax competition.[4] An entirely pro-capital ('right-wing') government maximizes the national investors' worldwide income. In a closed economy it maximizes the after-tax re-

[2]For examples of what other redistributive mechanisms the wealth tax scheme metaphorically captures see Alesina and Rodrik's paper.

[3]Taxation in open economies has received attention in e.g. Canzonieri (1989), Gosh (1991), and Devereux and Shi (1991), and Chamley (1992). For capital *income* taxation in open economies the "residence" or the "source" principle are commonly advocated. Under the *"source principle"* all types of income originating in a country are taxed uniformly, regardless of the place of residence of the income recipients. If a country may suffer from capital losses and absent any problems arising from transfer pricing, the source principle appears more suited as a tax principle, because governments in a non-cooperative environment cannot perfectly monitor their residents' income or wealth. See, for instance, Bovenberg (1994). Other justifications for why the assumption of the "source principle" for income taxation is still empirically relevant can e.g. be found in Gordon and Hines (2002), p. 1943, and Giovannini (1990). Therefore, in the paper the *source principle* for *wealth* taxation is adopted as a tax rule. For recent models using the source principle for income taxation see e.g. Lejour and Verbon (1997) and Strulik (2002). For an analysis with tax competition in Europe using the *"residence principle"* see e.g. Mendoza and Tesar (2003a) and Mendoza and Tesar (2003b).

[4]By assumption the wealth tax is a metaphor for redistributive mechanisms. Consequently tax competition among countries introduces non-cooperative behaviour in that metaphoric tax instrument. Concentrating on non-cooperation seems realistic in a world where long-run and binding agreements are difficult to enforce. Tax competition has been studied in numerous papers such as, for instance, Gordon (1983), Wilson (1986), Wildasin (1988), Bond and Samuelson (1989), Kehoe (1989), Sinn (1990), Persson and Tabellini (1992) or Kanbur and Keen (1993).

turn on capital and so growth and does not redistribute in the model. In contrast, an entirely pro-labour ('left-wing') government is concerned about redistribution, GDP and its growth.

In open economies and for technologically similar economies redistribution is shown to be lower relative to the optimal, closed economy policies. As the right-wing government is not concerned about redistribution, it just maximizes the after-tax return on capital. By that it maximizes growth, but also attracts foreign capital. Under common knowledge the left-wing government knows it cannot attract foreign capital. As a consequence and compared to its optimal, closed economy policy it chooses to redistribute less, to lose capital implying lower (initial) wages and to have relatively higher GDP growth. Interestingly, the foreign workers under a right-wing policy will benefit in this situation.

When two left-wing governments compete the strategic interaction between them is more intense as each government wants to get some capital off its opponent. In a symmetric equilibrium the left-wing governments redistribute, but less than in a closed economy. They face the trade-off between growth and redistribution, but they also need capital for high GDP. For fear of capital loss they set lower tax rates than in a closed economy. Hence, tax competition causes an optimizing left-wing government to concentrate on securing sufficiently high GDP and wages. By that the effects of the concern for redistribution are reduced.

As the integration of capital markets increases and no matter which opponent they face, the left-wing governments are shown to begin mimicking right-wing policies. For equally efficient economies the model has the surprising implication that a left-wing government is better off in terms of GDP growth if it faces competition from another left-wing government. That goes with the cost of a reduction in redistribution. Competing against a right-wing government in turn leads to relatively more redistribution in the optimum, at the cost of reduced GDP growth.

However, when an efficiency gap can be maintained the government with a technologically superior economy may attract capital. That is especially true for a left-wing government. If the gap is large enough, it redistributes *and* has higher GDP growth than a right-wing opponent. Thus, the growth redistribution trade-off is not so much a question of preferences, but rather a problem of being efficient or not (technology). Interestingly and contrary to some policy debates, it is shown that for a sufficiently efficient economy very high capital market integration ("globalization") does *not* necessarily constrain a nationally preferred redistribution policy. Interestingly, the theoretical results also imply that countries with relatively high growth should have capital inflows and so current account deficits.

As countries differ widely in their technologies this may provide one explanation for the empirical findings on the growth-redistribution-nexus in the cross-country studies mentioned above. In this paper I find tentative empirical support of the theoretical predictions for rich OECD countries. In particular, there seems to be evidence that structurally left-wing countries with relatively higher taxes, redistribution, and capital inflows are not doing worse in terms of growth than structurally right-wing countries.

The paper is organized as follows: Sections 2 and 3 describe the economies and derive the equilibrium. Sections 4 and 5 introduce policy. Section 6 analyzes tax competition. Section 7 presents some empirical evidence. Section 8 concludes.

2 The Model

Consider a two-country world with a *domestic* and a *foreign* economy. The economies are real ones and we abstract from nominal assets.[5] Denote variables in the foreign country by a (*). There are finitely many, identical individuals in each country, who are all equally impatient. By assumption individuals who own capital do not work, but they invest; in contrast workers never save and consume their entire income.[6] Each economy's population is immobile and normalized so that one may think of workers and capital owners as one person each. These persons derive logarithmic utility from the consumption of a homogeneous, malleable good that is produced in the two countries. By assumption all goods and capital stocks can be transferred costlessly between the economies. Following Barro (1990) aggregate domestic production takes place according to

$$Y_t = A\, K_t^{\alpha}\, G_t^{1-\alpha}\, L_t^{1-\alpha}, \quad \text{where} \quad 0 < \alpha < 1 \tag{1}$$

and Y_t is output produced in the home country, G_t are public inputs to production. Furthermore, $L_t = 1$ so that the domestic labour endowment is inelastic and constant.[7] The economies are otherwise identical and differences between them are due to A which is an efficiency index reflecting cultural, institutional and technological development. If $A = A^*$ the economies are called *similar*. Otherwise,

[5] This assumption follows e.g. Turnovsky (1997), ch. 6.

[6] This is a standard assumption which has been used by e.g. Kaldor (1956) and many others since then. See e.g. Judd (1999). In this context Bertola (1993) has shown that for utility maximizing agents who do not own initial capital it is not optimal to save/invest out of wage income along a balanced growth path. Similarly, it is not optimal to work for those who only own capital initially. The present paper builds on that result. The logic of the model would not change if instead one introduced a representative household who derives wage as well as capital income and makes investment decisions, and the government represented 'economic classes' within that household.

[7] Thus, we abstract from scale effects due to population size as in Alesina and Rodrik (1994).

they are called *different*. I abstract from problems arising from depreciation of the capital stock. K_t is an *index* of the domestically productive capital stock in the domestic economy. It takes the form $K_t = f(\omega_t k_t, (1-\omega_t^*)k_t^*) = \omega_t\ k_t + \phi_t\ (1-\omega_t)\ k_t^*$ where k_t (k_t^*) is the real capital stock owned by domestic (foreign) capitalists.[8]

The variable $\omega_t \in [0,1]$ denotes the fraction of real capital at date t owned by domestic capitalists that is retained at home for domestic production. The foreign owned capital stock k_t^* that becomes domestically productive depends on

$$\phi_t = \phi(\omega_t^*, z) = \max\left\{\epsilon, \omega_t^{*\frac{1}{z}}\right\} \quad , \quad \text{where } 0 \leq \omega^* \leq 1, z \geq 0, \tag{2}$$

and ϵ is positive and small. The assumption of a small ϵ means that there is a (relative) minimum (marginal) productivity of foreign owned capital operated in the domestic economy. The ϕ function captures that the productivity of foreign owned capital that is operated domestically depends on the amount foreigners send to the home country. This function satisfies $0 \leq \phi_t \leq 1$, $\phi_{\omega_t^*} \geq 0$, $\lim_{z\to\infty} \phi_t = 1$ and $\lim_{z\to 0} \phi_t = \epsilon$. The ϕ functions are symmetric for the economies and imply the following: The amount of domestically owned capital, $\omega_t k_t$, entering domestic production is fully productive at home. In contrast, the foreign capital owners may send $(1-\omega_t^*)k_t^*$ to the domestic economy, but their (the foreign owned) capital stock is not as productive in the domestic economy as in their home (foreign) economy. This is due to locational disadvantage effects as e.g. argued by Wong (1995), ch. 13. These effects depend on the amount of foreign owned capital that is sent to the home country. In particular, the assumption $\frac{d\phi}{d\omega_t^*} \geq 0$ implies that if foreign capital owners send some of their capital to the domestic economy (a *decrease* in ω^* and, thus, an *increase* in $(1-\omega_t^*)$), then the productivity

[8] Capital may be taken as broadly defined. Thus, it may thought of as including disembodied technological knowledge (blueprints), which is not always equally productive across countries.

of foreign owned capital operated in the domestic economy *falls*.[9] From this one easily verifies that $\omega_t^* \to 1$ implies $\phi \to 1$. Thus, when the foreigners do not send any capital to the domestic economy, their capital is potentially as productive as domestically owned capital. Furthermore, $\omega_t^* \to 0$ implies $\phi \to \epsilon$. Thus, when the foreigners send all their capital to the domestic economy, their capital is not very productive in the domestic economy.

The parameter z indicates how productive foreign owned capital is in domestic production, for a given allocation of foreign capital $(1-\omega_t^*)k_t^*$. Note that ϕ is non-decreasing in z, for given ω_t^*.[10] Thus, a higher z implies that foreign owned capital generally becomes more productive in the domestic economy.

2.1 The Firms

The *firms* in each country are owned by domestic or foreign capital owners who rent capital to the domestic firms. The firms operate in a competitive environment, act as profit maximizers, cannot influence the public inputs to production, and take the technology, in particular, the productivity indicator ϕ as given.[11]

Furthermore, we assume the following: Domestically owned capital may be used for the production of foreign type or domestic type good in the foreign economy. If the domestic capitalists send their capital abroad in order to produce there, they choose to pay the foreign workers (and the government) in foreign type good. But they choose to pay themselves in domestic type good. By assumption the foreign (domestic) firms using domestically (foreign) owned capital

[9]It can only fall until $\phi = \epsilon$, that is, until foreign capital hits its minimal productivity in the domestic economy. Thus, foreign owned capital in domestic production always contributes at least a little bit to the generation of domestic output.

[10]If ϕ is such that $\phi = \omega_t^{*\frac{1}{z}}$, then $\frac{d\phi}{dz} = -\frac{1}{z^2}\left(\ln\omega_t^*\right)\omega_t^{*\frac{1}{z}}$ which is positive when $\omega_t^* < 1$.

[11]Thus, the (small) firms ignore their influence on these variables so that both G_t and ϕ represent externalities, which the firms do not take account of when making their decisions.

can produce both types of good and once the capitalists have chosen which type of good is to be produced, one cannot change a domestic type into a foreign type good. Thus, if there is any domestically owned capital abroad (or any foreign owned capital in the domestic economy), the prices of the two types of goods must be the same, because, otherwise, a profit maximizing firm would produce only that good which commands the higher price. Hence, a firm using foreign owned capital in domestic production will produce both types of goods only if the prices of the goods are equal. That price serves as numéraire and is set equal to 1.

The domestic firms rent foreign or domestic capital, and hire labour in spot markets in each period in their country. Profit maximization then entails that firms pay each factor of production its marginal product

$$\begin{aligned} &\frac{\partial Y_t}{\partial(\omega_t k_t)} = \alpha A\ M = r_t \quad , \quad \frac{\partial Y_t}{\partial((1-\omega_t^*)k_t^*)} = \phi\ r_t\ , \\ &\frac{\partial Y_t}{\partial L_t} = (1-\alpha)A\ M\ K_t = w_t \quad , \quad \text{where}\ \ L_t = 1, \forall t\ \ \text{and}\ \ M \equiv \left(\frac{G_t}{K_t}\right)^{1-\alpha} . \end{aligned} \tag{3}$$

Due to the productivity differences the marginal product of foreign owned capital in domestic production is generally lower ($\phi \leq 1$) than that of domestically owned capital. Note that the marginal products depend on government policy through the amount of public services supplied.

From the factor input prices one can infer that the marginal rate of technical substitution (MRTS) between domestically and foreign owned capital operated in the domestic economy is given by ϕ, which the firms take as given and which corresponds to the relative price of the the two capital stocks. Notice that ϕ is not constant in general since it is (implicitly) determined by the investors abroad through their choice of ω_t^*. Thus, $\phi(\omega_t^*)$ is also a measure of the substitutability between the two capital stocks in domestic production with $MRTS = \phi(\omega_t^*)$. Notice that these capital stocks are in general not perfect substitutes. Calculating the (direct) elasticity of substitution of domestically owned for foreign owned capital, σ, for ω_t^* such that $\phi \in (\epsilon, 1)$ yields (see appendix A)[12]

$$\sigma = \frac{z\, \omega_t^*}{1 - \omega_t^*}. \tag{4}$$

The elasticity increases in ω_t^* for given z. It also increases in z for given ω_t^*. That means that the substitutability between domestically and foreign owned capital *decreases* (σ falls) as more foreign owned capital enters domestic production (lower ω_t^*, larger $(1 - \omega_t^*)$). Following Hicks (1936), this is interpreted as a situation where domestically and foreign owned capital become more "co-operant" as more foreign owned capital enters domestic production.[13]

In contrast, a higher z, implies that the two capital stocks become more "rival", that is, substitutable. This form of rivalry, captured by z, will be called *capital market integration.*[14] Thus, z is taken to represent the capital market integration in this paper. If $z \to 0$, then the capital stocks will be complete complements, and the capital market is not integrated. If, on the other hand, $z \to \infty$, then the capital market in perfectly integrated, the capital stocks are perfectly substitutable and so "rival".[15]

[12]Clearly, if ω_t^* approaches 1 (foreigners leave their capital in their country) or 0 (foreigners shift all of their capital abroad), then ϕ will be a constant and the capital stocks would be perfect ($\phi \to \epsilon$) or potentially perfect ($\phi \to 1$) substitutes in domestic production, $\sigma \to \infty$. However, these cases will not be relevant for the equilibria analyzed in this paper.

[13]Thus, as more foreign equipment enters domestic production it is combined in a more complementary way with domestic equipment.

[14]Capital market integration is also taken as an indicator of "globalization" in this paper.

[15]For this note that $z \to \infty$ implies $\phi = 1$ so that both capital stocks would get the same return in the domestic economy.

2.2 The Public Sector

The domestic government taxes the market value of capital (wealth), that is, $\omega_t k_t + \phi(\omega_t^*)(1-\omega_t^*)k_t^*$ at the rate τ. Thus, the government taxes less than $(1-\omega_t^*)k_t^*$ because if it raised $\tau(1-\omega_t^*)k_t^*$ in order to buy capital in the domestic market to provide them as public inputs in production, the buyers of that type of capital would only be willing to pay ϕ per unit of k_t^* for it, since foreign capital is less productive at home. Recall that foreign owned capital yields income $\phi r_t(1-\omega_t^*)$ at home. Therefore, the price per unit of foreign capital at home equals ϕ which is less than that of domestic capital. Then the total market value of foreign capital is given by $\phi(1-\omega_t^*)k_t^*$. This way of taxing wealth corresponds to the *source principle* requiring that all types of wealth in a country be taxed uniformly, regardless of the place of residence of the owners of wealth.

The governments run balanced budgets and use the tax revenues for providing public inputs to production so that $\tau K_t = G_t$. Thus, from equation (3)

$$r = \alpha A \tau^{1-\alpha} \quad \text{and} \quad w_t \equiv \eta(\tau) K_t = (1-\alpha) A \tau^{1-\alpha} K_t \tag{5}$$

so that the domestic return on domestically owned capital is constant and higher than the domestic return $\phi_t r$ on foreign owned capital. The wages are not constant, but grow with the domestically productive capital K_t.

2.3 The workers

The *workers* derive a utility stream from consuming their entire wages that are not taxed by assumption. Their intertemporal utility is given by

$$\int_0^\infty \ln C_t^W \, e^{-\rho t} dt \quad \text{where} \quad C_t^W = \eta(\tau) K_t. \tag{6}$$

2.4 The capitalists

The *capitalists* are identical and have perfect foresight. They choose how much to consume or invest and take $(r, r^*, \phi, \phi^*, \tau, \tau^*)$ as given. Thus, the domestic capital owners are price-takers in the domestic and foreign country. Although they own part of the foreign firms, they do not know that, when they send capital abroad, that will have an impact on productivity abroad and the returns they receive there. Thus, the domestic capital owners have no market power abroad and take ϕ^* as given. However, as they may invest in either country, they determine where their capital is to be located. Hence, their problem is

$$\max_{C_t^k, \omega_t} \int_0^\infty \ln C_t^k \, e^{-\rho t} dt \tag{7a}$$

$$s.t. \quad \dot{k}_t = (r - \tau) \, \omega_t k_t + (r^* - \tau^*)\phi^* \, (1 - \omega_t)k_t - C_t^k \tag{7b}$$

$$0 \leq \omega_t \leq 1 \tag{7c}$$

$$k(0) = \overline{k_0}, \quad k(\infty) = \text{free.} \tag{7d}$$

The capitalists' dynamic budget constraint in (7b) captures that the capital owners allocate their capital to the home or foreign country depending on the return on their capital. If they allocate $\omega_t k_t$ to the home country they receive r. If they allocate $(1-\omega_t)k_t$ to the foreign country, only $\phi^*(1-\omega)k_t$ will become productive and they will only receive capital income $r^*\phi^* \, (1 - \omega_t)k_t$ abroad. By assumption all goods and stocks can travel freely and re-investment of profits earned in a country is costless in that particular country.[16]

The solution to the capitalists' problem is standard (see appendix B) and

[16] The worldwide investment of the domestic capital owners i_t^n is the sum of what they invest at home, i_{1t}^n and of what they invest abroad, i_{2t}^n. Since goods and stocks can travel freely $i_{1t}^n = \omega_t \dot{k}_t$ and $i_{2t}^n = (1-\omega_t)\dot{k}_t$ which explains the $\dot{k}_t$ term on the LHS of the budget constraint.

implies that the optimal capital allocation is constant[17], and given by

$$\omega_t = \begin{cases} 1 & : \quad (r-\tau) > (r^* - \tau^*)\phi^* \\ \in [0,1] & : \quad (r-\tau) = (r^* - \tau^*)\phi^* \\ 0 & : \quad (r-\tau) < (r^* - \tau^*)\phi^*. \end{cases} \tag{8}$$

Thus, in the optimum the capitalists immediately shift their assets to the country where the after-tax return on capital is higher. Hence, relative to the planning horizon the speed of capital relocation is short. Let $\tilde{\omega}$ denote the optimal capital allocation according to equation (8). Then the capitalists' consumption grows at the rate

$$\gamma \equiv \frac{\dot{C}_t^k}{C_t^k} = (r-\tau)\tilde{\omega} + (r^* - \tau^*)\phi^*(1-\tilde{\omega}) - \rho, \tag{9}$$

which is constant over time and depends on the after-tax returns in the two countries. Furthermore, the capitalists set their consumption at $C_t^k = \rho k_t$ in the optimum. Thus, their consumption and wealth grow at the same rate.

3 Market Equilibrium

According to the optimal capital allocation decision of the domestic capitalists, $\tilde{\omega}$, domestically owned capital is shifted to the economy where the after-tax return is highest. For this the domestic capitalists take ϕ^* as given. However, the allocation decision will have an effect on $\phi^*(\omega)$ in equilibrium. We rule out extreme after-tax return differentials between economies and consider the case where $\phi^* < 1$.

1. If $r - \tau > (r^* - \tau^*)\phi^*$, the domestic investors will all shift their capital to the

[17]Notice that this implies that ϕ^* and, by analogy with the foreign capitalists' optimum, ϕ must also be constant in any equilibrium.

domestic country, $\omega = 1$. But then $\phi^*(\omega)$ will rise until $r - \tau \geq (r^* - \tau^*) \cdot 1$. But then clearly, $\tilde{\omega} = 1$.

2. If $r - \tau < (r^* - \tau^*)\phi^*$, the domestic investors will all shift their capital to the foreign country, $\omega = 0$. But then $\phi^*(\omega)$ will fall until $r - \tau = (r^* - \tau^*)\phi^*(\omega)$ in equilibrium. But then clearly, $0 \leq \tilde{\omega} < 1$.[18]

   In this equilibrium with $(r - \tau) = (r^* - \tau^*)\phi^*(\omega)$ and $\phi^* = \omega^{\frac{1}{z}}$ we then have

$$\omega^{\frac{1}{z}} = \frac{r - \tau}{r^* - \tau^*} \quad \text{and} \quad \tilde{\omega} = \left[\frac{r - \tau}{r^* - \tau^*}\right]^z \quad \text{if} \quad (r - \tau) < (r^* - \tau^*).$$

Hence, the optimal capital allocation in equilibrium is given by

$$\tilde{\omega} = \min\left\{\left(\frac{r - \tau}{r^* - \tau^*}\right)^z, 1\right\}. \tag{10}$$

For the domestic economy this means the following: If $(r - \tau) \geq (r^* - \tau^*)$, we have $\tilde{\omega} = 1$. For $(r - \tau) < (r^* - \tau^*)$, we have $\tilde{\omega} = \left(\frac{r-\tau}{r^*-\tau^*}\right)^z \leq 1$.

The growth rate of consumption of the capital owners depends on $\tilde{\omega}$ as follows:

1. If $(r - \tau) \geq (r^* - \tau^*)$, then $\tilde{\omega} = 1$ and so $\gamma = (r - \tau) - \rho$.

2. If $(r - \tau) < (r^* - \tau^*)$, then $\tilde{\omega} = \left(\frac{r-\tau}{r^*-\tau^*}\right)^z$ and

$$\begin{aligned} \gamma &= (r - \tau)\left(\tfrac{r-\tau}{r^*-\tau^*}\right)^z + \left[\left(\tfrac{r-\tau}{r^*-\tau^*}\right)^z\right]^{\frac{1}{z}} (r^* - \tau^*)\left(1 - \left(\tfrac{r-\tau}{r^*-\tau^*}\right)^z\right) - \rho \\ &= (r - \tau) - \rho \end{aligned}$$

[18] The following is also a theoretically possible case: If $r - \tau << (r^* - \tau^*)\phi^*$, and the after tax return differentials are extreme, the investors would all shift their capital to the foreign country. But then $\phi^*(\omega)$ might fall until $r - \tau < (r^* - \tau^*)\ \epsilon$. But then clearly, $\tilde{\omega} = 0$ and the foreign after-tax return must be huge relative to the domestic one because ϵ in (2) is small by assumption. This is ruled out in the paper since it is usually not observed, that is, return differentials by a factor of more than, say, a 100 are ruled out.

The fact that the growth rate of the capital owners consumption and wealth always grows at a rate that depends on the *domestic* after-tax rate of return only, is clearly a simplifying property of the model and depends on the simple capital allocation function. However, notice that, first, depending on the domestic return these growth rates may be very different, and, second, that an equalization of returns by (free) capital allocation is shared by many models in the literature. Importantly, however, there may be an asymmetry between wealth accumulation for foreign and domestic capital owners in the model. This is captured by

Lemma 1 *In equilibrium the growth rate of the domestic capital owners' wealth and consumption is determined by the domestic after-tax return on their wealth. In a two-country equilibrium we have*

$$\gamma = \tilde{\omega}(r-\tau) + (r^* - \tau^*)\phi^*(1-\tilde{\omega}) = (r-\tau) - \rho \tag{11a}$$

$$\gamma^* = \tilde{\omega}^*(r-\tau) + (r-\tau)\phi(1-\tilde{\omega}^*) = (r^*-\tau^*) - \rho \tag{11b}$$

where $(r-\tau) \neq (r^*-\tau^*)$ *is possible.*

Before discussing the implications of this result further we will analyze the closed economy first.

3.1 The Closed Economy

The closed economy equilibrium is characterized by steady state, balanced growth with $\gamma_Y = \gamma_k = \gamma = \gamma_{C^W}$ and $\omega = 1$. The growth rate is first increasing and then decreasing in τ and maximized when

$$\tau = \hat{\tau} \equiv [\alpha(1-\alpha)A]^{\frac{1}{\alpha}}. \tag{12}$$

Following Alesina and Rodrik's paper redistribution is defined here as any policy that reduces the incentive to accumulate. Taking growth maximizing policies as a benchmark has its virtues since people appear to have difficulties disentangling the relationship between utility enhancing income growth and the distribution of income at each point in time. See e.g. Amiel and Cowell (1999). Thus, any policy $\tau \gtrless \hat{\tau}$ redistributes and lowers growth in the model.[19]

3.2 Two-Country World

Consider the domestic economy with arbitrarily given tax rates and so fixed $\tilde{\omega}$ and $\tilde{\omega}^*$. In the open economy equilibrium the capitalists' consumption grows at the same, constant rate as their wealth. The same holds for the foreign capitalists. The total wealth of the domestic capitalists at any point in time is k_t and the budget constraint satisfies $\dot{k}_t = \gamma k_t = (r-\tau)\tilde{\omega}k_t + (r^* - \tau^*)\phi(1-\tilde{\omega})k_t - C^k$.

3.2.1 World Goods Market Equilibrium

With given $\tilde{\omega}, \tilde{\omega}^*$ the world resource constraint is

$$\dot{k}_t + \dot{k}_t^* = (r+\eta)K_t + (r^*+\eta^*)K_t^* - G_t - G_t^* - C_t^k - C_t^{k^*} - C_t^W - C_t^{W^*} \quad (13)$$

where $K_t = \tilde{\omega}k_t + \phi(1-\tilde{\omega}^*)k_t^*$, $K_t^* = \tilde{\omega}^* k_t^* + \phi^*(1-\tilde{\omega})k_t$, $G_t = \tau K_t$ and $G_t^* = \tau^* K_t^*$ since the governments run balanced budgets and the production functions imply $Y_t = rK_t + \eta K_t$ and $Y_t^* = r^* K_t^* + \eta^* K_t^*$. As Lemma (1) and private sector

[19] An alternative redistribution mechanism could be that a fraction of tax revenues is spent in the form of direct transfers to workers. See Alesina and Rodrik (1994), p. 466. However, the paper's qualitative results for open economies would not change if one introduced such a separate policy instrument. See Rehme (1995) or Rehme (1997).

optimality entail

$$\dot{k_t} + \dot{k_t^*} = \gamma k_t + \gamma^* k_t^* \quad = \quad [\tilde{\omega}(r-\tau) + (r^* - \tau^*)\phi^*(1-\tilde{\omega}) - \rho]\, k_t$$
$$+ [\tilde{\omega}^*(r-\tau) + (r-\tau)\phi(1-\tilde{\omega}^*) - \rho]\, k_t^*$$

the world resource constraint is met.

3.2.2 Wealth and Accumulation of Net Foreign Assets

Wealth in each economy is given by

$$W_t = \tilde{\omega} k_t + (1-\tilde{\omega})k_t = k_t \quad \text{and} \quad W_t^* = \tilde{\omega}^* k_t^* + (1-\tilde{\omega}^*)k_t^* = k_t^*,$$

and world wealth amounts to $W_t + W_t^* = k_t + k_t^*$. As regards the allocated capital (wealth) we use the following definitions:

$$V_t \equiv \tilde{\omega} k_t + (1-\tilde{\omega}^*)k_t^* \quad \text{and} \quad V_t^* \equiv \tilde{\omega}^* k_t^* + (1-\tilde{\omega})k_t, \tag{14}$$

where V_t denotes the capital that is *domiciled* in the home economy, and V_t^* represents the capital that is *domiciled* in the foreign economy.

Thus, domestic wealth is given by $W_t = V_t + N_t$, where N_t is defined by

$$N_t \equiv (1-\tilde{\omega})k_t - (1-\tilde{\omega}^*)k_t^* \tag{15}$$

and denotes the *net foreign assets* for the *domestic* economy.[20] If $N_t > 0$, then the domestic country has positive net foreign assets, and is a creditor. If $N_t < 0$, then the domestic country has negative net foreign assets, and is a debtor.

[20] Thus, $-N_t = (1-\tilde{\omega}^*)k_t^* - (1-\tilde{\omega})k_t$ denotes the net foreign assets of the *foreign* economy.

Thus, domestic wealth is $W_t = V_t + N_t$ and foreign wealth is $W_t^* = V_t^* - N_t$. For convenience we will drop time subscripts from now on. The *current account* balance is then given by the change in net foreign assets, i.e.

$$\dot{N} = (1 - \tilde{\omega})\dot{k} - (1 - \tilde{\omega}^*)\dot{k}^*. \tag{16}$$

Using the household budget constraints, the optimality conditions of the firms, and the government budget constraints one obtains (see appendix C)

$$\dot{N} = Y - C - G - \dot{V} + (r - \tau)\phi N + [(r^* - \tau^*)\phi^* - (r - \tau)\phi]\,(1 - \tilde{\omega})k, \tag{17}$$

starting from initial N_0, V_0 and k_0. In equation (17) domestic GDP equals output $Y = (r + \eta)K$, and aggregate domestic consumption is denoted by $C = C^k + C^W$.

The equation expresses that the rate of net foreign asset accumulation equals domestic output (Y) less domestic absorption ($C + G + \dot{V}$) plus the net international flow of earnings on foreign assets. For given tax rates, the rate of net foreign asset accumulation also depends on the allocation of the domestically owned capital stock, as reflected by $(1 - \tilde{\omega})k$.[21]

Intertemporal solvency of the current account requires

$$\lim_{t \to \infty} N e^{-[(r - \tau)\phi]t} = 0, \tag{18}$$

which is satisfied in equilibrium. See appendix D. Analogous reasoning applies to the foreign economy.

[21]For a similar result see Turnovsky (1997), p. 217.

3.2.3 Equilibrium Growth of GDP

In equilibrium GDP grows at the same rate as output Y which in turn grows at same rate as K_t, because G_t and K_t grow at the same rate. As all goods can travel costlessly, consumption adjusts at each point in time so as to maintain equilibrium.

Let $\nu_t \equiv \frac{\tilde{\omega} k_t}{K_t}$ and $\nu_t^* \equiv \frac{\phi(\tilde{\omega}^*)(1-\tilde{\omega}^*)k_t^*}{K_t}$ denote the shares of domestic and foreign owned capital in domestically productive capital. The domestic economy is then characterized by balanced, but not necessarily steady growth, since the evolution of the domestic economy is determined by

$$\Gamma_t \equiv \frac{\dot{K}_t}{K_t} = \frac{\gamma\tilde{\omega}\ k_0\ e^{\gamma t} + \gamma^*\phi(1-\tilde{\omega}^*)\ k_0^*\ e^{\gamma^* t}}{\tilde{\omega}\ k_0\ e^{\gamma t} + \phi(1-\tilde{\omega}^*)\ k_0^*\ e^{\gamma^* t}} = \nu_t\gamma + \nu_t^*\gamma^* \tag{19}$$

which is a weighted average of the growth rates of the domestic and the foreign capitalists' capital, allocated to the domestic economy.

Clearly, if $\tilde{\omega}^* = 1$, then $\Gamma_t = \gamma$ and so constant over time. However, if $\tilde{\omega}^* < 1$, then Γ_t will not be constant, because

$$\frac{d\Gamma_t}{dt} = \frac{\left(\gamma^2\tilde{\omega}\ k_0\ e^{\gamma t} + \gamma^{*2}\phi(1-\tilde{\omega}^*)\ k_0^*\ e^{\gamma^* t}\right)K_t - \left(\dot{K}_t\right)^2}{K_t^2} = (\gamma-\gamma^*)^2\Delta$$

where $\Delta = \frac{\tilde{\omega}k_0\ e^{\gamma t}\ \ \phi(1-\tilde{\omega}^*)k_0^*\ e^{\gamma^* t}}{K_t^2}$. In fact, Γ_t is increasing over time, unless $\gamma = \gamma^*$. Also

$$\lim_{t\to\infty}\Gamma_{t|\gamma>\gamma^*} = \frac{\gamma\tilde{\omega}k_0 + \lim\limits_{t\to\infty}\gamma^*\phi^* e^{(\gamma^*-\gamma)t}k_0^*}{\tilde{\omega}k_0 + \lim\limits_{t\to\infty}\phi^* e^{(\gamma^*-\gamma)t}k_0^*} = \gamma.$$

Lemma 2 *The equilibrium is characterized by balanced growth at the rate Γ_t.*

1. *If there is no foreign owned capital in the domestic economy, $\tilde{\omega}^* = 1$, then*

$\Gamma_t = \gamma$ and constant over time.

2. *If there is foreign owned capital in the domestic economy, $\tilde{\omega}^* < 1$, then Γ_t is increasing over time, $\frac{d\Gamma_t}{dt} > 0$, for any $\gamma \neq \gamma^*$. If $\gamma > \gamma^*$, then $\Gamma_t < \gamma$ and $\lim_{t \to \infty} \Gamma_{t|\gamma>\gamma^*} = \gamma$.*

Thus, if $\gamma > \gamma^*$, the GDP growth rate Γ_t is smaller than the growth rate of the domestic capital owner's wealth. This captures that foreign owned capital operating in the domestic economy puts a drag on domestic GDP growth, because it is less productive there. On the other hand the level of GDP is higher which is good for domestic wages. In the long run GDP growth will approach γ which would correspond to the economy's growth rate when the country remained autarkic.

Clearly, $\tilde{\omega}$ and $\tilde{\omega}^*$ are important for the open economy equilibrium. As they depend on the tax rates, structure on policy is introduced next.

4 The Government

The governments respect the right of private property[22] and maximize the welfare of their domestic clientele, thus, representing national interests only. Integrating (6) and (7a) yields that the domestic capital owners' intertemporal welfare (superscript r) is

$$V^r = \int_0^\infty \ln C_t^k e^{-\rho t} dt = \frac{\ln C_0^k}{\rho} + \frac{\gamma}{\rho^2}. \tag{20}$$

[22] Although the model's command optimum would involve expropriation of the capital stock even for a government maximizing the welfare of the capital owners, it is ruled out as it is not common in the real world.

Hence, a government serving domestic capitalists only is concerned about the capital owners' worldwide income and not GDP or GDP growth.

The welfare measure of the domestic workers (superscript l) integrates to

$$V^l = \int_0^\infty \ln C_t^W e^{-\rho t} dt = \frac{\ln C_0^W}{\rho} + \frac{1}{\rho} \int_0^\infty \Gamma_t \, e^{-\rho t} dt. \tag{21}$$

As wages depend on the productive capital stock, a government serving the workers only must be concerned about the level and growth of GDP.

5 Closed Economy Policies

Suppose the government maximizes a mixture of the agents' welfare. Such a government would choose (see Appendix E)

$$\tau[1 - \alpha(1-\alpha)A\tau^{-\alpha}] = \rho\beta(1-\alpha), \tag{22}$$

where β is the social weight attached to the workers' welfare. The tax rate solving this equation is denoted by $\check{\tau}$ and is greater than $\hat{\tau}$. As $\frac{d\check{\tau}}{d\beta} > 0$ and so $\frac{d\gamma}{d\beta} < 0$ more political power going to labour implies that growth is traded off against redistribution in the model. Thus, small differences in welfare weights induce different after-tax returns and growth. Notice that an entirely pro-capital ($\beta = 0$), that is, a *right-wing* government is only concerned about capital income, and in the model it chooses the growth maximizing tax rate $\hat{\tau}$.

Given the qualitative nature of the effects of different welfare weights on optimal policies, the paper concentrates on the polar cases of *right-wing*, entirely pro-capital ($\beta = 0$), and of *left-wing*, entirely pro-labour ($\beta = 1$), policies in the open economy analysis below.[23]

Furthermore, the following is worth noting: First, the after-tax return under the right-wing policy is maximal and given by $\hat{r} - \hat{\tau} = \hat{\tau}\left(\frac{\alpha}{1-\alpha}\right)$. From (12) an increase in A raises growth, the after-tax return and taxes under that policy. Second, from (22) an increase in A under a left-wing policy implies

$$\frac{d\tau}{dA} = \alpha(1-\alpha)\tau\left(\tau^{\alpha} - \alpha(1-\alpha)^2 A\right)^{-1} > 0$$

since $\check{\tau} > \hat{\tau}$.[24] Furthermore, $\frac{d\gamma}{dA} = r_A + (r_\tau - 1)\frac{d\tau}{dA} > 0$ if

$$\begin{aligned} \alpha\tau^{1-\alpha} &> \left(1-\alpha(1-\alpha)A\tau^{-\alpha}\right)\left[\alpha(1-\alpha)\tau\left(\tau^{\alpha}-\alpha(1-\alpha)^2A\right)^{-1}\right] \\ \tau^{\alpha} - \alpha^2(1-\alpha)^2A &> (1-\alpha)\tau^{\alpha} - \alpha^2(1-\alpha)^2A \end{aligned}$$

which is equivalent to $1 > 1-\alpha$ and true. Thus,

Lemma 3 *In the closed economy an increase in efficiency implies higher tax rates, higher after-tax returns and higher growth under the optimal left-wing or right-wing policy.*

Intuitively, a more efficient economy makes it worthwhile for left and right-wing governments to shift relatively more public resources into production, thereby rasing the return on capital and growth. The latter in turn is in the workers' long-run interest as their wages grow with the capital stock.

[23] Suppose $\beta = \beta^*$ in open economies. Then any change in government such as $\beta > \beta^*$ would imply the same qualitative results as the ones derived for the polar cases below.

[24] To see this notice that $\frac{d\tau}{dA} > 0$ requires $\tau^{\alpha} > \alpha(1-\alpha)^2 A$ which is equivalent to $\tau > \hat{\tau}(1-\alpha)^{\frac{1}{\alpha}}$ and always satisfied since $\check{\tau} > \hat{\tau}$ and $(1-\alpha)^{\frac{1}{\alpha}} < 1$.

6 Tax Competition

What happens to the closed economy policies if governments have to decide in a world with capital mobility and they cannot coordinate their policies? That is a relevant question when full tax harmonization is not feasible. As a consequence governments may engage in tax competition. (See, for instance, Sinn (1990) or Bovenberg (1994).) This problem is modelled here as a two-stage game in the vein of Devereux and Mansoorian (1992). The capitalists in either economy have the same initial capital stocks, and the economies are technologically similar, unless stated otherwise. Furthermore, all agents are taken to be equally patient across countries which is a reasonable assumption, if the agents can invest in a global environment. There is no uncertainty and common knowledge prevails. The governments act before the private sectors do.[25] Thus, given the capitalists' capital location decision the governments simultaneously decide on taxes. Given the taxes the private sector decides on where to locate the capital. We will look for equilibria in the Cournot-Nash tax competition game where each possible match between governments will be analyzed in turn.[26]

6.1 The Right-wing Government

The domestic right-wing government maximizes (20) taking τ^* as given.[27] The FOC involves $\frac{C^k_\tau}{\rho C^k} + \frac{\gamma_\tau}{\rho^2} = 0$. As $C^k = \rho k$ in steady state, $C^k_\tau = 0$. By Lemma 1 the equilibrium growth rate of domestically owned wealth only depends on the

[25] By assumption democratic governments of either political leaning are constantly reminded of their pre-election promises. Modelling problems of time inconsistency is beyond the scope of the paper. Thus, in the model governments commit themselves to their decisions. How the commitment is enforced is outside of the model.

[26] Game theoretic formulations of the distributional conflict between capital owners and workers can be found in Lancaster (1973) and the literature ensuing from that paper.

[27] The time subscript 0 will be suppressed in what follows.

domestic after-tax return.

This implies that the right-wing government chooses τ so that $\gamma_\tau = 0$, that is, its optimal, closed economy policy $\hat{\tau}$, which is independent of the degree of capital mobility, the efficiency in the foreign economy and the opponent's policy. Hence, in any Nash Equilibrium a right-wing government pursues a policy that maximizes the domestic investors' worldwide capital income, and it has a completely fixed reaction function.

6.2 Left-wing vs. Right-wing

Suppose the domestic left-wing government competes in taxes with a foreign right-wing government, and the economies are similar. As the foreign right-wing government always sets $\tau^* = \hat{\tau^*}$, the domestic left-wing government cannot guarantee a higher after-tax return than the foreign right-wing government.[28] But then $\tilde{\omega}^* = 1$, $C^W = \eta K_t = \eta(\tilde{\omega} k_t)$, and $\Gamma_t = \gamma$. Thus, the domestic left-wing government cannot attract any foreign capital. The FOC for the maximization of (21) is given by

$$\frac{C^W_\tau}{\rho\, C^W} + \frac{\gamma_\tau}{\rho^2} = \frac{\eta_\tau}{\eta} + \frac{\tilde{\omega}_\tau}{\tilde{\omega}} + \frac{r_\tau - 1}{\rho} = 0,$$

since $\gamma_\tau = (r_\tau - 1)$ and $\tilde{\omega}_\tau = \frac{z(r_\tau - 1)\tilde{\omega}}{r - \tau}$. Substituting and rearranging yields that the optimal left-wing tax rate, denoted $\check{\tau}_1$, solves

$$\frac{\eta_\tau}{\eta}\left[\frac{z}{r-\tau} + \frac{1}{\rho}\right]^{-1} = -\,(r_\tau - 1). \tag{23}$$

[28]This is due to the assumption of common knowledge and the left-wing government's redistributive objective and is intended to formulate a 'harsh' trade-off. Instead assume that governments despise capital outflows more than they like to redistribute. In such a framework Rehme (1999) and Rehme (2006) show that the optimal left-wing behaviour under right-left or left-left competition would be the same as the ones found here for the cases of perfect capital market integration.

As the LHS is non-negative, $r_\tau \leq 1$ and so $\check{\tau}_1 \geq \hat{\tau}$. If $z \to \infty$, then definitely $\check{\tau}_1 = \hat{\tau}$, because otherwise $\tilde{\omega} \to 0$ and $V^l \to -\infty$ which is not optimal. If $z = 0$, $\check{\tau}_1 = \check{\tau}$ and the solution reduces to the closed economy one. For $z > 0$ and finite, $\hat{\tau} < \check{\tau}_1 < \check{\tau}$ and $\frac{d\check{\tau}_1}{dz} < 0$. (See Appendix G.) Furthermore, $\tilde{\omega}^* = 1, \tilde{\omega} \leq 1$ implies a current account surplus for the domestic economy, $\dot{N} \geq 0$, by (16). Thus,

Proposition 1 *If a domestic, left-wing government competes in taxes with a foreign, right-wing government and the economies are similar,* $A = A^*$, *then for finite* z *less capital is located in the domestic economy,* $\tilde{\omega} < 1$ *and* $\tilde{\omega}^* = 1$. *The domestic economy has a current account surplus,* $\dot{N} \geq 0$. *The optimal, left-wing tax rate* $\check{\tau}_1$ *satisfies* $\hat{\tau} < \check{\tau}_1 < \check{\tau}$ *and decreases in* z. *Relative to the optimal left-wing closed economy policy GDP growth is higher,* $\check{\gamma} < \Gamma = \check{\gamma}_1 < \Gamma_t^*$; *redistribution and initial wages are lower than in the closed economy. If capital market integration becomes perfect* ($z \to \infty$), *the optimizing left-wing government mimics a right-wing policy* ($\check{\tau}_1 = \hat{\tau}$) *and* $\Gamma = \gamma = \Gamma^*$ *and* $\dot{N} = 0$.

According to the proposition there is steady state growth in the domestic, but not in the foreign economy in general. Foreign GDP usually increases over time, which is really good for the foreign workers.

Second, for a domestic left-wing government facing a foreign right-wing opponent and for similar economies $\check{\eta} > \check{\eta}_1\tilde{\omega}_1$ so that domestic initial wages are generally lower in an open than in a closed economy. In contrast, $\hat{\eta}^* k_0^* < \hat{\eta}^*(k_0^* + \phi^*(1-\tilde{\omega})k_0)$ which implies that foreign initial wages would be higher in general. Thus, under a foreign right-wing policy the foreign workers would benefit from opening up their economy in the case of left-right competition.

Third, left-wing governments reduce redistribution in equilibrium if capital market integration increases. Thus, the effects of the concern for inequality are competed away by fear of losing capital. Facing tax competition the left-wing government is better off if it puts more emphasis on getting enough capital, instead of simply redistributing income. When the economies are equally efficient *and* perfect capital market integration prevails, both governments optimally act right-wing by setting the tax rates that maximize the domestic capitalists' world-wide income.

6.3 Left-wing vs. Left-wing

Each government would benefit from getting some capital off its opponent. Both left-wing governments face the trade-off between setting high taxes for redistribution or losing capital.[29] If the economies have the same initial capital stocks and are equally efficient, the left-wing governments' problem is completely symmetric in terms of strategy spaces (action sets), agents etc. As the strategies are continuous variables and symmetric, we contemplate a symmetric game. According to the *symmetric equilibrium theorem* every symmetric game that has an equilibrium has at least one symmetric equilibrium.[30] For what follows only symmetric equilibria are considered.

Then we have for a symmetric equilibrium that $\tau = \tau^*$ with $k_0 = k_0^*$. Thus, $\tilde{\omega} = \tilde{\omega}^* = 1$, $\phi = \phi^* = 1$, $(r - \tau) = (r^* - \tau^*)$ and $\gamma = \gamma^*$. Under that restriction the FOC reduces to

$$\frac{\eta_\tau}{\eta} + \tilde{\omega}_\tau - \tilde{\omega}^*_\tau + \frac{\gamma_\tau}{\rho} = 0. \tag{24}$$

(See appendix F.) The first two expressions on the LHS represent the effects of

[29]A more general analysis is not easy because asymmetries in the payoff functions may lead to complicated non-steady state equilibria. However, asymmetries are dealt with in the paper below by attributing them to differences in A.

[30]See Lemma 6 in Dasgupta and Maskin (1986) or Theorem 5.10 in Rasmusen (1989), p. 127.

changes in wages. The third expression shows how the wealth growth rate reacts to changes in policy. Now

$$\tilde{\omega}_\tau = z \left(\frac{r-\tau}{r^*-\tau^*}\right)^{z-1} \left(\frac{r_\tau - 1}{r^*-\tau^*}\right) \quad \text{and} \quad \tilde{\omega}^*_\tau = -z \left(\frac{r^*-\tau^*}{r-\tau}\right)^{z-1} \left(\frac{(r_\tau-1)(r^*-\tau^*)}{(r-\tau)^2}\right).$$

Around $r - \tau = r^* - \tau^*$ we then obtain $\tilde{\omega}_\tau - \tilde{\omega}^*_\tau = 2z\left(\frac{r_\tau - 1}{r-\tau}\right)$ so that the FOC for a symmetric equilibrium reduces to

$$\frac{\eta_\tau}{\eta}\left[\frac{2\,z}{r-\tau} + \frac{1}{\rho}\right]^{-1} = -(r_\tau - 1). \tag{25}$$

Let $\check{\tau}_2$ denote the optimal tax rate solving this equation. If $z \longrightarrow \infty$, then $\check{\tau}_2 \longrightarrow \hat{\tau}$, and if $z \longrightarrow 0$, then $\check{\tau}_2 \longrightarrow \check{\tau}$, where $\check{\tau}$ is the optimal left-wing policy in the closed economy. As in the case of left-right competition $\check{\tau}_2 < \check{\tau}$ and $\frac{d\check{\tau}_2}{dz} < 0$ if $z > 0$. Furthermore, $\tilde{\omega} = \tilde{\omega}^* = 1$ imply that the current account is balanced for both economies, $\dot{N} = 0$.

Proposition 2 *If two left-wing governments compete in taxes, the economies are similar, $A = A^*$, and have the same initial capital stock, $k_0 = k_0^*$, then the game has a symmetric equilibrium in which both governments set the same tax rates, $\check{\tau}_2 = \check{\tau}_2^*$. In the optimum more capital market integration reduces redistribution, that is, $\check{\tau}_2 < \check{\tau}$ and $\frac{d\check{\tau}_2}{dz} < 0$ for $z > 0$. Both economies' GDP grows at the same rate, $\Gamma = \gamma = \gamma^* = \Gamma^*$ and the current accounts are balanced, $\dot{N} = 0$. If capital market integration becomes perfect, $z \longrightarrow \infty$, then $\check{\tau}_2 \longrightarrow \hat{\tau}$ and optimizing left-wing governments mimic right-wing policies.*

Thus, although both governments would like to redistribute, the fear of losing capital makes them choose a tax rate lower than in the closed economy, that is, makes them redistribute less.

6.4 Left-Right vs. Left-Left Competition

Consider the RHS of (23) and (25). There is less redistribution if the domestic left-wing government faces a foreign left-wing government, because for any $z > 0$ and τ it is true that $\left[\left(\frac{2z}{r-\tau}\right) + \frac{1}{\rho}\right] > \left[\frac{z}{r-\tau} + \frac{\omega}{\rho}\right]$. Thus, for any solution $-(r_\tau - 1)$ is lower and so closer to zero in (25) than in (23). Hence, $\check{\tau}_2 < \check{\tau}_1$ for $z > 0$ and finite.

Proposition 3 *If the economies are similar, $A = A^*$, and $k_0 = k_0^*$, and the domestic left-wing government faces either a foreign right-wing or a foreign left-wing government, then $\check{\tau}_1 \geq \check{\tau}_2$, and $\Gamma(\check{\tau}_1) \leq \Gamma(\check{\tau}_2)$ for any $z \in [0, \infty)$.*

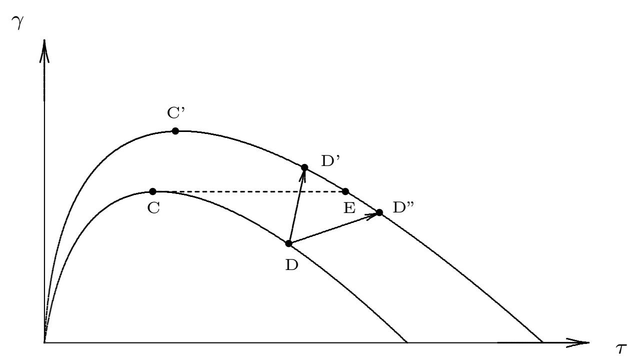
Hence, for two equally efficient economies a domestic left-wing government competing in taxes redistributes *at least* as much when facing a right-wing as when facing a left-wing government. Also, it taxes wealth *at least* as much when facing a right-wing as when facing a left-wing government. Thus, for a left-wing government it matters a lot who it competes with in taxes. The comparison between the two possible opponents suggests that one may observe more GDP growth at the expense of less redistribution if the domestic left-wing government faces a foreign left-wing government. Alternatively, one may observe more redistribution and less GDP growth if the domestic left-wing government competes with a foreign right-wing government.

In the model the foreign right-wing government guarantees $\omega^* = 1$ so that the left-wing government has no chance to attract foreign capital. The strategic interaction between two left-wing governments is more intense because each government may get some capital off its left-wing opponent. That is in conflict with more redistribution, but may be worthwhile in terms of growth.

6.5 Different Economies

If a *domestic right-wing* government with a more efficient *open* economy chooses its nationally optimal tax policy, no opponent can do better, because $\hat{r} - \hat{\tau} > \hat{r^*} - \hat{\tau^*}$ at C' in figure 1. Thus, the foreign opponent may choose anything and experiences capital outflows. An efficient economy's right-wing government has higher GDP growth than any of its opponents. This is associated with a current account deficit for the domestic economy.

Figure 1: Tax Competition Among Different Economies



Next, consider a domestic left-wing government. First, no matter which foreign government it competes with it will set $\tau = \hat{\tau}$ when $z \to \infty$ and $A = A^*$. Second, if its *closed* economy becomes more efficient the government may choose D' or D". In an *open*, relatively more efficient economy facing very high capital market integration, the left-wing government will set its tax rate so that it gets all the capital. In that case and for *any* foreign vs. domestic after-tax return combinations where $A > A^*$ the tax rate τ approaches $\hat{\tau}$ as $z \to \infty$ implying that C' would be optimal.

Suppose the capital market integration is low. Then the left-wing government may choose any policy between D' and D". If it chooses D", it tolerates some capital outflows as a price for increased redistribution with higher taxes. Such a policy would be welfare maximizing and correspond to the common notion of the trade-off between redistribution and growth for technologically different countries. Notice, however, that it would also imply higher growth than in the closed economy at D.

Numerical Simulation						
	A	$\hat{\tau}^*$	$\check{\tau}$	γ^*	γ	Δ
1.	1.05	0.063	0.113	0.013	-0.005	-
2.	1.10	0.063	0.120	0.013	0.020	+
3.	1.20	0.063	0.135	0.013	0.038	+
4.	2.00	0.063	0.298	0.013	0.198	+
$z \approx 0$, $A^* = 1$, $\alpha = 0.5$ and $\rho = 0.05$						

On the other hand, the simulation above highlights that when the efficiency difference is large enough, implying a policy to the left of E, a left-wing government might redistribute, attract foreign capital and cause relatively higher growth than any other, inefficient economy's government.

Proposition 4 *If the domestic economy is more efficient, $A > A^*$, a domestic left-wing government will optimally choose a policy such that*

1. *it definitely gets foreign capital, $\omega = 1$ and $\omega^* < 1$, when the capital market integration is very high, $z \to \infty$, and $D' \to C'$ or the efficiency difference is large enough (D' vs. C). It then has higher GDP growth than any foreign government, $\Gamma > \Gamma^*$, and a current account deficit, $\dot{N} < 0$, and it redistributes.*

2. *it may tolerate some capital outflows at D", leading to relatively lower GDP growth, $\Gamma < \Gamma^*$, but more redistribution than at D' and higher growth than in the closed economy at D. Under this scenario the domestic economy has a current account surplus, $\dot{N} > 0$.*

Efficiency differences and very high capital market integration are really bad for the workers in the inefficient, foreign economy, because the capital outflow may reduce their welfare dramatically. As an efficient economy's left-wing government only represents domestic workers in the model (a form of left-wing nationalism), its policy causes the foreign workers to suffer in the inefficient economy.

More importantly, however, the proposition shows that across countries one may *observe* redistribution, i.e. high taxes favouring the non-accumulated factor of production *and* higher GDP growth than in another, less efficient economy with a non-redistributing government. This endogeneity effect of redistributive policies may, therefore, account for the empirical observation of the positive association between redistribution and growth in samples with many countries linked by capital mobility.

Normatively, the result shows that raising efficiency is in the interest of all agents. That is particularly true for the workers with a left-wing government.[31]

7 Empirical Evidence

The results of the paper imply another interesting prediction. According to the propositions we should observe that economies that have relatively higher growth should also have current account deficits. This would hold regardless of political preferences.

The following table presents some tentative evidence using long-run indicators for a group of 23 rich OECD countries, for which data covering the period 1975-2000 were available. The data refer to averages for the period. The variables denote the following: "Corporatism" is taken from Garrett (1998), ch. 5.

[31] A formal argument that the model has precisely this feature for a closed economy can be found in Rehme (2000) and Rehme (2006).

If the index is "1", then the country is classified as having a "social democratic corporatism"-regime. This corresponds to a structurally (long-run) left-wing social arrangement in a particular country.[32] A value of "2" represents countries that cannot be labelled right- or left-wing. Garrett refers to them as "Incoherent". A value of "3" stands for countries that feature "market liberalism" and represent structurally (long-run) right-wing countries. All the other countries, indexed by x, were not classified and feature here only for comparability.

"CA/GDP" is an average of the current account positions of a country in terms of percent of its GDP over the sample period as given by the WDI (2002). "GR" is the average of yearly per capita growth rates from WDI (2002). "Tax/GDP" is the average of the ratio of all tax revenues in terms of GDP over the sample period as reported by OECD (2002). "Redist." represents redistribution and is taken from Milanovic (2000) who assembled Gini coefficients for gross and net income for the sample period. The difference between the Gini coefficients for gross and net income is then a measure of redistribution in incomes. Finally, "Y75" represents GDP per capita in 1975.

With these variables an interesting picture emerges for the countries that can be politically ranked.[33] The group of structurally (long-run) left-wing countries (Austria, Denmark, Finland, Norway and Sweden) have relatively high growth (2.1 percent), a current account deficit of 0.58 percent of GDP, high taxes (0.44)

[32] A country's ranking was created from a left-labour power index, based on the balance of power indicator from Castles and Mair (1984) for a set of democratic countries. For instance, countries featuring a "1" were countries that ranked in the top five on the left-labour power index for the period 1985-1990. Countries with a "2" were ranked in the middle four and countries with a "3" were ranked in the bottom four of the left-labour index for that period. See the details in Garrett's book. Thus, implicit in this paper is the assumption that *long-run* political regime characteristics (e.g. fundamental labour laws, long-run political party platforms, the unions' role in wage bargaining etc.) have not substantially changed over the period 1975-2000.

[33] The countries that were not ranked comprise Australia, Switzerland, Spain, Greece, Ireland, Iceland, New Zealand, Portugal and Mexico.

and high redistribution 17.51. In turn, the group of structurally (long-run) right-wing countries (Canada, France, U.K., Japan and United States) have also high growth (2.03 percent), also a current account deficit of 0.46 percent of GDP, relatively low taxes (0.33) and relatively low redistribution 12.82.

Table 1: Economic Performance, OECD, 1975-2000 (Period Averages)

Country	Corporatism	CA/GDP	GR	Tax/GDP	Redist.	Y75
AUT	1	-1.60	2.12	0.41	n.a.	6382
DNK	1	-0.96	1.68	0.47	18.85	7262
FIN	1	-0.49	2.30	0.42	13.88	5866
NOR	1	0.66	2.86	0.42	15.07	6340
SWE	1	-0.54	1.55	0.50	22.22	6825
Average		-0.58	2.10	0.44	17.51	6535
Std.		0.83	0.52	0.04	3.79	530
BEL	2	1.71	1.98	0.44	24.93	6704
DEU	2	0.66	1.92	0.37	15.59	6300
ITA	2	-0.05	2.05	0.35	12.75	5624
NLD	2	3.11	1.80	0.43	14.68	6653
Average		1.36	1.94	0.40	16.99	6320
Std.		1.38	0.11	0.04	5.43	498
CAN	3	-2.27	1.75	0.34	10.82	7381
FRA	3	0.30	1.78	0.42	15.52	6390
GBR	3	-0.89	1.98	0.36	15.15	5831
JPN	3	2.03	2.53	0.28	n.a.	5985
USA	3	-1.47	2.12	0.27	9.78	8162
Average		-0.46	2.03	0.33	12.82	6750
Std.		1.68	0.32	0.06	2.94	994
AUS	x	-3.92	2.01	0.28	14.13	6416
CHE	x	5.33	0.75	0.31	7.10	9507
ESP	x	-1.38	2.05	0.29	11.30	4697
GRC	x	-3.73	1.56	0.28	n.a.	4829
IRL	x	-2.53	4.48	0.33	17.90	3435
ISL	x	-2.77	2.26	0.31	n.a.	6802
NZL	x	-5.63	0.65	0.27	n.a.	6405
PRT	x	-3.71	2.56	0.28	n.a.	3422
MEX	x	-2.184	1.105	0.17	n.a.	4526
Average		-2.28	1.94	0.28	12.60	5559
Std.		3.11	1.17	0.05	4.56	1936
AVERAGE		-0.884	1.99	0.35	14.97	6162
STD.		2.484	0.75	0.08	4.49	1375

Source: Garrett (1998), Milanovic (2000), OECD (2002), WDI (2002)

This shows that structurally left-wing countries are not doing bad in terms of growth. Also, both structurally right- and left-wing countries have higher growth than the set of countries ranked as incoherent (Belgium, Germany, Italy and Netherlands). Furthermore, the latter group of countries have on average relatively lower growth and a long-run current account surplus. This would lend support to the paper's implication that relatively high growth and current account deficits might be expected. Thus, the data suggest that relatively high redistribution and relatively high growth rates together with current account deficits are possible.

Of course, the present data cannot explain *why* we observe a missing tradeoff between redistribution and growth. In the theory part it was argued that economic efficiency, A, and optimal government policies drive any possible tradeoff. However, data for productivity or efficiency differences between countries are often unreliable and depend on a series of important further assumptions that will not be made in the present paper. Thus, evidence for the reason why a tradeoff is not necessarily observed has to remain a data black box A at this stage.

8 Conclusion

It is often shown that redistribution causes low growth, although across countries both are often found to be positively associated. This paper analyzes that puzzle in a model where the possibility of losing capital features saliently in the optimal decisions of redistributing governments in a non-cooperative world.

When economies are technologically similar, capital market integration calls for lower redistribution in an optimum with tax competition, especially for two competing left-wing governments which both care about redistribution.

If a left and a right-wing government compete and the economies are equally efficient, a left-wing government is unable to attract foreign capital and redistributes at least as much as it would when competing with another left-wing government. If the opponent has the same preferences, a left-wing government will choose higher GDP growth and higher wages at the cost of reduced redistribution. The result hinges on the intensity of strategic interaction and the degree of capital market integration. As capital markets become more integrated, tax competition intensifies and optimizing left-wing governments begin to mimic right-wing policies no matter who the opponent is.

When economies are technologically different more capital will locate in the economy with a superior technology. If such an economy's government wishes to redistribute, it can afford to do so - perhaps, but not necessarily - at the expense of losing some domestically owned capital. Hence, in a non-cooperative world redistribution depends on efficiency and on a government's opponent abroad.

Empirically, the paper's data for a politically ranked subset of rich OECD countries for the period 1975-2000 suggest that countries that have been structurally left-wing have on average had high taxes and high redistribution, but also have had relatively high growth rates and experienced capital inflows.

Normatively, the model implies that policies geared to make an economy more efficient are in the interest of both workers and capital owners. That is particularly true for the workers with a left-wing government.

In terms of positive economics the paper argues that one may well observe redistribution with relatively high GDP growth in open economies and that government preferences alone may not adequately explain these observed patterns.

Several caveats apply. For instance, history matters in more complicated dynamic games. Competition is among many governments in reality. Other asymmetries than those in efficiency might be interesting to analyze. Furthermore, efficiency may also be influenced by policy. These and other issues are left for further research.

A The elasticity of substitution between domestically and foreign owned capital

In order to evaluate the substitution possibilities between domestically and foreign owned capital in domestic production for our multi-input production function we use the concept of the direct elasticity of substitution. See e.g. Cowell (1986), p. 29.

$$\sigma = \left[\frac{d\left(\frac{\omega_t k_t}{(1-\omega_t^*)k_t^*}\right)}{d\phi} \right] \left[\frac{\phi}{\left(\frac{\omega_t k_t}{(1-\omega_t^*)k_t^*}\right)} \right] \tag{A1}$$

where $\phi(\omega_t^*)$ corresponds to the MRTS between domestically and foreign owned capital in domestic production. This (point) elasticity is defined around some ω_t^*, ω_t at a particular point in time. Then $d\phi(\omega_t^*) = \phi' \; d\omega_t^*$ around some ω_t^*, where ϕ' denotes the derivative of $\phi(\omega_t^*)$ w.r.t. ω_t^*, and given that we contemplate the elasticity around some point. Thus,

$$\sigma = \left[\frac{d\left(\frac{\omega_t k_t}{(1-\omega_t^*)k_t^*}\right)}{\phi' d\omega_t^*} \right] \left[\frac{\phi}{\left(\frac{\omega_t k_t}{(1-\omega_t^*)k_t^*}\right)} \right] = \left[\frac{d\left(\frac{\omega_t k_t}{(1-\omega_t^*)k_t^*}\right)}{d\omega_t^*} \right] \left(\frac{\phi}{\phi'}\right) \left[\frac{(1-\omega_t^*)k_t^*}{\omega_t k_t}\right].$$

If we let the ratio of the differentials approach a derivative and simplify, we obtain

$$\sigma = \left[\frac{k_t^* \omega_t k_t}{[(1-\omega_t^*)k_t^*]^2}\right] \left(\frac{\phi}{\phi'}\right) \left[\frac{(1-\omega_t^*)k_t^*}{\omega_t k_t}\right] = \left(\frac{\phi}{\phi'}\right) \left(\frac{1}{1-\omega_t^*}\right).$$

Since $\left(\frac{\phi}{\phi'}\right) = \frac{\omega_t^{*\frac{1}{z}}}{\frac{1}{z}\,\omega_t^{*\frac{1}{z}-1}}$ we get $\sigma = \dfrac{z\omega_t^*}{1-\omega_t^*}$. It should be borne in mind that this elasticity only holds for $\phi(\omega_t^*) \in (\epsilon, 1)$ and $\omega_t^* \in [0, 1)$, which is the relevant range for the equilibria in which capital flows.

B The capital owners' optimum

The current value Hamiltonian for the capital owners' problem is given by

$$\mathcal{H} = \ln c_t + \mu_t \left[(r-\tau)\omega_t k_t + \phi\;(1-\omega)k_t\right],$$

where μ_t is the shadow price of one more unit of investment at date t. The necessary first order conditions for the maximization of $\mathcal{H}$ are given by (7b), (7c), (7d) and

$$\frac{1}{C_t^k} - \mu_t = 0 \tag{B1a}$$

$$\mu_t(r-\tau)k_t - \mu_t(r^*-\tau^*)\phi k_t = 0 \tag{B1b}$$

$$\dot{\mu}_t = \mu_t\rho - \mu_t\left[(r-\tau)\omega_t + (r^*-\tau^*)\phi(1-\omega_t)\right] \tag{B1c}$$

$$\lim_{t\to\infty} k_t \mu_t e^{-\rho t} = 0. \tag{B1d}$$

Equation (B1a) equates the marginal utility of consumption to the shadow price of more investment, (B1c) is the standard *Euler* equation relating the costs of foregone investment (LHS) to the discounted gain in marginal utility (RHS), and the transversality condition (B1d) ensures that the present value of the capital stock equals zero asymptotically. Equation (B1b) determines the optimal capital allocation when taking ϕ as given. It is given by equation (8) in the text.

Denoting the optimal choice of ω by $\tilde{\omega}$, which is constant over time, and by equations (B1a) and (B1c) consumption then grows at the rate

$$\gamma \equiv \frac{\dot{C}_t^k}{C_t^k} = (r-\tau)\tilde{\omega} + (r^* - \tau^*)\phi(1-\tilde{\omega}) - \rho, \tag{B2}$$

which is also constant over time when the taxes are constant.

Integrating the budget constraint (7b) and using the transversality condition (B1d) in conjunction with (B1a) and (B2) implies that in the optimum $C_t^k = \rho k_t$. Thus, the capitalists' consumption and their wealth grow at the same rate in the optimum.

Furthermore, evaluating the Hamiltonian at the optimal value for the control variables $C_t^k = \rho k_t$ and $\omega = \tilde{\omega}$, which is constant, one verifies that the Hamiltonian is concave in the state variable k_t for a given co-state variable μ_t so that Arrow's sufficiency condition for a maximum is met.

C Derivation of the Current Account

The change in net foreign assets is given by

$$\dot{N} = (1-\tilde{\omega})\dot{k} - (1-\tilde{\omega}^*)\dot{k}^*. \tag{C1}$$

From the domestic household and government budget constraints we have

$$(1-\tilde{\omega})\dot{k} = (r-\tau)\tilde{\omega}k + (r^* - \tau^*)\phi^*(1-\tilde{\omega})k - C^k + \eta K - C^W - \tilde{\omega}\dot{k} - G + \tau K.$$

Substituting into equation (16) yields

$$\dot{N} = (r-\tau)\tilde{\omega}k + (r^* - \tau^*)\phi^*(1-\tilde{\omega})k - C^k + \eta K - C^W - G + \tau K - \dot{V}$$

where $\dot{V} = \left[\tilde{\omega}\dot{k} + (1-\tilde{\omega}^*)\dot{k}^*\right]$. Substituting for $\tau K = \tau\left[\tilde{\omega}k + \phi(1-\tilde{\omega}^*)k^*\right]$ establishes

$$\dot{N} = r\tilde{\omega}k + (r^* - \tau^*)\phi^*(1-\tilde{\omega})k - C^k + \eta K - C^W - G + \tau\phi(1-\tilde{\omega}^*)k^* - \dot{V}.$$

We can transform this expression so that

$$\begin{aligned}
\dot{N} &= r\tilde{\omega}k + (r^* - \tau^*)\phi^*(1-\tilde{\omega})k - C^k + \eta K - C^W - G + \tau\phi(1-\tilde{\omega}^*)k^* - \dot{V} \\
&\quad + [\phi r(1-\tilde{\omega}^*)k^* - \phi r(1-\tilde{\omega}^*)k^*] \\
&= [r\tilde{\omega}k + \phi r(1-\tilde{\omega}^*)k^* + \eta K] - C^k - C^W - G - \dot{V} \\
&\quad + (r^* - \tau^*)\phi^*(1-\tilde{\omega}) - (r-\tau)\phi(1-\tilde{\omega}^*)k^* \\
&= (r+\eta)K - C^k - C^W - G - \dot{V} \\
&\quad + (r^* - \tau^*)\phi^*(1-\tilde{\omega}) - (r-\tau)\phi(1-\tilde{\omega}^*)k^* \\
&\quad + [(r-\tau)\phi(1-\tilde{\omega})k - (r-\tau)\phi(1-\tilde{\omega})k] .
\end{aligned}$$

As domestic GDP equals output Y, which equals $(r+\eta)K$, and denoting aggregate domestic consumption by $C = C^k + C^W$, we have

$$\begin{aligned}
\dot{N} &= Y - C - G - \dot{V} + (r-\tau)\phi\,[(1-\tilde{\omega})k - (1-\tilde{\omega}^*)k^*] \\
&\quad + [(r^* - \tau^*)\phi^* - (r-\tau)\phi]\,(1-\tilde{\omega})k \\
\dot{N} &= Y - C - G - \dot{V} + (r-\tau)\phi N + [(r^* - \tau^*)\phi^* - (r-\tau)\phi]\,(1-\tilde{\omega})k
\end{aligned}$$

which corresponds to equation (17) in the text.

D Intertemporal Current Account Solvency

Notice that $N = (1-\tilde{\omega})k - (1-\omega^*)k^*$ and $k = k_0 e^{\gamma t}, k^* = k_0^* e^{\gamma^* t}$, as well as $\gamma = (r-\tau) - \rho$ and $\gamma^* = (r^* - \tau^*) - \rho$ imply that in equilibrium

$$\lim_{t\to\infty} N e^{-[(r-\tau)\phi]t} = \lim_{t\to\infty} \left[(1-\tilde{\omega})k_0\ e^{[\gamma-(r-\tau)\phi]t} - (1-\tilde{\omega}^*)k_0^*\ e^{[\gamma^*-(r-\tau)\phi]t}\right]. \quad \text{(D1)}$$

1. If $(r-\tau) > (r^* - \tau^*)$, then $\tilde{\omega} = 1$, $\tilde{\omega}^* < 1$, $\phi < 1$ and $(r-\tau)\phi = (r^* - \tau^*)$. But then equation (D1) implies

$$\lim_{t\to\infty} \left[0 - k_0^*\ e^{[\gamma^*-(r-\tau)\phi]t}\right] = \lim_{t\to\infty} \left[0 - k_0^*\ e^{[-\rho]t}\right] = 0.$$

2. If $(r-\tau) < (r^* - \tau^*)$, then $\tilde{\omega} < 1$, $\tilde{\omega}^* = 1$, $\phi = 1$. But then

$$\lim_{t\to\infty} \left[(1-\tilde{\omega})k_0\ e^{[\gamma-(r-\tau)]t} - 0\right] = \lim_{t\to\infty} \left[(1-\tilde{\omega})k_0\ e^{[-\rho]t} - 0\right] = 0.$$

Thus, intertemporal solvency for financing current account surpluses or deficits for the domestic economy holds. The same is true for the foreign economy. If we had looked at that economy's current account first, the solvency condition would have been

$$\lim_{t\to\infty} -N e^{-[(r^*-\tau^*)\phi^*]t} = 0$$

which is only equivalent to (18), if $(r^* - \tau^*)\phi^* = (r-\tau)\phi$. But this condition holds by the following arguments:

1. If $(r^* - \tau^*) > (r - \tau)$, then $\tilde{\omega}^* = 1, \tilde{\omega} < 1$, and $\phi = 1$ and $\phi^*(\tilde{\omega}) = \frac{r-\tau}{r^*-\tau^*}$. Thus

$$(r^* - \tau^*)\phi^* = (r - \tau)\phi \quad \Leftrightarrow \quad (r^* - \tau^*) \cdot 1 = (r - \tau)\left(\frac{r - \tau}{r^* - \tau^*}\right)$$

   which is true.

2. If $(r^* - \tau^*) < (r - \tau)$, then $\tilde{\omega}^* < 1, \tilde{\omega} = 1$, and $\phi^* = 1$ and $\phi(\tilde{\omega}^*) = \frac{r^*-\tau^*}{r-\tau}$. Thus

$$(r^* - \tau^*)\phi^* = (r - \tau)\phi \quad \Leftrightarrow \quad (r^* - \tau^*)\left(\frac{r^* - \tau^*}{r - \tau}\right) = (r - \tau) \cdot 1$$

   which is true.

Hence, the intertemporal solvency condition is met for the economies.

E Optimal closed economy policies

The government's problem is: $\max_{\tau} \ (1 - \beta)\, V^r + \beta\, V^l$, where β is the social weight attached to the workers' intertemporal welfare. The FOC is given by

$$\frac{\eta_\tau}{\eta} = -\frac{r_\tau - 1}{\beta\rho} \quad \Leftrightarrow \quad \frac{(1-\alpha)E}{\tau E} = -\frac{\alpha E - 1}{\beta\rho} \quad \Leftrightarrow \quad (1-\alpha)\beta\rho = \tau - \alpha\tau E$$

where $\eta = \frac{1-\alpha}{\alpha}\, r$ and $r_\tau = \alpha E(1 - \lambda)$ with $E \equiv (1-\alpha)A[\tau]^{-\alpha}$. Thus, the optimal tax rate solves

$$(1-\alpha)\beta\rho = \tau\left[1 - \alpha(1-\alpha)A\tau^{-\alpha}\right]. \tag{E1}$$

Lemma $\gamma(\tau)$ is inversely related to β.

Proof: As $\gamma(\tau) = \alpha A\tau^{1-\alpha} - \tau - \rho$, $\gamma_\tau < 0$ for any $\tau > \hat{\tau}$ as determined by (E1). Suppose $\beta > 0$. Then $\check{\tau}$ solves (E1) and by the implicit function theorem $\frac{d\check{\tau}}{d\beta} > 0$. Thus, $\frac{d\gamma}{d\beta} = \gamma_\tau \frac{d\check{\tau}}{d\beta} < 0$ which proves the lemma.

From the Lemma and equation (E1) the optimal right-wing ($\beta = 0$) policy implies $\tau = \hat{\tau}$, that is, it maximizes growth.

F The left-wing government's problem

The left-wing government maximizes $\int_0^\infty \ln C_t^W e^{-\rho t} dt$ with respect to its tax rate. Recall that

$$C_t^W = \eta K_t = \eta\left[\tilde{\omega} k_0 e^{\gamma t} + \phi(\tilde{\omega}^*)(1 - \tilde{\omega}^*)k_0^* e^{\gamma^* t}\right].$$

For constant policies in the optimum employ the *Leibniz Rule* and differentiate through the integral to obtain

$$\int_0^\infty \left(\frac{\partial C_t^W}{\partial \tau} \frac{1}{C_t^W} \right) e^{-\rho t} dt = 0 \qquad \text{where} \tag{F1}$$

$$\frac{\partial C_t^W}{\partial \tau} \frac{1}{C_t^W} = \frac{\eta_\tau K_t + \eta \frac{\partial K_t}{\partial \tau}}{\eta K_t} = \frac{\eta_\tau}{\eta} + \frac{\partial K_t}{\partial \tau} \frac{1}{K_t}. \tag{F2}$$

The term $\frac{\eta_\tau}{\eta}$ is constant over time. For the change in K_t one gets

$$\begin{aligned} \frac{\partial K_t}{\partial \tau} &= \tilde{\omega}_\tau k_0 e^{\gamma t} + \gamma_\tau \tilde{\omega} k_0 e^{\gamma t} \cdot t \\ &\quad + \phi_\tau (1 - \tilde{\omega}^*) k_0^* e^{\gamma^* t} - \tilde{\omega}_\tau^* \phi k_0^* e^{\gamma^* t} + \gamma_\tau^* \phi (1 - \tilde{\omega}^*) k_0^* e^{\gamma^* t} \cdot t. \end{aligned} \tag{F3}$$

Then we have in a symmetric equilibrium that $\tau = \tau^*$ with $k_0 = k_0^*$. Thus, $\tilde{\omega} = \tilde{\omega}^* = 1$, $\phi = \phi^* = 1$, $(r - \tau) = (r^* - \tau^*)$ and $\gamma = \gamma^*$. Then equation (F3) reduces to

$$\frac{\partial K_t}{\partial \tau} = \tilde{\omega}_\tau k_0 e^{\gamma t} + \gamma_\tau \tilde{\omega} k_0 e^{\gamma t} \cdot t + 0 - \tilde{\omega}_\tau^* \cdot 1 \cdot k_0^* e^{\gamma^* t} + 0. \tag{F4}$$

Furthermore, $K_t = k_0 e^{\gamma t}$ in a symmetric equilibrium. But then

$$\frac{\partial K_t / \partial \tau}{K_t} = \frac{\tilde{\omega}_\tau k_0 e^{\gamma t} + \gamma_\tau \tilde{\omega} k_0 e^{\gamma t} \cdot t - \tilde{\omega}_\tau^* \cdot 1 \cdot k_0^* e^{\gamma^* t}}{k_0 e^{\gamma t}} = \tilde{\omega}_\tau - \tilde{\omega}_\tau^* + \gamma_\tau \cdot t \tag{F5}$$

when $k_0 = k_0^*$. Thus, the FOC in a symmetric equilibrium boils down to

$$\left[\frac{\eta_\tau}{\eta} + \tilde{\omega}_\tau - \tilde{\omega}_\tau^* \right] \frac{1}{\rho} + \gamma_\tau \int_0^\infty t \cdot e^{-\rho t} dt = 0. \tag{F6}$$

Integrating and simplification yield

$$\frac{\eta_\tau}{\eta} + \tilde{\omega}_\tau - \tilde{\omega}_\tau^* + \frac{\gamma_\tau}{\rho} = 0 \tag{F7}$$

which is equivalent to the expression in (24).

G The optimal left-wing tax rates decrease in z

The FOCs for the left-wing governments in equation (23) and (25) can be summarized by

$$\frac{\eta_\tau}{\eta} + \frac{r_\tau - 1}{\rho} + \frac{zx(r - \tau - 1)}{r - \tau} = \Delta = 0,$$

where $x = 1$ in (23), and $x = 2$ in (25). To find the response of the optimal tax rate satisfying the FOC we use the implicit function theorem to get $Ad\tau + Bdz = 0$, where

$A \equiv \frac{\partial \Delta}{\partial \tau}$ and $B \equiv \frac{\partial \Delta}{\partial z}$, which are given by

$$A = \left(\frac{\eta_{\tau\tau} \cdot \eta - \eta_\tau \eta_\tau}{\eta^2} + \frac{r_{\tau\tau}}{\rho} + \frac{\frac{zx \cdot r_{\tau\tau}}{r-\tau} - zx(r_\tau - 1)^2}{(r-\tau)^2} \right) \quad \text{and} \quad B = x \left(\frac{r_\tau - 1}{r - \tau} \right).$$

For finite z one easily verifies that $r_{\tau\tau} < 0, \eta > 0, \eta_\tau > 0, \eta_{\tau\tau} < 0$ and $(r_\tau - 1) < 0$ for the optimal tax rates $\check{\tau}_1$ and $\check{\tau}_2$. Hence, $A < 0$ and $B <$ and so

$$\frac{d\check{\tau}_i}{dz} = -\frac{B}{A} < 0 \quad \text{for} \quad i = 1, 2.$$

Thus, the optimal tax rates for the left-wing governments decrease in z under left-right and left-left competition among similar economies.

References

Aghion, P., E. Caroli, and C. Garcia-Peñalosa (1999): "Inequality and Economic Growth: The Perspective of the New Growth Theories," *Journal of Economic Literature*, 37, 1615–1660.

Alesina, A., and D. Rodrik (1994): "Distributive Politics and Economic Growth," *Quarterly Journal of Economics*, 109, 465–490.

Amiel, Y., and F. A. Cowell (1999): *Thinking about Inequality.* Cambridge University Press, Cambridge, UK.

Barro, R. J. (1990): "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, S103–S125.

Barro, R. J., N. G. Mankiw, and X. Sala-i-Martin (1995): "Capital Mobility in Neoclassical Models of Growth," *American Economic Review*, 85, 103–115.

Bénabou, R. (1996): "Inequality and Growth," in *NBER Macroeconomics Annual 1996*, ed. by B. S. Bernanke, and J. J. Rotemberg, pp. 11–73. MIT Press, Cambridge and London.

Bertola, G. (1993): "Factor Shares and Savings in Endogenous Growth," *American Economic Review*, 83, 1184–1198.

——— (1999): "Macroeconomics of Distribution and Growth," in *Handbook of Income Distribution*, ed. by A. B. Atkinson, and F. Bourguignon. Elsevier Science, North-Holland.

Bond, E. W., and L. Samuelson (1989): "Strategic Behaviour and the Rules for International Taxation of Capital," *Economic Journal*, 99, 1099–1111.

Bovenberg, A. L. (1994): "Capital Taxation in the World Economy," in *The Handbook of International Macroeconomics*, ed. by F. van der Ploeg, pp. 116–150. Blackwell Publishers, Cambridge, MA.

Canzonieri, M. B. (1989): "Adverse Incentives in the Taxation of Foreigners," *Journal of International Economics*, 27, 283–297.

Castles, F., and P. Mair (1984): "Left-Right Political Scales: Some Expert Judgments," *European Journal of Political Research*, 12, 73–88.

Chamley, C. (1992): "The Last Shall be First: Efficient Constraints on Foreign Borrowing in a Model of Endogenous Growth," *Journal of Economic Theory*, 58, 335–354.

Cowell, F. A. (1986): *Microeconomic Principles*. Philip Allan, Hemel Hampstead, U.K.

Dasgupta, P., and E. Maskin (1986): "The Existence of Equilibrium in Discontinuous Economic Games, I: Theory," *Review of Economic Studies*, LIII, 1–26.

Devereux, M. B., and A. Mansoorian (1992): "International Fiscal Policy Coordination and Economic Growth," *International Economic Review*, 33, 249–268.

Devereux, M. B., and S. Shi (1991): "Capital Accumulation and the Current Account in a Two-Country Model," *Journal of International Economics*, 30, 1–25.

Easterly, W., and S. Rebelo (1993): "Fiscal policy and economic growth. An empirical investigation," *Journal of Monetary Economics*, 32, 417–458.

Galor, O., and J. Zeira (1993): "Income Distribution and Macroeconomics," *Review of Economic Studies*, 60, 35–52.

Garrett, G. (1998): *Partisan Politics in the Global Economy*. Cambridge University Press, Cambridge, U.K.

Giovannini, A. (1990): "Reforming Capital Income Taxation in the Open Economy: Theoretical Issues," in *Reforming Capital Income Taxation*, ed. by H. Siebert, pp. 3–18. J. C. B. Mohr, Tübingen.

Gordon, R. H. (1983): "An Optimal Taxation Approach to Fiscal Federalism," *Quarterly Journal of Economics*, 98, 567–586.

Gordon, R. H., and J. R. Hines (2002): "International Taxation," in *Handbook of Public Economics*, ed. by A. J. Auerbach, and M. Feldstein, vol. 4, pp. 1935–1995. Elsevier, North-Holland.

Gosh, A. R. (1991): "Strategic Aspects of Public Finance in a World with High Capital Mobility," *Journal of International Economics*, 30, 229–247.

Hicks, J. R. (1936): "Distribution and Ecnomic Progress: A Revised Version," *Review of Economic Studies*, 4, 1–12.

Judd, K. L. (1999): "Optimal Taxation and Spending in General Competitive Growth Models," *Journal of Public Economics*, 71, 1–26.

Kaldor, N. (1956): "Alternative Theories of Income Distribution," *Review of Economic Studies*, 48(5), 83–100.

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

Kehoe, P. J. (1989): "Policy Coordination Among Benevolent Governments May Be Undesirable," *Review of Economic Studies*, 56, 289–296.

Lancaster, K. (1973): "The Dynamic Inefficiency of Capitalism," *Journal of Political Economy*, 81, 1092–1109.

Lee, W., and J. E. Roemer (1998): "Income Distribution, Redistributive Politics, and Economic Growth," *Journal of Economic Growth*, 3, 217–240.

Lejour, A. M., and H. A. A. Verbon (1997): "Tax Competition and Redistribution in a Two-Country Endogenous-Growth Model," *International Tax and Public Finance*, 4, 485–497.

Lucas, R. E. (1990): "Why Doesn't Capital Flow from Rich to Poor Countries," *American Economic Review*, 80, 92–96.

Mendoza, E. G., and L. T. Tesar (2003a): "A Quantitative Analysis of Tax Competition v. Tax Coordination Under Perfect Capital Mobility," Working Paper 9746, NBER.

——— (2003b): "Winners and Losers of Tax Competition in the European Union," Working Paper 10051, NBER.

Milanovic, B. (2000): "The Median Voter Hypothesis, Income Inequality and Income Redistribution: An Empirical Test with the Required Data," Working Paper 256, Luxembourg Income Study, Syracuse, New York.

OECD (2002): "Revenue Statistics 1965-2001," online data, OECD, Paris, available at http://www.oecdwash.org/DATA/online.htm.

Perotti, R. (1993): "Political Equilibrium, Income Distribution, and Growth," *Review of Economic Studies*, 60, 755–776.

——— (1994): "Income distribution and investment," *European Economic Review*, 38, 827–835.

Persson, T., and G. Tabellini (1992): "The Politics of 1992: Fiscal Policy and European Integration," *Review of Economic Studies*, 59, 689–701.

——— (1994): "Is Inequality Harmful for Growth?," *American Economic Review*, 84, 600–621.

Rasmusen, E. (1989): *Games and Information. An Introduction to Game Theory.* Basil Blackwell, Oxford, reprint with corrections edn.

Rehme, G. (1995): "Redistribution, Wealth Tax Competition and Capital Flight in Growing Economies," Working Paper ECO 95/9, European University Institute, Florence, Italy.

——— (1997): "Economic Growth, (Re)-Distributive Policies, Capital Mobility and Tax Competition in Open Economies," Working Paper ECO 97/24, European University Institute, Florence, Italy.

——— (1999): "Why are the Data at Odds with Theory? Growth and (Re-)Distributive Policies in Integrated Economies," Working Paper ECO 99/43, European University Institute, Florence, Italy.

——— (2000): "Economic Growth and (Re-)Distributive Policies: A Comparative Dynamic Analysis," Working Paper ECO 00/13, European University Institute, Florence, Italy.

——— (2006): "Redistribution and Economic Growth in Integrated Economies," *Journal of Macroeconomics*, 28, 392–408.

Saint-Paul, G., and T. Verdier (1996): "Inequality, Redistribution and Growth: A Challenge to the Conventional Political Economy Approach," *European Economic Review*, 40, 719–728.

Sala-i-Martin, X. (1996): "A Positive Theory of Social Security," *Journal of Economic Growth*, 1, 277–304.

Sinn, H. W. (1990): "Tax Harmonization and Tax Competition in Europe," *European Economic Review*, 34, 489–504.

Strulik, H. (2002): "Fiscal Policy Reforms in a Global Economy," *International Tax and Public Finance*, 9, 73–91.

Turnovsky, S. J. (1997): *International Macroeconomic Dynamics.* MIT Press, Cambridge, Mass.

Ventura, J. (1997): "Growth and Interdependence," *Quarterly Journal of Economics*, 112, 57–84.

WDI (2002): *World Development Indicators 2002,*The World Bank, Washington, DC.

Wildasin, D. E. (1988): "Nash Equilibria in Models of Fiscal Competition," *Journal of Public Economics*, 35, 229–240.

Wilson, J. D. (1986): "A Theory of Interregional Tax Competition," *Journal of Urban Economics*, 19, 296–315.

Wong, K. (1995): *International Trade in Goods and Factor Mobility.* MIT Press, Cambridge, Mass.