Income distribution and tax competition

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Abstract

The literature on international tax competition has shown how increased international mobility of the tax base may create a downward pressure on tax rates and give rise to increased inequality in disposable income. This paper endogenises the mobility of the tax base, explaining mobility as a function of the pre-tax income distribution. We show that increased pre-tax income inequality may reduce the ability of governments to carry out redistributive policies. Moreover, increased inequality in one country may also negatively affect the ability of other countries to carry out such policies. The mechanisms suggested here provide one explanation of the empirical observation that countries with an egalitarian pre-tax income structure typically have a more redistributive tax system than more inegalitarian countries.

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1 Introduction

Income inequalities are rising in most OECD countries (Gottschalk and Smeeding, 1997). This fact applies to inequalities in income both before and after taxes and transfers. Evidently, governments have not been able, or perhaps willing, to fully counter the rising gap in market incomes by implementing more ambitious redistribution programs. In fact, tax rates on high incomes have been cut rather than raised in many countries during the last two decades (OECD, 2000).

Standard closed economy models of taxation and redistribution typically predict that higher pre-tax inequality should lead to more redistribution, see for instance see Sandmo (1976) on optimal tax theory and Roberts (1977) and Meltzer and Richard (1981) on median voter models. The tax competition literature, on the other hand, emphasises that when the tax base is mobile across international borders, the *ability* of governments to tax may be rather limited.[1] In these models, increased inequality in disposable incomes may be explained by increased mobility in the tax base (e.g. Zodrow and Mieszkowski, 1986, Wilson, 1986, Sinn, 1990).

The present model endogenises the mobility of the tax base, explaining mobility as a function of the pre-tax income distribution. The mechanism we suggest is strikingly simple, but, we believe, highly realistic: Increased concentration of wealth (or income) reduces the relative importance of mobility costs and thus increases the attractiveness of relocating to countries with lower tax rates.

Facing a more elastic tax base, governments may find it optimal to respond by choosing a lower tax rate. Hence, our paper suggests that increased pre-tax inequality may be accompanied by lower tax rates and therefore less redistribution. The paper may in this way shed light on the rather puzzling empirical observation that countries with more pre-tax inequality tend to be less redistributive than countries with less inequality (see Perotti, 1996).[2] Moreover, the paper describes some important international spillovers: Increased inequality in one country may reduce the potential for redistribution in another.

The paper is organized as follows. In section 2 we describe the model, and in section 3 we analyze the question of how increased pre-tax income inequality affects tax rates across countries. Section 4 contains discussion and extensions, and section 5 concludes.

[1] For empirical evidence on tax competition, see Besley, Griffith and Klemm (2001).

[2] In another paper, Bjorvatn and Cappelen (2001), we analyze the "redistribution puzzle" from a different perspective. There, our proposed explanation links inequality with residential segregation, which in turn negatively affects the feeling of solidarity of the rich towards the poor and hence their willingness to vote for redistributive taxation.

2 Model

There are three countries in the model, $J = A, B, C$, which may be inhabited by two types of people, a group of rich tax payers and a group of poor transfer recipients.[3] We can think of the tax base as capital or capital income, perhaps as income derived from human capital. Individual income, or equivalently wealth, is exogenously given and taxed by national governments according to the residency principle. This implies that the international allocation of capital is unaffected by taxes and therefore that there is no efficiency loss from taxation.

Tax payers are internationally mobile, and taxes may affect their residential choice. Since the paper addresses questions of tax motivated migration, we focus our analysis by assuming that transfer recipients are immobile. Tax payers may legally reduce their tax burden by migrating to a lower tax jurisdiction. There are, however, illegal or quasi-legal ways of reducing the tax bill that do not necessarily involve the physical relocation of the tax payer. Examples include the opening of bank accounts or the registering of one's firms in low tax countries.

We wish to analyze how the mobility of the tax base affects governments' ability to collect taxes. Hence, we shall take as given the existence of a political will to tax the rich. For simplicity, assume that each government seeks to maximize the utility of the worst off group of individuals. As long as the disposable income of transfer recipients is lower than that of the tax payers (which we shall assume holds), the governments' objective is equivalent to maximizing tax revenues.[4] The mobility of the tax base limits the governments' ability to collect taxes and introduces a fiscal spillover effect between countries.

The number of native tax payers in country J is given by s_J. Assume that s_C is small. For convenience, let $s_C = 0$. We then know that in equilibrium $t_C^* < t_A^*, t_B^*$, where t_K is the tax rate in country K and the asterisk indicates the equilibrium value. If this inequality did not hold, country C would have no tax base and would therefore receive zero tax income. Assuming that the relocation cost is independent of which country a person moves to, the migration will be from countries A and B to C, with no mobility between A and B. The structure of the model facilitates the analysis and also captures

[3] In section 4 we discuss the case of more than three countries.

[4] In section 4 we discuss how employing a more general welfare function would affect the results of our model.

a realistic feature of international tax competition. Countries with a larger population of native tax payers (in our model A and B) face competition for their tax bases from tax havens such as Luxembourg, Monaco, or Jersey (in our model C). In terms of the present model, it is no coincidence that tax havens tend to be small countries, since these countries have more to gain by lowering their tax rates.[5] Concerns that harmful tax competition, in particular from tax havens, will result in a downward pressure on tax rates, is a major policy issue in the OECD countries. The OECD has identified 35 countries as being tax heavens and has taken steps to reduce the extent of such practises (OECD, 1998).

Native tax payers of any one country are assumed to have identical, exogenously given pre-tax incomes. The after-tax income of a person remaining in his native country $K = A, B$ is

$$w_K(1 - t_K), \tag{1}$$

where w_K is the pre-tax income of a native tax payer in country K. We assume that the income of the poor is fixed and always less than the pre-tax income of the rich. For simplicity, let the income of the poor people in country A and B be identical and equal to zero. This implies that w_K defines both the absolute disposable income of a rich individual in K and the income gap between rich and poor in that country. We can thus view w_K as a measure of pre-tax inequality.

Tax payers compare their post-tax income at home with the post-tax income they could get in the low tax country, taking into account that a move to another country involves certain relocation costs. Examples of relocation costs include searching for a new location (which may involve hiring tax lawyers), moving to the new place (perhaps setting up a new headquarters), operating in a new environment (which may involve building up a new social and professional network and possibly learning a new language), and perhaps the expected disutility of being caught doing something illegal and being punished for it (or perhaps the bad conscience of doing something illegal, even if the chances of being caught are negligible). We shall allow for differences in relocation costs both between types of individuals, with "types" here defined by the level of pre-tax income, and between individuals within each type.

[5] This mechanism is analyzed in Kanbur and Keen (1993).

Since all tax payers who are natives of the same country have the same pre-tax income they are also of the same type. The after-tax income of a person i who leaves his native country K for country C is

$$w_K(1-t_C)-\mu_K^i, \tag{2}$$

where $\mu_K^i=\mu^i\left(w_K\right)$ is the relocation cost for this individual. Note that we have assumed that pre-tax income is unaffected by choice of location. Hence, relocation in this model is purely tax-motivated. Certainly, in reality locational choice is guided by a number of reasons in addition to that of reducing the tax bill, but to focus on the issue at hand we disregard such additional factors.

A person will leave for country C if the after-tax income in country K is lower than the after-tax income in country C minus relocation costs. A person i with a pre-tax income of w_K is indifferent between staying in K or moving to C when

$$w_K(1-t_K)=w_K(1-t_C)-\mu_K^i. \tag{3}$$

From (3) we can easily derive the critical relocation cost that makes a person indifferent between staying or leaving as

$$\tilde{\mu}_K=w_K(t_K-t_C). \tag{4}$$

People characterized by $\mu_K^i<\tilde{\mu}_K$ will leave K for country C. For analytical convenience, let the relocation cost be uniformly distributed within the group of rich individuals, with the support $(0,\bar{\mu}_K)$, where $\bar{\mu}_K\equiv\bar{\mu}\left(w_K\right)$ is the highest relocation cost for an individual living in K. The share of country K's native tax payers that move to country C in equilibrium can then be found as

$$\sigma_K\equiv\min(\frac{\tilde{\mu}_K}{\bar{\mu}_K},1)=\min\left(\frac{w_K(t_K-t_C)}{\bar{\mu}_K},1\right), \tag{5}$$

which also implies that the number of tax payers remaining in country K, ρ_K, equals

$$\rho_K=s_K(1-\sigma_K). \tag{6}$$

The objective functions of countries K and C can then be written as

$$T_K = t_K w_K \rho_K, \tag{7}$$

$$T_C = t_C w_A (s_A - \rho_A) + t_C w_B (s_B - \rho_B), \tag{8}$$

which, using (5) and (6), and the fact that no country will set their tax rate so high that they lose all their tax payers, i.e., that $\sigma_K < 1$, can be expressed as

$$T_K = t_K w_K s_K \left(1 - \frac{w_K \left(t_K - t_C\right)}{\bar{\mu}_K}\right), \tag{9}$$

$$T_C = t_C w_A s_A (\frac{w_A (t_A - t_C)}{\bar{\mu}_A}) + t_C w_B s_B (\frac{w_B (t_B - t_C)}{\bar{\mu}_B}). \tag{10}$$

Maximizing (9) with respect to t_K, country K's reaction function can be derived from the first order condition as

$$t_K \left(t_C\right) = \frac{\bar{\mu}_K}{2 w_K} + \frac{t_C}{2}. \tag{11}$$

We observe that country K's optimal tax rate is increasing in t_C. Similarly, country C's reaction function can be derived from (10) as

$$t_C \left(t_A, t_B\right) = \frac{1}{2} \frac{w_A^2 s_A t_A \bar{\mu}_B + w_B^2 s_B t_B \bar{\mu}_A}{w_A^2 s_A \bar{\mu}_B + w_B^2 s_B \bar{\mu}_A}. \tag{12}$$

Note that while the optimal taxes for countries A and B are not directly interlinked, a change in one of the two countries' tax rates, say t_A, triggers a response by country C, which in turn affects the optimal tax rate of country B. From (11) and (12) we can derive the Nash-equilibrium tax rates. These are reported in Appendix A.

Before addressing the questions motivating our study, let us briefly discuss the importance of the relation between pre-tax income and relocation costs. From (5) it can be shown that

$$sign\left(\frac{\partial \sigma_K}{\partial w_K}\right) = sign\left(1 - \varepsilon_K\right),$$

where

$$\varepsilon_K \equiv \frac{\partial \bar{\mu}_K}{\partial w_K}\frac{w_K}{\bar{\mu}_K}.$$

i.e., the elasticity of the upper support of the relocation cost with respect to pre-tax income. This elasticity can thus be seen as a measure of the elasticity of the tax base. If $\varepsilon_K < 1$, the richer are the tax payers in country K, the more responsive they are to international differences in tax rates. For instance, if relocation costs are independent of income levels, then $\varepsilon_K = 0$. If higher income is associated with higher general skills that make international relocation easier, then $\varepsilon_K < 0$. If $\varepsilon_K > 1$, the mobility of tax payers in K is reduced as the pre-tax income of the natives goes up. This could perhaps be the case if living in one's native country is a luxury good.

Intuitively it seems reasonable to assume that individuals with a high pre-tax income are more likely to change residency in response to tax differentials than people with lower incomes, i.e., that $\varepsilon_K < 1$. There is also some empirically evidence to support this intuition. For instance, Schwartz (1973), show that people endowed with more human capital are more mobile than those with less human capital, which in our model would suggest that $(\partial \bar{\mu}_K / \partial w_K) < 0$, implying that $\varepsilon_K < 0$. The qualitative results of our model depend crucially on whether ε_K is larger or smaller than unity. We present $\varepsilon_K < 1$ as the "benchmark" case, but also comment on how our results are affected by $\varepsilon_K > 1$.

3 Analysis

We are primarily concerned with two questions. First, how does increased pre-tax income inequality on an international scale affect tax rates across countries? We call this the symmetric case. Second, how does increased inequality in *some* countries affect tax rates across countries? The answer to this second question also allows us to address the issue of international spillovers and the redistribution puzzle discussed in the introduction. This is the asymmetric case.

3.1 The symmetric case

To answer the first question, we study the case of complete symmetry between countries A and B. Hence, $s_A = s_B = s$, $w_A = w_B = w$, which in turn implies that $\bar{\mu}_A = \bar{\mu}_B = \bar{\mu}$. From Appendix A, we can then find the equilibrium tax rates as

$$t_A^* = t_B^* = \frac{2\bar{\mu}}{3w}, \tag{13}$$

$$t_C^* = \frac{\bar{\mu}}{3w}. \tag{14}$$

From these equations, given that $\varepsilon < 1$, we can make the following observation:

Proposition 1 *An increase in the pre-tax income of tax payers reduces the equilibrium tax rates in all countries.*

Proof. See Appendix B. ■

Since w measures pre-tax income inequality, this proposition also states that increased pre-tax inequality reduces equilibrium tax rates. The intuition for the proposition is straightforward: An increase in income increases the benefit of being located in a low-tax jurisdiction. If the costs of relocation are not increasing too much with income, i.e., given that $\varepsilon < 1$, higher income means that more people will leave the high tax countries for any given difference in tax rate between high and low tax countries. In this sense, the tax base has become more elastic. This in turn intensifies tax competition, leading to lower tax rates in equilibrium. The opposite holds for $\varepsilon > 1$. Inserting (13) into (9) and (14) into (10), we find that:

$$T_K^* = \frac{4s\bar{\mu}}{9}, \qquad T_C^* = \frac{2s\bar{\mu}}{9}. \tag{15}$$

Evidently, total tax income in equilibrium falls with w if $\varepsilon < 0$, and increases with w if $\varepsilon > 0$. While an increase in per capita income increases the tax base, it also increases its elasticity with respect to tax rates. If $\varepsilon < 0$, the first effect dominates and if $\varepsilon > 0$, the second effect dominates.

3.2 The asymmetric case

How does increased concentration of wealth in one country affect international tax rates? We consider two cases. In the first, we assume that GDP per capita is the same in A and B, but that tax payers may be richer in one country than in another. In the second case we allow for differences in GDP per capita between A and B.

We start by first focussing exclusively on the distribution of income. Assume therefore that the total population in A and B and the two countries' average incomes are the same. This means that $s_A w_A = s_B w_B \equiv W$. Let B be the country experiencing an increased concentration of wealth, implying an increase in w_B and a reduction in s_B (and therefore an increase in the number of poor people). Since the number of tax payers and their pre-tax income in A by assumption are unchanged, we can make the following normalization; $s_A = \bar{\mu}_A = 1$. From Appendix A, the equilibrium tax rates can now be expressed as

$$t_A^* = \frac{5 s_B \bar{\mu}_B + 3}{6W \left(s_B \bar{\mu}_B + 1 \right)}, \tag{16}$$

$$t_B^* = \frac{5 s_B \bar{\mu}_B + 3 \left(s_B \bar{\mu}_B \right)^2}{6W \left(s_B \bar{\mu}_B + 1 \right)}, \tag{17}$$

$$t_C^* = \frac{2 s_B \bar{\mu}_B}{3W \left(s_B \bar{\mu}_B + 1 \right)}. \tag{18}$$

Given $\varepsilon_B < 1$, it is straightforward to demonstrate that

Proposition 2 *i) An increase in the concentration of pre-tax income in one country leads to lower tax rates in all countries; ii) The reduction in the tax rate is largest in the country where the increased concentration of pre-tax income takes place.*

Proof. See Appendix C. ■

Hence, if $\varepsilon < 1$ an increase in inequality abroad reduces the scope for redistribution at home. If $\varepsilon > 1$, the opposite result holds. As explained earlier, the more wealthy are tax payers in a country, in this case country

B, the more elastic is the tax base in this country. This intensifies the tax competition between country B and C. The resulting lower tax rates in C leads to lower tax rates also in A. However, since the elasticity of the tax base in A is unchanged, and thus lower than in country B, the reduction in t_A is less than that of t_B. Hence, although increased pre-tax inequality in one country leads to a larger gap between the disposable income of rich and poor in all countries, countries with an egalitarian pre-tax income distribution are less vulnerable to tax competition than countries with a more unequal income distribution. Comparing the situation in A and B we can easily see that:

Corollary 1 *The country with the more unequal pre-tax income distribution has the lower tax rate.*

Proof. See Appendix C. ■

In light of this corollary, our model may thus provide an explanation for what we in the introduction called the redistribution puzzle, i.e., the observation that countries with more inegalitarian pre-tax income distributions tend to be less redistributive than more egalitarian societies.

So far we have studied the effect of income distribution on tax competition while keeping the size of the economies in A and B identical. Now, we turn our attention to how differences in the aggregate level of income in these countries may affect tax rates in equilibrium. Varying the number of the rich people in country B, and assuming a constant w_B, we can derive the following proposition (given that $\varepsilon_B < 1$):

Proposition 3 *A change in the number of tax payers has no effect on equilibrium tax rates if tax payers everywhere have equal income. If tax payers in one country, say country B, are richer (poorer) than in the other, then increasing the number of tax payers in B reduces (increases) the equilibrium tax rates in all countries.*

Proof. See Appendix D. ■

The opposite result holds for $\varepsilon_B > 1$. Intuitively, an increase in s_B increases the weight that country C attaches to country B's tax base. The effect this has on C's tax rate depends on whether B is a high income country or a lower income country. If $w_B > w_A$, and if increasing income does not increase costs of mobility too much, i.e., for $\varepsilon_B < 1$, then country B has the more elastic tax base, and hence an increase in s_B increases the overall elasticity of the tax base in the view of C. The optimal response of C is therefore to lower its tax rate, leading to an overall reduction in tax rates. Conversely, if $w_B < w_A$ and $\varepsilon_B < 1$, an increase in s_B reduces the overall elasticity of the tax base, leading to higher equilibrium tax rates everywhere.

4 Discussion and extensions

The analysis above is based on the assumption that the governments' objective is to maximize the welfare of the poor. How would our results be affected if the governments instead had been concerned with maximizing the average welfare in the economy? We can approach this question by looking at the situation where the revenue maximizing government has set its tax rate optimally. In this situation the net revenue effect from a marginal increase in the tax rate is zero, since the increased tax revenue collected from the rich individuals who stay in the country is exactly equal to the loss in tax revenue from the tax payers who decide to move. If the government had given some weight to the utility of the rich individuals, this tax rate would have been too high: a reduction in the tax rate would have had no effect on the utility of the poor, but it would have increased the utility of the rich individuals who stay in the country.

Giving some weight to the rich will result in a larger reduction in the tax rate (relative to the tax rate that maximizes tax revenues) the larger is the pre-tax income equality. The reason is simply that, given decreasing marginal utility of income, the welfare gain from a reduction in the tax rate is larger when the tax payers are not so rich. This is a well known result from the optimal tax literature. Hence, assigning positive weight to the utility of the rich would modify, and possibly even reverse, our result that countries with a more unequal pre-tax distribution have lower tax rates. However, the mechanisms that we analyse in the present paper would apply even if we were to assign positive weight to the welfare of the rich. Adding another consideration, namely the intensity in the political will to redistribute, does not make our results concerning the *ability* to tax irrelevant.

Our analysis has considered the interaction between three countries. Increasing the number of high tax countries will not affect the model in any important way. Adding a new country of type A or type B will have exactly the same effect as increasing the size of these countries, an experiment we conducted in Section 3.3. From this we can conclude that including a country with above average inequality would result in lower tax rates and therefore a larger gap in disposable incomes internationally, while including a country with a more equal pre-tax income distribution than the average would work in the opposite direction.

On the other hand, introducing another low-tax country, i.e., another tax haven, will affect the equilibrium in the model in a more significant way. If the low-tax countries engage in Bertrand competition over tax rates, their taxes will be pushed toward zero. In this case it follows from (11) that the tax rates for the high-tax countries are given by $t_K(0) = \frac{\bar{\mu}_K}{2w_K}$. Since the tax rates in the low-tax countries are unaffected by the taxes set in the high-tax countries, there will not be any interdependence between the high-tax countries in this situation. The tax rate in each country would then be determined by national factors alone.

5 Concluding remarks

Increased income inequality is often seen as the result of increased tax competition, which in turn is explained in terms of increased mobility of the tax base. The basic hypothesis in the present paper is that the mobility of the tax base is linked to the pre-tax income distribution. Based on this assumption, we show that increased inequality in pre-tax income levels may force governments to reduce taxes on the rich, thus increasing the gap in disposable income between rich and poor in society. We also show that increased pre-tax inequality in one country may affect redistributive policies in other countries. More specifically, increased pre-tax inequality in one country may reduce the potential for redistribution in another.

Empirical evidence suggests that countries with a large gap in pre-tax income levels between rich and poor are less redistributive than countries which are more egalitarian in this respect. At least if we follow the logic of optimal tax theory and median voter models, this observation is puzzling. The present paper points to one possible explanation to this puzzle. If the elasticity of the tax base is increasing in the concentration of income and wealth, increased concentration of income and wealth reduces the ability of governments to carry out redistribution policies.

It is often presumed that globalization presents a special challenge to egalitarian countries. However, we show that countries with an egalitarian pre-tax income distribution might be less vulnerable to tax competition than countries with a more unequal income distribution.

An interesting extension to the present model would be to endogenize not only redistribution, and therefore disposable income, but also pre-tax income. Many would argue that the mobility of factors of production, goods and services and technology, in short, what is often referred to as "globalization", may explain the rising inequality in pre-tax income distribution that we observe in many OECD countries. Adding mechanisms that endogenize both pre-tax and post-tax income distribution could provide some additional, interesting insights. We leave this for further research.

Appendix A

$$t_A^* = \frac{\bar{\mu}_A}{6}\frac{4w_A^2 s_A\bar{\mu}_B + 3w_B^2 s_B\bar{\mu}_A + w_A w_B s_B\bar{\mu}_B}{w_A\left(w_B^2 s_B\bar{\mu}_A + w_A^2 s_A\bar{\mu}_B\right)}, \tag{A1}$$

$$t_B^* = \frac{\bar{\mu}_B}{6}\frac{4w_B^2 s_B\bar{\mu}_A + 3w_A^2 s_A\bar{\mu}_B + w_B w_A s_A\bar{\mu}_A}{w_B\left(w_B^2 s_B\bar{\mu}_A + w_A^2 s_A\bar{\mu}_B\right)}, \tag{A2}$$

$$t_C^* = \frac{\bar{\mu}_A\bar{\mu}_B}{3}\frac{\left(s_A w_A + w_B s_B\right)}{\left(w_A^2 s_A\bar{\mu}_B + w_B^2 s_B\bar{\mu}_A\right)}. \tag{A3}$$

Appendix B

From (13) and (14) we can easily find that

$$\frac{\partial t_A^*}{\partial w} = \frac{\partial t_B^*}{\partial w} = \frac{2\bar{\mu}}{3w^2}\left(\varepsilon - 1\right), \tag{A4}$$

$$\frac{\partial t_C^*}{\partial w} = \frac{\bar{\mu}}{3w^2}\left(\varepsilon - 1\right), \tag{A5}$$

where $\varepsilon \equiv \frac{\partial\bar{\mu}}{\partial w}\frac{w}{\bar{\mu}}$. Clearly, $\frac{\partial t_A^*}{\partial w}, \frac{\partial t_B^*}{\partial w}, \frac{\partial t_C^*}{\partial w}$ are negative if $\varepsilon < 1$ and positive if $\varepsilon > 1$. This proves Proposition 1.

Appendix C

Define $s_B \bar{\mu}_B \equiv x(s_B) \equiv x$. From (16),(17), and (18) we find that

$$\frac{\partial t_A^*}{\partial s_B} = \frac{\partial x(s_B)}{\partial s_B}(12W), \tag{A6}$$

$$\frac{\partial t_B^*}{\partial s_B} = \frac{\partial x(s_B)}{\partial s_B}\left(30Wx + 18Wx^2\right), \tag{A7}$$

$$\frac{\partial t_C^*}{\partial s_B} = \frac{\partial x(s_B)}{\partial s_B}(6W). \tag{A8}$$

Since the terms in the parenthesis in (A6)-(A8) are all positive, the sign of these derivatives depends on the sign of $\frac{\partial x(s_B)}{\partial s_B}$. Some algebra shows that

$$\frac{\partial x(s_B)}{\partial s_B} = \bar{\mu}_B + s_B \frac{\partial \bar{\mu}_B}{\partial s_B} = \bar{\mu}_B (1 - \varepsilon_B), \tag{A9}$$

where we have used the fact that $W = w_B s_B$ and that

$$\frac{\partial \bar{\mu}_B}{\partial s_B} = \frac{\partial \bar{\mu}_B}{\partial w_B}\frac{\partial w_B}{\partial s_B}, \qquad \frac{\partial w_B}{\partial s_B} = -\frac{W}{(s_B)^2} = \frac{w_B}{s_B}.$$

Hence,

$$sign\left(\frac{\partial t_J^*}{\partial s_B}\right) = sign(1 - \varepsilon_B), \qquad J = A, B, C$$

If, as we believe, $\varepsilon_B < 1$, then increased (reduced) concentration of wealth in country B, i.e., a reduction (increase) in s_B, reduces (increases) equilibrium tax rates in all countries. If $\varepsilon_B > 1$, the opposite result holds. This proves part one of Proposition 2.

Turning to part two of Proposition 2, define $\tau_A \equiv \frac{t_B^*}{t_A^*}$ and $\tau_C \equiv \frac{t_B^*}{t_C^*}$. From (16),(17), and (18), we find that

$$\tau_A = \frac{5x + 3x^2}{5x + 3}$$

and

$$\tau_C = \frac{5+3x}{4}.$$

It is straightforward to show that

$$\frac{\partial \tau_A}{\partial s_B} = \frac{\partial x(s_B)}{\partial s_B}\left(15x^2 + 18x\right), \tag{A10}$$

$$\frac{\partial \tau_C}{\partial s_B} = \frac{\partial x(s_B)}{\partial s_B}\left(\frac{3}{4}\right). \tag{A11}$$

Since the parentheses in (A10) and (A11) are both positive, the sign of the derivatives is determined by $\frac{\partial x(s_B)}{\partial s_B}$, which from (A9) we know has the sign of $(1-\varepsilon_B)$. Hence:

$$sign\left(\frac{\partial \tau_L}{\partial s_B}\right) = sign\left(1-\varepsilon_B\right), \qquad L = A, C.$$

If $\varepsilon_B < 1$, then increased (reduced) concentration of wealth in country B, i.e., a reduction (increase) in s_B, reduces (increases) equilibrium tax rates in that country more than in the other countries. If $\varepsilon_B < 1$, the opposite result holds. This proves part two of proposition 2.

From (A10) and the discussion above, we also know that if $s_B < 1$, i.e., if there is a greater concentration of wealth in B than in A, and given that $\varepsilon_B < 1$, then the equilibrium tax rate in B will also be lower than that in A. This proves Corollary 1.

Appendix D

From (11) we know that a change in the number or tax payers in $K = A, B$, i.e., s_K, affects these countries' tax rates only via its effect on t_C. Hence, to investigate the impact of the number of tax payers on equilibrium tax rates, it suffices to consider the effect on t_C. Again, let the situation in A be unchanged which means that we without loss of generality can normalize w_A and s_A to unity. Wen can then simplify (A3) to

$$t_C^* = \frac{\bar{\mu}_A \bar{\mu}_B}{3} \frac{(1 + w_B s_B)}{(\bar{\mu}_B + w_B^2 s_B \bar{\mu}_A)}. \tag{A12}$$

From (A12) we can show that

$$sign(\frac{\partial t_C^*}{\partial s_B}) = sign(\bar{\mu}_B - w_B\bar{\mu}_A). \tag{A13}$$

Evidently, in the symmetric case of $w_B = w_A = 1$, which also implies $\bar{\mu}_B = \bar{\mu}_A$, the sign of (A13) is zero. Hence, when tax payers have equal pre-tax incomes everywhere, their number does not affect equilibrium tax rates. What is the sign of (A13) if $w_B > w_A$? The answer can be found by taking the derivative of (A13) with respect to w_B:

$$sign(\frac{\partial\,(t_C^*)^2}{\partial s_B \partial w_B}) = sign(\frac{\partial\bar{\mu}_B}{\partial w_B}\frac{1}{\bar{\mu}_A} - 1). \tag{A14}$$

Evaluated at the symmetric case of $w_B = w_A = 1$ and therefore $\bar{\mu}_B = \bar{\mu}_A$, the right hand side of (A14) reduces to $sign\,(\varepsilon_B - 1)$. Hence, if $w_B > w_A$ and $\varepsilon_B < 1$, an increase (reduction) in the number of tax payers in B reduces (increases) the equilibrium tax rate in C and therefore changes tax rates in A and B in the same direction. If $w_B < w_A$, an increase (reduction) in the number of tax payers in B increases (reduces) the equilibrium tax rate in C and again changes tax rates in A and B in the same direction. If $\varepsilon_B > 1$, the impact on t_C^* of a change in s_B would be the opposite. This proves Proposition 3.

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