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Redistribution and Economic Growth in Integrated Economies

Günther Rehme

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Economic Theory

Redistribution and Economic Growth in Integrated Economies*†

Günther Rehme

Technische Universität Darmstadt‡

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Abstract

Many theoretical models show that redistribution causes low growth or capital outflows even though empirically redistribution and growth are often found to be positively associated across countries. This paper argues that tax competition and the danger of capital outflows leads optimizing governments to pursue high growth, no redistribution policies in technologically similar economies. However, the government of a technologically superior economy may attract foreign and domestically owned capital and may have relatively higher GDP growth and more resources for redistribution than in a closed economy. Thus, redistributing governments may have a relatively stronger interest in technological advance or high economic integration. The results imply that one may well observe a positive association between redistribution and growth across countries.

KEYWORDS: Growth; Redistribution; Tax Competition; Capital Mobility

JEL Classification: O4, H21, D33, C72, C21, F21

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‡*Correspondence*: TU Darmstadt, FB 1/VWL 1, Schloss, D-64283 Darmstadt, Germany. *phone:* +49-6151-162219; *fax:* +49-6151-165553; *E-mail*: rehme@hrzpub.tu-darmstadt.de

1 Introduction

In the theoretical literature it is frequently argued that redistributive taxation causes low growth or capital outflows even though the same authors usually establish that inequality is bad for growth. See, for example, Perotti (1993), Bertola (1993), Alesina and Rodrik (1994), Persson and Tabellini (1994) and others. Surprisingly, empirical studies such as e.g. Easterly and Rebelo (1993), Perotti (1994) or Sala-i-Martin (1996) often find that redistributive transfers are significantly positively related to long-run growth across countries. This paper analyzes that puzzle in an non-cooperative, open economy framework.[1]

Suppose the government faced the redistribution-capital-outflow-low-growth problem and that stopping capital outflows was good for growth. Then in a world, in which capital was - perhaps only weakly - mobile, it might deal with the problem in two reasonable ways. First, the government could act sequentially. It might prefer not to tolerate capital outflows at all. After having secured the maximum possible size of the capital stock, it might then, and only if feasible, redistribute. Second, it could solve the problem simultaneously. It might strictly prefer to redistribute at the expense of losing some capital. Below the sequential approach is referred to as SQ and the simultaneous approach as SM.[2]

Clearly, the welfare implications of SM or SQ would in general be very different. However, this paper concentrates on the case where both would lead to the

[1]Thus, the paper complements research which argues that redistribution may be good for growth in closed economies. See e.g. Saint-Paul and Verdier (1996), Lee and Roemer (1998), Aghion, Caroli and García-Peñalosa (1999) or Jovanovic (2000). For surveys of the redistribution-growth literature see, for example, Bénabou (1996), Bertola (1999) or Temple (1999).

[2]For instance, Rehme (1997) shows that when economies are technologically similar and linked by imperfect capital mobility, a government pursuing SM knows it cannot offer a better return to capital than the growth maximizing one. It then decides to let capital flow out and redistribute the capital that remains in the country. Capital outflows might be prevented, however, if the government pursued a SQ policy as argued in this paper.

same policy which is given in a situation when capital mobility is perfect.

In the model and as is common, the accumulated factor of production is identified with capital and the non-accumulated factor of production with labour. The paper builds on Alesina and Rodrik (1994) by analyzing optimizing governments that tax the capital owners' wealth. The tax scheme is meant to represent a broad class of tax arrangements and is to be interpreted as a metaphor capturing the essence for many kinds of redistributive policies.[3] In order to focus on distributional conflicts the agents are assumed to be represented by governments that are either entirely pro-capital ('right-wing'), or completely pro-labour ('left-wing'). The logic of the model would be the same if governments attached different social weights to the workers' and capital owners' welfare.

For given policies the open economy market equilibrium is characterized by balanced growth and the return on capital is always equal across countries. However, their levels of GDP may be very different. In this setting governments are taken to engage in tax competition which has been studied in numerous papers.[4]

Within countries changes in government usually do not appear to produce drastic changes in redistribution policy. However, essential policy differences *between* countries seem to have important consequences for their economic performance. See e.g. Razin and Yuen (1996). These differences are captured as follows: A right-wing government wants to maximize the domestic capital owners' worldwide income and does not care about the domestically installed capital stock. In contrast, a left-wing government wants a high level and growth of GDP, because

[3]Clearly, tax schemes differ widely across countries and usually depend on many things such as history, politics, or institutions. Therefore, an answer to the question which particular tax scheme a society chooses has to remain outside of this paper's analysis. For similar arguments and examples of what other redistributive mechanisms the wealth tax scheme metaphorically captures see Alesina and Rodrik's paper.

[4]See, 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).

wages depend positively on the domestically productive capital stock. Therefore, it does everything to prevent capital flight and wishes to attract ('grab') as much domestically or foreign owned capital as possible.

For technologically similar economies, whose governments compete in taxes, it is shown that in equilibrium there is no room for redistribution. Thus, even two left-wing governments do not redistribute in the optimum. The intuition for the result is the following: For redistribution a government has to set high taxes, which imply a low return to capital, inducing capital flight. The resulting decrease in welfare is so high that a left-wing government is better off if it does not redistribute. Compensation is given by stopping any capital relocation and securing high wages.

If two right-wing governments compete, there is an infinite number of Nash equilibria in which the capital owners never pay more or less than the tax rate which maximizes their worldwide income. As a consequence there is almost surely capital flight for one country, in which the workers would 'starve'. In contrast the capital owners would not suffer, because they can derive income abroad.

Under left-right competition the equilibrium is unique, because the left-wing government wants to 'grab' capital and pursue a high tax, high wage policy. But high taxes drive out capital. Thus, the left-wing government tries to undercut its opponent in order to attract capital. In equilibrium both choose the growth maximizing tax rate. The equilibrium capital allocation is indeterminate, but the occurrence of capital flight is of measure zero. Interestingly, one economy's workers may then be better off under a right-wing than under a left-wing policy.

If two left-wing governments compete, both choose the growth maximizing policy as well. The effects of redistributive concerns are competed away for fear of capital flight. Hence, for similar countries, distributive preferences alone do

not lead to non-maximal growth.

If the countries differ in technology, the efficient economy's government can always guarantee a higher after-tax return on capital and find more productive capital located in its economy than an inefficient economy's one. A government in a technologically superior economy is then able to redistribute *and* have higher GDP growth than its opponent. The amount of redistribution is limited by the tax choices of its opponent and its efficiency advantage. But because of capital relocation from abroad more resources can be redistributed and the level and growth of GDP are higher when capital mobility is very high. For these reasons it would be in the *interest* of an efficient economy's redistributing government to operate in a world with very high capital mobility. Furthermore, it is argued that in the long-run a government that wishes to redistribute would generally have a relatively *stronger* interest in innovation (superior technology) than a non-redistributing government as that enlarges redistributive freedom.

Thus, distributing resources towards labour is bad for notional growth in the model. However, in terms of *observable* comparisons, either an optimizing, redistributing government chooses the growth maximizing tax rate in similar countries against any opponent or it has a more efficient economy, distributes resources towards labour *and* has a higher observed GDP growth than its opponent, no matter whether the latter wants to redistribute or not. But then redistribution should correlate positively with growth when comparing countries.

The paper is organized as follows: Section 2 presents the model set-up, and presents the optimal, closed economy policies. Section 3 analyzes tax competition among governments. Section 4 concludes.

2 The Model

Consider a two-country world with a domestic and a foreign country. Denote variables in the foreign country by a $(*)$. It is commonly assumed that labour is less mobile than capital.[5] To capture that it is assumed that there are many identical, immobile individuals in each country, who are all equally patient. The capital owners do not work, but they invest; the workers never save and just consume their entire income.[6] Both groups derive logarithmic utility, defined on $\overline{\mathbb{R}} \equiv \mathbb{R} \cup \{-\infty\}$, from the consumption of a homogeneous, malleable good that is produced in the two countries. Foreign and domestic output are perfect substitutes in consumption. Following Barro (1990) aggregate production is carried out according to

$$Y_t = A\, K_t^{\alpha}\, G_t^{1-\alpha}\, L_t^{1-\alpha} \quad \text{where} \quad K_t = \omega_t k_t + (1-\omega_t^*) k_t^*, \tag{1}$$

$\alpha \in (0,1)$ and Y_t is output produced in the home country. K_t is an index of the domestically productive capital stock, and k_t (k_t^*) is the (broad) capital stock, including disembodied technological knowledge, owned by domestic (foreign) capitalists and G_t are public inputs to production. Furthermore, $L_t = 1$, so that labour is supplied inelastically. Technology differences between the countries are due to A, which is an efficiency index, reflecting cultural, institutional and technological development. If both countries are equally efficient ($A = A^*$),

[5] An interesting alternative to this assumption is provided by Lee (1999) who studies tax competition with distributional conflicts showing that it is optimal for labour to follow capital.

[6] This uses a shortcut of a result due to Bertola (1993) who has shown in an endogenous growth framework that agents whose initial income derives from labour (capital) only will not find it optimal to save (to work) on a steady state, balanced growth path. Thus, the model set-up is reminiscent of Kaldor (1956), where different proportions of profits and wages are saved. However, in Kaldorian models growth determines factor share incomes, whereas in endogenous growth models the direction is rather from factor shares to growth.

the economies are called *similar*, because they may well be different in certain elements of the index such as institutional or cultural development. If $A \neq A^*$ the economies are called *different*.

The fraction of real capital at date t owned by domestic capitalists allocated to the home country is denoted by $\omega_t \in [0, 1]$. The rest is located abroad. Thus, the capital stocks are taken to be perfectly mobile across countries. In the context of long-run growth, this is taken to reflect that relocation costs of capital, including technological knowledge, are negligible in the *long-run* compared to the income stream that may be derived from operating the capital stock somewhere else. Furthermore, the model allows for the case that all of the domestically owned capital is located abroad which is supposed to bring out sharply any long-run effects capital flight may have. Throughout the analysis I abstract from problems arising from depreciation of the capital stock.

The Public Sector. In both countries wealth is taxed at constant rates, and the governments adopt the *source principle* for wealth taxation.[7] This may be justified by the observation that in a non-cooperative environment with very high capital mobility, and absent any problems arising from transfer pricing, governments may not be able to monitor their residents' wealth perfectly. For similar points see e.g. Razin and Sadka (1991). Furthermore, constancy of the tax rates is assumed in order to concentrate on long-term, time-consistent policies.

The domestic tax rate τ is levied on domestically owned wealth $\omega_t k_t$ and foreign owned wealth $(1 - \omega_t^*)k_t^*$ operating in the domestic economy. Analogous

[7]The *source principle* requires that all types of income originating in a country be taxed uniformly, regardless of the place of residence of the income recipients. Here the governments adopt the source principle for the taxation of internationally mobile *wealth*. Differential taxation of foreigners' and residents' wealth at source in a similar set-up has been analyzed in Rehme (1995). The results there suggest that tax discrimination may lead to non-steady state equilibria or similar results as in this paper.

definitions hold for the foreign country and its government. Both governments run balanced budgets, $\tau K_t = G_t$. Thus, domestic tax revenues are used for public expenditures spent on public inputs channelled into domestic production.

The Private Sector. The *firms* are owned by domestic and foreign capital owners, who rent capital to and demand shares of the firms. They take public inputs to production parametrically. Perfect competition and profit maximization entail that the domestic firms pay each factor of production its marginal product

$$r = \frac{\partial Y_t}{\partial K_t} = \alpha A \tau^{1-\alpha}, \quad \text{and} \quad w_t = \frac{\partial Y_t}{\partial L_t} \equiv \eta(\tau) K_t = (1-\alpha) A \tau^{1-\alpha} K_t \tag{2}$$

where $L_t = 1$ for all t. As k and k^* are perfect substitutes in production, the return on foreign and domestically owned capital is equal and constant in each country. Furthermore, the wages grow with the aggregate capital stock. For fixed K_t the *pre-tax* return on capital and the wage rate are increasing in taxes.

The *workers* derive utility from consuming their entire income, they do not invest and are not taxed by assumption. Their intertemporal utility is given by

$$\int_0^\infty \ln C_t^W \, e^{-\rho t} dt \quad \text{where} \quad C_t^W = \eta(\tau) K_t. \tag{3}$$

The *capitalists* choose how much to consume or invest, they have perfect foresight, and take prices and policy as given. As they may invest in either country they determine where to allocate their capital stock. Physical capital is taken to be entirely collateralized by tradeable stocks at each point in time. The

capitalists' maximization problem is

$$\max_{C_t^k, \omega_t} \int_0^\infty \ln C_t^k \, e^{-\rho t} dt \tag{4a}$$

$$s.t. \quad \dot{k}_t = (r - \tau)\omega_t k_t + (r^* - \tau^*)(1 - \omega_t)k_t - C_t^k \,, \tag{4b}$$

$$0 \leq \omega_t \leq 1 \,, \tag{4c}$$

$$k(0) = \overline{k_0}, \quad k(\infty) = \text{free}. \tag{4d}$$

where equation (4b) is the dynamic budget constraint of the capitalists who earn $r\omega_t k_t$ income at home and $r^*(1 - \omega_t)k_t$ income abroad. By assumption perfect capital mobility prevails so that it is costless to send and install capital abroad.

The solution to this problem is standard and and involves the capital allocation decision,

$$\omega_t = \begin{cases} 1 & : \quad (r - \tau) > (r^* - \tau^*) \\ \in [0, 1] & : \quad (r - \tau) = (r^* - \tau^*) \\ 0 & : \quad (r - \tau) < (r^* - \tau^*) \end{cases} \tag{5}$$

by which the capitalists immediately shift their assets to the country where the after-tax return on capital is higher. Thus, relative to the planning horizon the speed of capital relocation is short. This is due to the assumption that relocation costs are negligible relative to the planning horizon in which a new, higher income stream may be derived forever. Note that even if the after-tax returns are equal, $\omega = 1$ or $\omega = 0$ are possible.[8] Furthermore, for given tax rates and ω the transversality condition and the budget constraint imply that consumption and

[8]Some authors such as Lancaster (1973) and contributions based on his paper analyze investment bang-bang problems and simply define indeterminacies away. However, indeterminacies may contain qualitatively valuable information as is argued in this paper.

wealth optimally grow at the same rate

$$\gamma = \frac{\dot{C}_t^k}{C_t^k} = \frac{\dot{k}_t}{k_t} = M - \rho, \quad \text{where} \quad M \equiv max\,(r - \tau, r^* - \tau^*) \tag{6}$$

which depends on the after-tax returns in the two countries. It is possible in the model that growth is completely determined by the foreign after-tax return when $\omega = 0$ and all the domestic capital would 'bang' into the foreign country.

Market Equilibrium. In the closed economy $\omega = 1, K_t = k_t$ for given tax rates. From the budget constraints the steady state market equilibrium for given policy is characterized by balanced growth of all aggregates at the rate γ. Furthermore, the long-run growth rate is first increasing and then decreasing, thus, concave in τ, and maximized when $\tau = \hat{\tau} \equiv [\alpha(1-\alpha)A]^{\frac{1}{\alpha}}$.

Following Alesina and Rodrik redistribution is defined in this model as taxation that creates disincentives to accumulate, and it is measured as follows:

Definition 1 *Redistribution is measured by $\lambda = \frac{\tau}{\hat{\tau}}$, that is, by the fraction of taxes (in terms of tax base) levied under policy τ to the taxes (in terms of tax base) under policy $\hat{\tau}$ where the latter guarantees the highest after-tax income for the owners of the accumulated factor of production.*

Thus, for any $\tau > \hat{\tau}$ resources are redistributed from the accumulated to the non-accumulated factor of production leading to lower growth.[9]

For the derivation of the *two-country market equilibrium* and given arbitrary

[9]Taking growth maximizing policies as a benchmark may have its virtues when taking into account that 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). 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. It is not difficult to verify that the paper's qualitative results for open economies would not change if one introduced such a separate policy instrument. See Rehme (1999).

tax rates consider the domestic economy first. Divide (4b) by k_t, and use the fact that in steady state γ_k is constant. Rearranging and taking time derivatives yields $\gamma = \gamma_k$ and constant. Also, substituting γ for γ_k in (4b) establishes that $C_t^k = \rho k_t$ as the capitalists' instantaneous consumption in steady state. Hence, in the open economy the domestic capitalists' consumption grows at the same, constant rate as their capital stock. The total wealth of the domestic capitalists at any point in time is k_t and the budget constraint satisfies equation (4b). Analogous reasoning applies to the foreign capitalists. For given ω, ω^* one easily verifies that the world resource constraint is met.

In equilibrium $\text{GDP}_t = Y_t$ so that GDP must grow at the same rate as output. But Y_t grows at same rate as K_t since G_t grows at the same rate as K_t. Then the evolution of the domestic economy is determined by the growth rate of the aggregate, domestically productive capital stock which is given by

$$\Gamma_t \equiv \frac{\dot{K}_t}{K_t} = \frac{\gamma\omega e^{\gamma t} k_0 + \gamma^*(1-\omega^*)e^{\gamma^* t} k_0^*}{\omega e^{\gamma t} k_0 + (1-\omega^*)e^{\gamma^* t} k_0^*}. \tag{7}$$

Let $a(\tau) \equiv r - \tau$, $b(\tau^*) \equiv r^* - \tau^*$ and $M \equiv max\,(a(\tau), b(\tau^*))$ and notice that $\gamma = M - \rho = \gamma^*$. Thus, the capital income component of GNP grows at equal rates across countries. But then the aggregate capital stock in (7) grows at

$$\Gamma_t = \begin{cases} \gamma & : \quad \text{for } \forall\ \omega, \omega^* \text{ s.t. } \omega \neq 0\ \wedge \omega^* \neq 1 \\ 0 & : \quad \text{if } \omega = 0 \wedge \omega^* = 1, \end{cases} \tag{8}$$

because if there is capital flight all capital is shifted abroad. Otherwise, the aggregate capital stock grows at the same rate as the capital income component of GNP.[10]

[10]Thus, return discrepancies are immediately 'arbitraged' out, exerting a smoothing effect on growth. Any alteration in these differentials would generally induce instantaneous convergence

The allocation of capital has important consequences for the instantaneous *levels* of output, consumption and the aggregate capital stock. From (4b) and (6) the capital owners' instantaneous consumption is $C_t^k = \rho k_t$, and similarly for the workers' instantaneous consumption one gets $C_t^W = \eta K_t$ when there is no capital flight. For both groups consumption depends on the after-tax return on capital. If a country experiences capital flight, aggregate production breaks down completely in the model and the workers must 'starve'. The capital owners, however, would survive, because they may derive income abroad and may consume foreign goods.

In equilibrium the worker's and the capitalist's welfare is $\int_0^t \ln C_t^j \; e^{-\rho t} dt$ where $j = k, W$. Let $t \to \infty$ and use integration by parts. For this define $v_2 = \ln C_t^j$, and $dv_1 = e^{-\rho t} dt$. Recall that $\Gamma = \gamma$ when there is no capital flight so that $dv_2 = \frac{\dot{C_t^j}}{C_t^j} = \gamma$ and constant in steady state. Then $v_1 = -\frac{1}{\rho} \; e^{-\rho t}$ and

$$\int_0^\infty \ln C_t^j \; e^{-\rho t} \; dt \;\; = \;\; \frac{1}{\rho} \left[- \; \ln C_t^j \; e^{-\rho t} \right]_0^\infty + \frac{1}{\rho} \int_0^\infty \gamma \; e^{-\rho t} \; dt = \frac{\ln C_0^j}{\rho} - \frac{\gamma}{\rho^2}$$

where $C_0^k = \rho k_0$ and $C_0^W = (\eta + \lambda\tau) K_0$ and $K_0 = \omega k_0 + (1 - \omega^*) k_0^*$. If there is capital flight, the workers suffer infinite disutility. In general, the capitalist's as well as the worker's welfare depends positively on growth and capital.

The Government. The domestic government maximizes the intertemporal utility of its national clientele. A government that is entirely pro-capital is called 'right-wing' and a government that is completely pro-labour is referred to as 'left-wing'.[11]

to a new steady state. For instance, Razin and Yuen (1997) show that capital mobility may be a powerful force in equalizing output growth across countries.

[11] Thus, the paper relates to recent partisan political models which are an alternative to the Downsian models. See Roemer (2001) or Lee and Roemer (2001). In these models, two political parties propose differentiated policies at the equilibrium, whereas ideological parties can never exist at the equilibrium in the Downsian framework. Thus, the partisan political

The capital owners' welfare is

$$V^r = \frac{\ln(\rho k_0)}{\rho} + \frac{\gamma}{\rho^2}, \qquad \forall\ \omega, \omega^* \in [0,1]. \tag{9}$$

so that the model's *right-wing* government is only concerned about growth of the capital owners' wealth.

The welfare of the workers is given by

$$V^l = \begin{cases} \dfrac{\ln\left[\eta(\tau)K_0\right]}{\rho} + \dfrac{\gamma}{\rho^2} & : \quad \forall \omega, \omega^* \text{ s.t. } \omega \neq 0, \omega^* \neq 1 \\ -\infty & : \quad \omega = 0, \omega^* = 1, \end{cases} \tag{10}$$

which is not a proper function, since for arbitrary policies the ω's may be indeterminate. But V^l is definitely increasing in γ and so in M. As M determines ω and ω^*, any left-wing policy must try to optimize M and would, thus, also try to maximize growth. More importantly, however, the *left-wing* government wants to secure a high capital stock and so high wages. It will want to avoid any situation that leads to capital flight. In that sense and for a given growth rate the left-wing government wants to *'grab'* capital.

Closed Economy Policies. The government chooses taxes to maximize its clientele's welfare and it respects the right of private property.[12] Suppose it solves $\max_{\tau}\ (1-\beta)\,V^r + \beta\,V^l$ s.t. $\lambda \geq 0$ where β denotes the social weights attached to the workers' intertemporal welfare.

Let $E \equiv (1-\alpha)A\tau^{-\alpha}$. Then the first order condition for the maximization

models provide a justification for the assumption that ideological parties exist and compete.

[12] As expropriation is not very common in the real world, it is ruled out as a policy option, even though all agents would prefer a command optimum in the model.

problem is given by

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

Implicitly differentiating yields $\frac{d\tau}{d\beta} > 0$ and so $\frac{d\gamma}{d\beta} = \frac{\partial\gamma}{\partial\tau}\frac{d\tau}{d\beta} < 0$ when $\beta > 0$. Hence, shifting social weight to labour reduces the after-tax return on capital and so growth in the model. For simplicity I will concentrate on the polar cases of left- and right-wing policies in what follows.

The optimal *left-wing* ($\beta = 1$) policy is then given by

$$\tau[1 - \alpha(1-\alpha)A\tau^{-\alpha}] = \rho(1-\alpha). \tag{11}$$

The tax rate solving this equation is denoted by $\check{\tau}$.

The *right-wing* government is only concerned about capital income in the model. Maximizing (9) it chooses the growth maximizing tax rate $\hat{\tau}$ and does not redistribute. Under the left-wing policy $\check{\tau} > \hat{\tau}$ so that that policy does not maximize growth. Thus, governments trade off growth against redistribution when $\check{\tau} > \hat{\tau}$.

Furthermore, notice $\frac{d\check{\tau}}{dA} = \alpha(1-\alpha)\check{\tau}\left(\check{\tau}^\alpha - \alpha(1-\alpha)^2 A\right)^{-1} > 0$ and $\frac{d\hat{\tau}}{dA} = \hat{\tau}\left(\alpha A\right)^{-1} > 0$. For a change in A in a closed economy one gets $\frac{d\lambda}{dA} = \frac{\frac{d\check{\tau}}{dA}}{\hat{\tau}} - \frac{\frac{d\hat{\tau}}{dA}\check{\tau}}{\hat{\tau}^2}$. Now $\frac{d\lambda}{dA} < 0$ if $\frac{d\check{\tau}}{dA}\,\hat{\tau} < \frac{d\hat{\tau}}{dA}\,\check{\tau} \;\Leftrightarrow\; \hat{\tau} < \check{\tau}$ which is true. Hence, the optima imply that an increase in efficiency leads to *less* redistribution in the model. Although higher A implies higher $\hat{\tau}$ and $\check{\tau}$, the increase in $\hat{\tau}$ is relatively bigger than that of $\check{\tau}$. This means for a closed economy that relatively and for an increase in efficiency it is better to have higher tax rates and channel more public resources into production under the right-wing than under the redistributing policy.

3 Tax Competition

It is clear that the optimal, closed economy policies will be affected if governments have to decide in a world with capital mobility and they cannot coordinate their policies. If full tax harmonization is not feasible, governments may engage in tax competition as has, for instance, been argued by Sinn (1990) or Bovenberg (1994). Tax competition is modelled here as a two-stage game where the governments move simultaneously, but before the private sector. The strategies of the governments are the choices of taxes. The governments and the private sector agents move simultaneously. Furthermore, both economies have the same initial capital stock $k_0 = k_0^*$, and are equally efficient, $A = A^*$, unless stated otherwise. Solving backwards requires a government to maximize welfare taking its opponent's choice of τ^* as given. Thus, each government's problem is to choose taxes so that $\tau = argmax\left\{V^j; \text{given } \tau^*\right\}$, where $j = l, r$. That is now analyzed for economies which are technologically similar or significantly different.

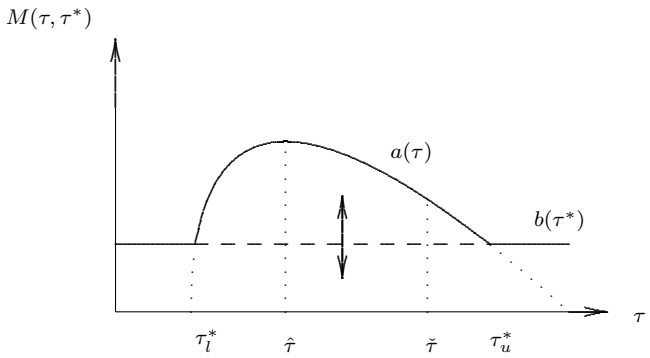
Technologically Similar Economies Consider a domestic, non-redistributing government. As V^r is increasing in γ and only the growth rate depends on taxes, the right-wing governments' problem reduces to finding

$$\tau = argmax\left\{M; \text{given } \tau^*\right\}.$$

Thus, it wants to maximize M, given τ^* and given the optimal, private sector reaction functions ω and ω^*. Recall $a(\tau) \equiv r - \tau$ and $b(\tau^*) \equiv r^* - \tau^*$, where b is independent of τ. Then $M = max(a, b)$ and a is a continuous function of τ. But for given τ^* the function b is as well, because a constant is a continuous function of a variable x. Then $M(\tau) = max\left(a(\tau), b(\tau^*)\right) = \frac{a(\tau)+b(\tau^*)}{2} + \left|\frac{a(\tau)-b(\tau^*)}{2}\right|$, which

may be differentiable under certain conditions.[13]

Figure 1: $M(\tau, \tau^*)$ for the domestic government and given τ^*



Clearly, for similar economies $\hat{\tau} = \hat{\tau^*}$. Suppose the foreign government sets $\tau^* \gtrless \hat{\tau^*}$, then $b < \hat{b}$ where $\hat{b} = \hat{r^*} - \hat{\tau^*}$. As a consequence there is some $\tau \in [\tau_l^*, \tau_u^*]$ where $a \geq b$, because at τ_l^*, τ_u^* the functions a and b intersect. From Figure 1, the domestic right-wing government will choose $\tau \in (\tau_l^*, \tau_u^*)$. But then M is differentiable and $\frac{dM}{d\tau} = r_\tau - 1 = 0$ and so $\tau = \hat{\tau}$ is an optimizing response of the domestic right-wing government.

Suppose the foreign government sets $\tau^* = \hat{\tau}$. In that case the $b(\tau^*)$-line would be tangential to the point $\hat{a}$ and M would not be differentiable anymore. Thus, if $\tau^* = \hat{\tau}$ the optimal response is indeterminate.

Lemma 1 *In similar economies the best response of a domestic right-wing government against any foreign opponent is to choose*

$$\begin{array}{llll} (1) & \tau = \hat{\tau} & \textit{if} & \tau^* < \hat{\tau} \\ (2) & \tau \in [0,1] & \textit{if} & \tau^* = \hat{\tau}. \end{array}$$

[13]Use the following property of the $max(\cdot)$ function. Let $f(x)$ and $g(x)$ be two differentiable functions in x, then $max\,(f(x), g(x)) = \frac{f(x)+g(x)}{2} + \left|\frac{f(x)-g(x)}{2}\right|$.

The indeterminacy when the opponent sets $\hat{\tau}$ reflects that the right-wing government does not care about the aggregate capital stock and ω, ω^* per se. It just wants to guarantee the highest worldwide income derived from domestically owned capital. So when the opponent chooses $\hat{\tau}^*$ in technologically similar economies, the domestic right-wing government's problem has already been solved by its foreign opponent.

A domestic left-wing government's problem is to find

$$\tau = argmax \left\{ V^l; \text{given } \tau^* \right\}.$$

Suppose $\tau^* > \hat{\tau}$. From Figure 1 it is not difficult to see that if $\tau^* > \check{\tau}$ the domestic left-wing government sets $\tau = \check{\tau}$. If $\hat{\tau} < \tau^* \leq \check{\tau}$, it is optimal to set $\tau = \tau^* - \epsilon$, where ϵ is small. As $\tau^* \to \hat{\tau}$ the domestic left-wing government will definitely set $\tau = \hat{\tau}$. Thus,

Lemma 2 *In similar economies the best response of a domestic left-wing government against any foreign opponent is to choose*

$$\begin{array}{lll} (1) & \tau = \check{\tau} & \textit{if} \;\; \tau^* > \check{\tau} \\ (2) & \tau = \tau^* - \epsilon, & \textit{if} \;\; \hat{\tau} < \tau^* \leq \check{\tau} \\ (3) & \tau = \hat{\tau}, & \textit{if} \;\; \tau^* \to \hat{\tau}. \end{array}$$

Given the best response functions the outcome of tax competition in similar economies is as follows: For *two right-wing* governments and by symmetry Lemma 1 implies that there is an infinite number of Nash equilibria. That is due to the

fact that if one player chooses $\hat{\tau}$ the other player is indifferent what to choose. Then the investors would never pay more or less than $\hat{\tau}$. In the Nash equilibrium the after-tax returns are equal so that capital flight may take place.

Proposition 1 *If two right-wing governments engage in tax competition in similar economies, there is an infinite number of Nash equilibria. The capitalists never pay more or less than $\hat{\tau}$ in either country. Capital flight is possible and there will be maximum GDP growth in at least one economy.*

The infinite number of equilibria has an important economic meaning in the model.[14] A right-wing government is not concerned about the aggregate capital stock. It just maximizes the capitalists' worldwide income. If the foreign opponent actually chooses $\hat{\tau}^*$ in equilibrium, then the domestic right-wing government's problem is solved and it may optimally choose any tax rate. That has significant consequences for the workers in either country. Among all equilibria the one with $\tau = \tau^* = \hat{\tau}$ is of measure zero and so quite improbable (although perhaps the most plausible.) Consider the class of equilibria where $\tau^* = \hat{\tau}$ and $\tau \in [0, 1]$ and $\tau \neq \hat{\tau}$. Then in equilibrium one definitely observes capital flight in the domestic economy so that $\Gamma = 0$ and the domestic workers would 'starve'. In contrast, the foreign workers would be quite well off, since all the capital would locate in their country. Hence, under right-right competition, capital flight is

[14] If one allows for equilibrium refinements à-la Selten (1975), the introduction of small probabilities that the opponent plays irrationally leads to a unique *trembling hand perfect equilibrium* in which both right-wing governments set $\hat{\tau}$. As concerns strategic behaviour trembling hand perfection seems a superior concept to require. On the other hand, the model's extremely large number of equilibria captures qualitatively interesting economic phenomena. For that reason Nash equilibrium refinements are not considered any further. Furthermore, it may be argued that the indeterminacy would also vanish when 'right-wing' governments attached some (possibly very small) weight on the workers' welfare. It is not difficult to verify that then the 'right-wing' government would optimally mimic a 'left-wing' strategy, driven by the fear to lose capital. But the latter is of no concern whatsoever for the capital owners. For that reason the paper concentrates on strictly pro-capital ('right-wing') objectives and policies.

quite likely, the workers of one country may be really badly off and the capital owners are equally well off in either economy.

If a *left-wing* and a *right-wing* government compete in taxes, the Nash equilibrium is *unique*. In a closed economy the domestic left-wing government chooses $\tau > \hat{\tau}$. Lemma 1 implies that for all $\tau \neq \hat{\tau}$ the foreign right-wing government chooses $\tau^* = \hat{\tau}$. By Lemma 2 the domestic left-wing government always tries to undercut its opponent's choice for fear of capital flight. But then the foreign right-wing government makes sure that the capitalists income is maximized by setting $\tau^* = \hat{\tau}$ whereupon the left-wing government will choose $\tau = \hat{\tau}$. As a consequence it cannot be that $\lambda > 1$.

Proposition 2 *There is a unique Nash equilibrium in the* <u>*right-left*</u> *tax competition game with similar economies. The governments set* $\tau = \hat{\tau} = \tau^*$. *There is no redistribution,* $\lambda = 1$, *in the domestic left-wing government's economy. Capital flight is almost impossible and there is maximum GDP growth in both economies.*

The objective of 'grabbing' capital prevents redistribution in equilibrium and is due to the left-wing government's fear of capital flight. Capital 'grabbing' and the right-wing objective of capital income maximization reduce the number of Nash equilibria to one. Thus, *policy heterogeneity* removes a source of indeterminacy, makes capital flight quite unlikely and leads to equal GNP and GDP growth for both economies. That is so, because in equilibrium with $\tau = \tau^* = \hat{\tau}$, the after-tax returns will be equal and any ω, ω^* combination is possible. Thus, in contrast to the closed economy, a non-cooperative environment causes the left-wing government to mimic a growth maximizing policy. Importantly, the possibility of capital flight for the domestic economy is of measure zero. Hence, the workers

are ex ante better off under left-right than under right-right tax competition. Proposition 1 implies that under right-right competition capital flight happens in one economy so that the workers in that country will 'starve'. As the capital allocation is indeterminate in an equilibrium with $\tau = \tau^* = \hat{\tau}$ (Proposition 2), the workers may be better off under *either* a right *or* a left-wing government. If the capitalists happen to shift more capital into the foreign right-wing government's economy, its workers will be better off than their domestic counterparts. That has the rather surprising implication that the workers may be better off under a right-wing government.

Corollary 1 *Under left-right tax competition in technologically similar economies ($A = A^*$), the workers may be better off under a right <u>or</u> a left-wing government.*

Economically, the results suggest that in highly integrated, technologically similar economies political preferences per se are not very important in determining growth or the well-being of a government's clientele.

By Lemma 2 *two left-wing governments* try to undercut each other. But the process of undercutting leads to $\tau = \hat{\tau} = \tau^*$ and no redistribution.

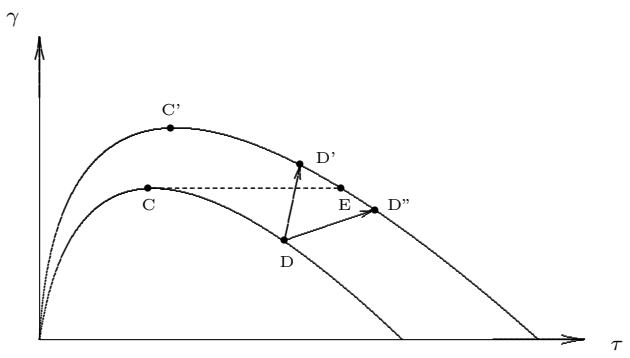
Proposition 3 *There is a <u>unique</u> Nash equilibrium in the <u>left-left</u> tax competition game in similar economies. Both governments set $\tau = \hat{\tau} = \tau^*$. There is no redistribution, $\lambda = 1 = \lambda^*$ in either country. Capital flight is almost impossible and there is maximum GDP growth in both economies.*

With perfect capital mobility redistribution is not optimal in a non-cooperative environment, even though the opponent may have the same distributive preferences. Thus, the effects of the concern for redistribution are competed away for fear of capital flight. Interestingly, that makes two left-wing governments

mimic growth maximizing policies in the model. The workers are compensated for non-redistribution by high growth of their wage income.

Technologically Different Economies If a *domestic right-wing* government with a more efficient economy chooses its nationally optimal tax policy, no opponent can do better, because $\hat{a} > \hat{b}$ at C' in Figure 2. Thus, the foreign opponent may choose anything and experiences capital flight. The efficient economy's right-wing government has higher GDP growth than any of its opponents.

Figure 2: Tax Competition Among Different Economies



If a redistributing government's closed economy becomes more efficient the government may choose D' or D". In either case redistribution (λ) will decrease as has been shown above. However, in the open economy D" cannot be optimal. A *domestic left-wing* government with a more efficient economy will undercut its opponent to prevent capital flight. It chooses τ such that $a > \hat{b}$ at a point such as D', which may be very close to but is definitely to the left of point E, because a foreign right-wing government would choose $\hat{\tau}^*$ at C, if it could, and a foreign left-wing government might choose that in the limit. Thus, redistribution ($\lambda > 1$) and relatively high GDP growth are possible when a government with a

more efficient economy chooses $\hat{a} > a > \hat{b}$.

Proposition 4 *A domestic* <u>*left-wing*</u> *government with a more efficient economy sets taxes so that it gets all the capital, has higher GDP growth than its opponent and redistributes. The capital income component of GNP grows at equal rates across countries.*

Efficiency differences induce capital flight for an inefficient economy. Theoretically, an efficient economy's right-wing policy leads to higher GDP growth than a left-wing policy, when competing with inefficient economies' governments. The efficient economy's left-wing government tries to get all the capital, but does not necessarily choose the growth maximizing tax rate. Thus, a *hypothetical* comparison of regimes when $A > A^*$ reveals that tax policies favouring the non-accumulated factor of production might be bad for growth.

However, by Proposition 4 one may *observe* higher taxes favouring the non-accumulated factor of production *and* higher GDP growth than in another, less efficient economy with a non-redistributing government. Thus, in integrated economies it is well possible that an efficient economy's government distributes towards labour and grows more than a less efficient economy under a non-redistributing policy. Notice that the efficient economy's government attracts more resources for redistribution than in the closed economy and does this at the expense of the inefficient economy's workers. In that sense the workers of an inefficient economy have to be afraid of a 'nationalistic', left-wing policy abroad.

But then a government that wishes to redistribute should be relatively more interested in having a superior technology brought about by innovations and technical progress. Indeed, this is implied by the model by the following arguments:

Under the optimal policies in the closed economy the welfare of the agents in

(9) and (10) is given by $V^i(A, \tau(A))$ where $n = l, r$. An increase in A changes welfare by $dV^i = \frac{\partial V^i}{\partial A}\, dA + \frac{\partial V^i}{\partial \tau}\, \frac{\partial \tau}{\partial A}\, dA$. By the *envelope theorem* $\frac{\partial V^r}{\partial \tau} = 0$ under the optimal right-wing policy and $\frac{\partial V^l}{\partial \tau} = 0$ under the optimal left-wing policy. Thus,

$$\frac{dV^r}{dA}_{|\hat{\tau}} = \frac{\partial \hat{\gamma}}{\partial A}_{|\hat{\tau}} \left(\frac{1}{\rho^2}\right) \quad \text{and} \quad \frac{dV^l}{dA}_{|\check{\tau}} = \frac{\partial \eta}{\partial A}_{|\check{\tau}} \left(\frac{1}{\eta\rho}\right) + \frac{\partial \check{\gamma}}{\partial A}_{|\check{\tau}} \left(\frac{1}{\rho^2}\right).$$

Evaluating the derivatives yields

$$\frac{\partial \hat{\gamma}}{\partial A}_{|\hat{\tau}} = \frac{\partial \hat{r}}{\partial A}_{|\hat{\tau}} = \alpha \hat{\tau}^{1-\alpha} < \frac{\partial \check{\gamma}}{\partial A}_{|\check{\tau}} = \frac{\partial \check{r}}{\partial A}_{|\check{\tau}} = \alpha \check{\tau}^{1-\alpha}$$

because $\check{\tau} > \hat{\tau}$. Hence, $0 < \frac{dV^r}{dA}_{|\hat{\tau}} < \frac{dV^l}{dA}_{|\check{\tau}}$.

Thus, the model implies for a closed economy that an advance in technology would benefit a pro-labour government relatively more in the long run than a pro-capital government.[15] The reason is that, once policy is controlled for, higher A has a stronger effect on the pre-tax return on capital under the left-wing policy. This is because the left-wing policy channels more public inputs into production. A better technology allows these public inputs to be used more efficiently and that raises the pre-tax return. This effect is larger under the left-wing policy. Given the optimal policy a higher pre-tax return is good for growth and that affects the welfare of the workers more than that of the capital owners.

The result relates to growth models based on the patent race literature. See, for example, Reinganum (1989), Barro and Sala–i–Martin (1995), chpt. 7 or Aghion and Howitt (1998). These models tell us that incumbents of the lead-

[15] In this context Rehme (2000) also shows for the closed economy that this holds as well for the individual worker and capital owner. Of course, the result need not apply in the short run when workers might have to learn new technologies or there is resistance to reform. For models studying these issues see e.g. Fernandez and Rodrik (1991), Helpman and Rangel (1999) or Canton, de Groot and Nahuis (1999).

ing edge technology have a strong incentive to undertake research to keep their leading edge position with high growth. Thus, (redistributing) countries that are technological leaders may have a strong incentive to expend large amounts of resources on R&D to keep their leading position vis-a-vis technological followers and in order to protect their redistributive freedom. This latter element means that redistributing countries may have a relatively greater incentive to keep or get into a technological leadership position.

For integrated economies a similar conclusion may be rationalized as follows: Take the foreign inefficient economy. A right-wing government in that economy would choose $\hat{\tau}^*$ at point C in Figure 2 in a closed economy. If the opponent in the efficient economy chooses C' or anything to the left of point E, the right-wing government's clientele, that is, the capital owners in the inefficient economy would not suffer. In contrast, even when a government that wishes to redistribute is forced to choose a point such as C with no redistribution, its clientele, that is, the workers would suffer infinite disutility in the inefficient economy.

Proposition 5 *Governments that represent the non-accumulated factor of production only and that wish to redistribute resources from the accumulated to the non-accumulated factor of production may have a relatively greater incentive in the long run to have an economy with a superior technology than governments representing the accumulated factor of production only.*

The paper hypothesizes that governments in an integrated world would only distribute resources towards the non-accumulated factor of production, if they have an efficiency advantage vis-à-vis another government's economy. Is that not the case, it is argued that a government would optimally not redistribute. But then one would observe a positive and spurious association between redistribution

and growth when across countries redistributing governments act as in this paper. Hence, the effect of redistributive taxation on growth in an integrated world may be less an issue of political preferences, but more one of efficiency differences.

To generalize these results suppose capital mobility was not perfect. Then in a market equilibrium the returns to capital would in general not be the same across countries for given policy. For similar countries the tax competition equilibria would all be unique because of the costs to capital relocations or due to a SQ policy, which strictly attempts to prevent capital outflows. Furthermore, in a technologically superior economy the policies would be qualitatively the same if the government pursued SM and perfect capital mobility prevailed or pursued SQ and capital mobility was imperfect. Thus, all the essential qualitative results would hold if, complementing Rehme (1997), there was imperfect capital mobility and the government pursued a SQ policy.

4 Conclusion

In contrast to theoretical predictions, redistribution is often found to correlate positively with long-run growth across countries in empirical studies. This discrepancy in results is analyzed by placing growth-redistribution problems in a two-country world with capital mobility and tax competition among governments.

It is shown that the possibility of capital outflows features saliently in the optimal decisions of redistributing governments. In the paper a left-wing government wants to attract as much capital as possible for securing high wages and for redistribution. It is concerned about the level and growth of domestic GDP. In contrast, a right-wing government only wants to maximize the national capitalists' worldwide return on capital.

For tax competition among similar economies and no matter what distributional preferences a government has, the fear of capital flight leads to maximum growth of the capital income component of GNP in equilibrium and no redistribution takes place. That holds even though all governments might care about redistribution. The reason is that capital is good for redistributing governments. Capital flight reduces wages and the welfare loss incurred by a drop in wages outweighs the welfare gain derived from redistribution. However, political preferences do matter as regards GDP. Under right-right tax competition one economy will surely experience capital flight and its GDP will not grow. That constellation is bad for the workers. If a left-wing government competes against any opponent, no capital flight will take place. In that sense, (re-)distributive preferences are important for a country's non-accumulated factor of production.

If the countries are technologically different, more capital will locate in the efficient economy and it will have higher growth. If the efficient country's government wishes to redistribute, it may do so without losing any capital. In fact, it may have more resources for redistribution than in a closed economy and may, thus, be interested in high economic integration. The amount of redistribution depends on who the opponent is and on the efficiency gap that distinguishes it from its opponents. From these arguments it follows that one might well observe a positive association between growth and redistribution.

Furthermore, the paper argues that policies that make a domestic economy more efficient are in the interest of both domestic workers and foreign as well as domestic capital owners. However, the pressure to do so would be relatively larger for the workers as they may suffer more from possible capital outflows than the capital owners.

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