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Globalization, income tax structure and the redistribution–progressivity tradeoff

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Abstract

We build a simple model in which (i) households select their country of residence depending on income taxation and on the cost of migrating and living abroad, and (ii) globalization comes with a decrease in the cost of migration. Globalization leads to (i) a maximum between-country income-tax gap which is lower for the high incomes, (ii) a decrease in income tax rates and (iii) a convergence in the taxation structures of the different countries. In addition, globalization generates changes in income tax schedules and redistribution which display three successive stages. In the first stage, the redistribution goal is consistent with tax progressivity. In the second stage, the tax schedule becomes regressive at the top. Thirdly, if the migration cost continues to decline, the government can typically not achieve its redistribution goal, even if redistribution is its first priority, and there is no equilibrium taxation schedule, the tax structure becoming volatile. These results are in line with observed facts. Finally, the model shows that globalization tends to generate and magnify a trade-off between less redistribution and less tax progressivity. This provides an explanation for the middle class curse and the social democrat curse experienced by a large majority of advanced countries over the last three decades.

Keywords: globalization, income tax, migration, progressivity, redistribution, tax competition.

JEL Classification: F22, H23, H24, H26, I38.

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1. Introduction

Since the early eighties, the shape of income tax has significantly changed in all advanced economies. First, income taxation has become less progressive and the top marginal income tax rates have significantly decreased. Second, the between-country gap in top marginal income tax rates has substantially shrunk and the tax structures have converged. Third, taxation has become regressive at the top in some states and countries, i.e., the effective tax rates are decreasing for the highest incomes. Forth, these moves have not come with a decrease in the average effective income tax rates, which suggests that the tax burden has moved towards the middle class. Finally, the after-tax and transfers inequality and poverty have increased in most advanced countries since the mid-nineties despite the rise in public social expenditures.

This paper shows that, if globalization lessens the cost of migrating between advanced countries, this typically modifies the income tax structure and fosters the above mentioned developments.

Globalization lessens the cost of migration through several channels. First, the adoption of English as lingua franca at the World level and the harmonisation of living standards across countries (particularly for skilled and well-paid households) have typically reduced the every day's sacrifice of living abroad. Second, the international recognition of diplomas and qualifications allows the migrants to work abroad without losing their skill. This is particularly true for the highest skills. Third, the decrease in transportation costs and the expansion of financial globalization and international communications through the internet lower substantially the cost of moving to foreign countries. These developments began in the eighties, but they have known a rapid and general extension in the nineties and 2000s.

In the model developed here, we assume that globalization results in a continuous decrease in the cost of migration. This reduces the taxation gap (difference in income tax rates) consistent with no-migration, and it is shown that this gap is lower and the related reduction is greater for the highest incomes. We subsequently introduce a social planner with a twofold goal, redistribution and disposable income of the national residents. We assume that redistribution is the government's primary goal to show that, even so, the social planner prefers a decrease in redistribution to letting high incomes quit the country. We then analyse the occurrence of the setting of progressive income tax schedules and the relation between redistribution and tax progressivity.

We firstly show that globalization makes the countries' tax structures to converge and the marginal tax rates to decrease. We subsequently reveal that the globalization-related decrease in the cost of migrating generates three stages in the taxation schedule. When this cost is above an endogenously-determined first level, the policy maker can achieve its redistribution goal with a progressive income tax structure. Below this level but above a second cost threshold, the achievement of the redistribution goal requires a regressive-at-the-top tax structure. Below the second threshold, the policy maker cannot enforce his redistribution objective even if this is its first priority, and the taxation schedules become volatile due to a lack of equilibrium. We finally find that the decrease in migration cost produces and magnifies a tradeoff between redistribution and progressivity. This generates a middle class curse and a social democracy curse.

Section 2 exposes the stylised facts and the literature on which the paper is based. Section 3 exposes the model general framework in terms of taxation and migration. Section 4 presents the governments' objectives and determines the optimal decisions and the related tax structures. The main findings are discussed and we conclude in Section 5.

2. Stylised facts and literature

2.1. Stylised facts

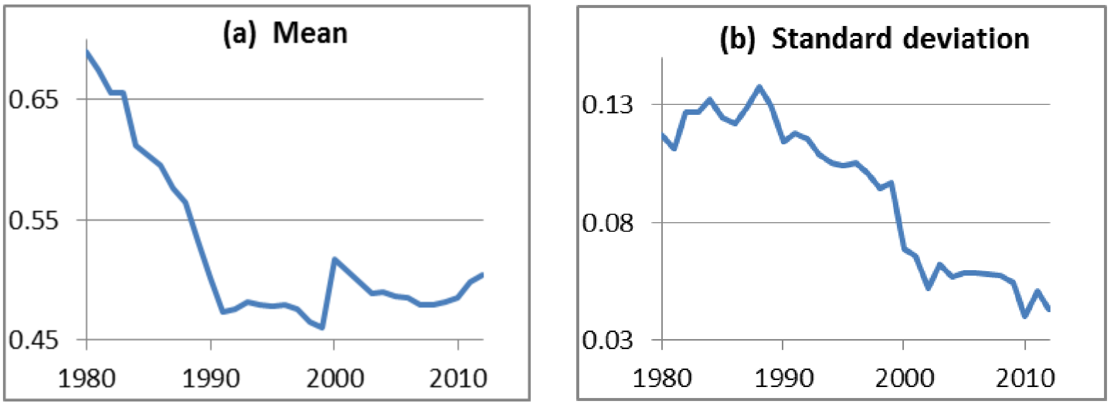
The model developed here is based on a series of observed facts: (i) a decrease in income tax progressivity and a convergence of the income tax structure; (ii) indications that the tax structure is regressive at the top in some countries; (iii) increasingly globalised economies; (iv) increases in both inequality (and poverty) and public social expenditures in most advanced countries; (v) a decrease in the cost of migrating.

2.1.1. *Less progressivity and convergence of the top marginal rates*

Since the early eighties, the progressivity of income taxation has declined in all advanced countries (Foster et al., 2015; Alvaredo et al., 2017). All of them display progressive statutory income tax systems, with growing tax rates applied to the successive income brackets. Within such structures, the reduction in progressivity typically results from lower tax rates on the top income brackets and/or from higher rates on the middle or bottom brackets.

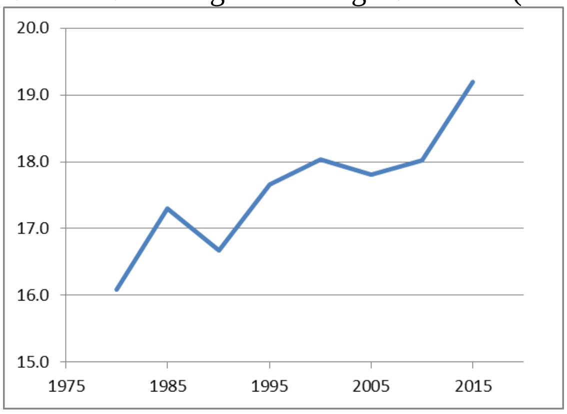
The decrease in the top marginal tax rates and their convergence across advanced countries is now well documented. Figure 1-a shows that the decrease in the marginal rates occurred in the 1980s up to the early 1990s, i.e., at the moment of capital liberalization. In contrast, their convergence depicted by the decrease in the standard deviation have been continuous since the late 1980s. Finally, the VAT rates have increased in all advanced countries (Fig. 2). This shows that the effective income taxes rates (including sales taxes) have tended to rise for lower and middle incomes.

Figure 1. Advanced countries: Top marginal income tax rates, 1980-2012



Source: OECD Stat. (a) unweighted average, advanced economies.

Figure 2. OECD: Unweighted average VAT rate (1980-2015)



Source: OECD, Consumption Tax trends 2016. Chapter 2.

2.1.2. *Tax structure regressive at the top*

Figure 1 focuses on the sole top marginal income tax rate. Nevertheless, as regards real incomes and tax-related migrations, one should consider both the income tax and the sales taxes (particularly the VAT), which have a direct impact on purchasing power. In other words, the right indicator is the effective income tax (including taxes on consumption) and not the marginal rate.

In a number of American states and European countries, the effective tax rate on income has become regressive, i.e., it decreases with the taxpayer's income. In the case of the US, ITEP (2015) shows that, on average of all the American states, the lower one's income, the higher one's overall effective state and local tax rate.

2.1.3. *Redistribution*

Over the last thirty years, despite an increase in the share of GDP allocated to social public expenditures in all OECD countries (Figure 3), the relative redistribution rate has not changed much (Figure 4) and this has led to a rise in inequality (Figure 5).

Fig. 3. Social Public expenditure (% GDP)

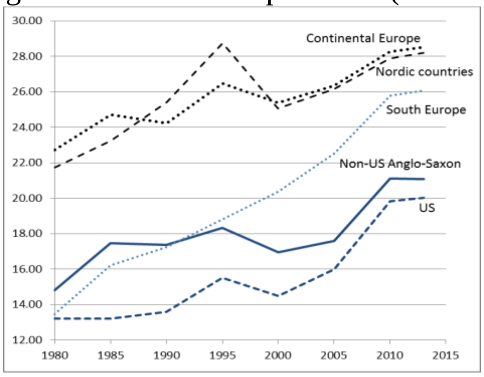


Fig. 4. Relative redistribution rate

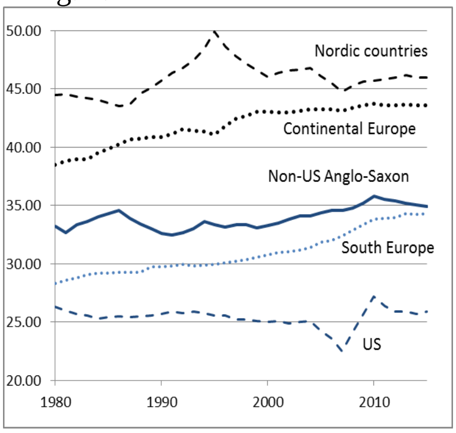
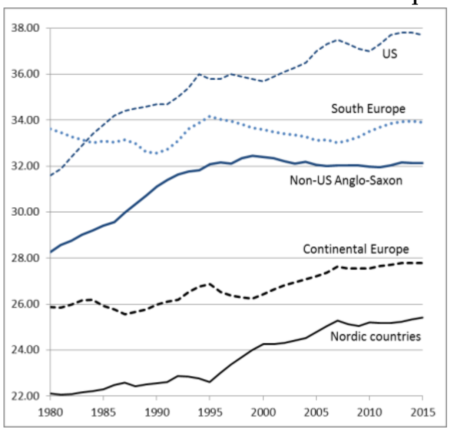


Fig. 5. Post-redistribution income inequality



Source:Fig. 3: OECD Stat. Fig. 4-5: WIID, 2016.
Non-weighted average. Continental Europe: Austria, Belgium, France, Germany, Netherlands / Non-US Anglo-Saxon countries: Australia, Canada, Ireland, New Zealand, UK / Nordic countries: Denmark, Finland, Norway, Sweden. $\textit{Relative redistribution rate} = \dfrac{\text{pre-tax \& redist. Gini} - \text{post-tax \& redist. Gini}}{\text{pre-tax \& redist. Gini}}$

2.1.4. *Globalization and cost of migrating abroad*

In all advanced economies, globalization has known a significant development in its different dimensions since the eighties.

The KOF index of economic flows (combining trade, FDI and financial flows) provides a synthetic measurement of the economic globalization process. Fig. 5 depicts this index on average for advanced economies and reveals a continuous and significant increase over the last forty years. It should be noted that, for advanced economies, the FDI and financial flows have been the main components of globalization progress since the mid -1980s.

It is rather difficult to summarize within one indicator all the components of the migration cost across advanced countries. However, the KOF index of *social* globalization provides a synthetic value of different elements which are essential in both the monetary and the cultural costs of migrating abroad. This index puts together three components, namely, (i) personal contacts, which measure the personal interactions between one country and abroad (telecom traffic, journeys, number of immigrants, number of letters), (ii) information flows which measure the potential flows of information between one country and other countries, and (iii) cultural proximity denoting the openness of the population to international cultural standards. It is clear that the rise in those components leads to both lower monetary cost and lower cultural and psychological costs of migrating abroad.

Fig. 6. KOF index of economic flows.
(Advanced countries: mean)

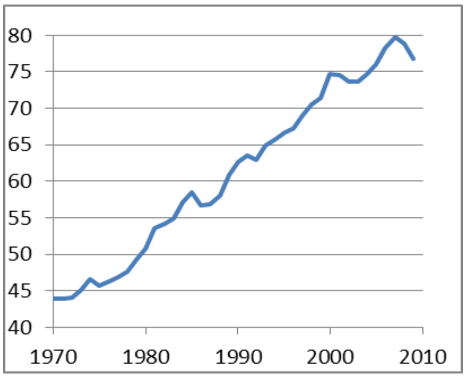


Fig. 7. KOF index of social Globalization
(Advanced economies: Mean and Stand. Dev./Mean)

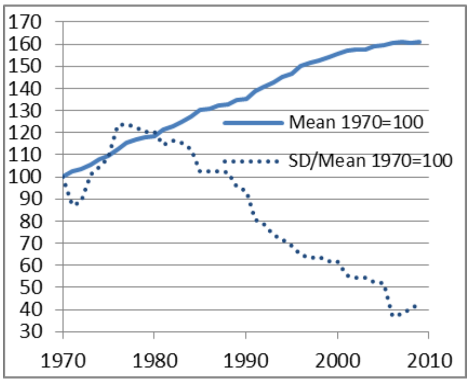


Figure 7 clearly denotes a constant increase in social globalization in advanced economies as well as a constant and substantial decrease in the standard deviation across countries. This typically suggests a decrease in migration costs. It must be added that this decrease is typically higher for educated and rich households.

2.2. Literature

The model developed here relates (i) to the literature on income tax and welfare and (ii) to the literature on tax competition.

2.2.1. *Income tax and welfare*

Following Mirrlees (1971), the early literature on optimal income tax rates was based on a game between the social planner and the tax payers. When increasing the marginal income tax, the social planner discourages labour supply and effort, which in turn lessens the amount of income and the perceived taxes. This was analysed by Mirrlees as an incentive for workers to hide their actual 'ability' and increase their leisure as a response to higher marginal tax rates. This literature is not summarised here, and we refer to Mankiw et al. (2009) who distinguish five major results[1] and show that the policies pursued over the thirty last years have only partially followed the theoretical recommendations.

In fact, this literature focuses on the influence of the marginal tax rate on the behaviour of individuals in their production activity, and on the related impact on welfare. It thereby depends on the weight the welfare function gives to production (taxes hamper activity) and to equality (redistribution is based on taxes). On top of that, this type of analysis targets the behaviour of individuals inside their home country without considering their possible migration abroad to escape from high levies.

2.2.2. *Tax competition*

The mobility of tax bases across countries generates tax competition. Since the seminal work of Zodrow & Mierzkowski (1986), the analysis of tax competition has known large developments, both theoretical and empirical.

The analysis of Zodrow and Mierzkowski, as well as the majority of the subsequent literature on the subject, is centred on corporate tax competition (CTC), which has been the first to be comprehensively investigated. This is not surprising provided that mobility has been both earlier and less costly for capital than for other tax bases. A first strand of theoretical literature has shown that CTC leads to sub-optimal situation in terms of social welfare (Zodrow & Mierzkowski, 1986; Wildasin, 1988; Bucovetsky & Wilson, 1991; Wilson, 1999; Kanbur & Keen, 1991), except in the case of residence based taxation (Bucovetsky & Wilson, 1991; Razin & Sadka, 1991). As regards the empirical literature, the results critically depend on the indicator selected to measure corporate taxation.[2] The CTC hypothesis is confirmed when focusing on statutory corporate tax rates and on the impact of corporate tax upon FDI, but it is typically rejected when accounting for the corporate tax on GDP ratio, or on the effective tax rate.

As regards income tax, tax competition is linked to taxpayers' mobility. The theoretical approach to the impact of taxpayers' migration on income tax competition has known a

[1] 1) Optimal marginal tax rate schedules depend on ability distribution ; 2) The optimal marginal tax schedule could decline at high incomes; 3) A flat tax with a universal lump-sum transfer could be close to optimal; 4) The optimal redistribution rises with wage inequality; 5) Taxes should depend on personal characteristics as well as income; 6) Only final goods ought to be taxed, and typically uniformly; 7) Capital income ought to be untaxed, at least in expectation; 8) in stochastic, dynamic economies, optimal tax policy requires increased sophistication.

[2] Reviews by Crinò (2009), De Mooij & Ederveen (2008), Devereux & Maffini (2007), Devereux & Fuest (2012), and Zodrow (2010).

significant expansion over the last three decades. This literature reveals various and sometimes opposite results depending on the model and its assumptions.

The impact of labour mobility on optimal income taxation was first tackled by Mirrlees (1982). The subsequent literature focused on the behaviour of jurisdictions competing in income taxation and income redistribution because of potential migration of both the net taxpayers and the net transfer recipients. Wildasin (1991) showed that (i) the benefits for both types of individuals must be equalized across jurisdictions and that this can be achieved either by coordination or by a central government. Assuming no coordination and no central adjustment, Hindricks (1999) determined the Nash equilibria when the poor and the rich are imperfectly mobile and jurisdictions compete either in tax, in transfers or in both. He showed (i) that the cut in redistribution is larger when competing in transfers than when competing in taxes, and the reduction is in-between when competing in both, and (ii) that the mobility of the rich is detrimental to redistribution, whereas the effect of the mobility of the poor depends on whether we are in a tax competition or a redistribution competition regime.

In a series of papers, Simula & Trannoy (2005, 2010 and 2012) analysed taxation and welfare when countries are competing in income taxes because of labour mobility. These approaches combine the impacts of taxes on labour supply and on taxpayers' migration in models with skill (productivity) heterogeneity across individuals. They determine optimal tax schemes depending on whether the welfare function is national-oriented (based on the welfare of citizen living in the home country), citizen-oriented (welfare of citizen wherever they live) or resident-oriented (welfare of the residents), and on whether the individuals' productivities are perfectly known or not. The cut in redistribution to the low-skilled due to tax competition is common to almost all configurations. In a number of configurations, the marginal tax rate on the highest skill is reduced and it can even be decreasing. This can also lead to a curse of the middle-skilled who pay more taxes to fund redistribution.

Bierbrauer et al. (2013) analyse the choices of income tax systems in a model with tax competition between two countries, a welfare function depicting the average utility of residents, non-observable skills, and perfect mobility across countries. They show that there is no equilibria in which individuals with the highest skill make positive tax payments and no equilibria in which the lowest-skilled residents receive a subsidy, in either country. In equilibrium, it is even possible for highest skilled to receive a net transfer funded by taxes on lower skilled individuals.

Lehmann et al. (2014) determine the optimal marginal income tax rate corresponding to the Nash equilibrium between two countries maximizing a welfare objective (maximin) with individuals who differ in both skills and migration costs. The solution crucially depends on the semi-elasticity of migration. The simulations implemented for the US reveal a welfare loss between 0.4 and 5.3% for the worst-off and a gain between 18.9 and 29.3% for the top 1%.

In a world with a finite number of countries whose governments attempt to maximize the welfare of the low-skilled by taxing skilled workers' labour income, Tobias (2016) shows that a race to the bottom does not always emerges, the sustainability of the welfare state depending on the shape of the probability distribution of skilled workers' location preferences.

The empirical works on income tax competition are both more recent and rather scarce compared to the theoretical literature.[3] If the decrease in the top marginal tax rates and their convergence are well documented, their relation with the threat of migration of tax bases is rather difficult to estimate. A number of works however suggest the existence of income tax competition. Several studies are centred on the Swiss case because of the key position of this country as a tax haven. By comparing the Swiss cantons, Feld & Reulier (2005) reveal a race to the bottom dynamics, with however no full convergence because of cultural divergence. Johannesen (2014) analyse the impact of the recent reform introducing a withholding tax which limits the scope for tax evasion on interest income for EU residents but not for non-EU residents. The after-reform large decline in deposits owned by EU residents relative to non-EU suggests that those deposits were motivated by tax evasion. In the case of Denmark, Kleven et al. (2014) show that the Danish preferential foreigner tax scheme introduced in 1991 has had a significant effect on the inflow of highly paid foreigners.

3. The model

3.1. General framework

There are two countries, Home and Foreign (a star * indicates Foreign values), which have the same level of development. Consequently, the same individual has the same pay in both countries regardless of migration costs.

In both countries, households (individuals) are identical except in their income, which ensures that redistribution is only based on income differences.

In each country, the government perceives an income tax the rates of which, $\tau(i)$ and $\tau^*(i)$, depend on personal income i. Hence, two individuals with the same income pay the same

[3] In contrast, a large empirical literature has investigated the behavioural elasticities (labour supply elasticity, income elasticity etc.) with respect to income taxation. See the review by Saez et al. (2012).

income tax in the same country. In both countries, incomes are distributed inside the interval $\left[\underline{I},\overline{I}\right]$, where $\underline{I}>0$ is the lowest income and $\overline{I}$ the highest.

The rate $\tau(i)$ is defined as an effective income tax rate which encompasses the direct income taxation but also the sales taxes such as the VAT *and all the transfers and redistribution provided to households*. Consequently, the tax rates $\tau(i)$ can be positive or negative. When the rate is negative, this indicates net redistribution, the individual receiving then the subsidy $-\tau(i)\times i$.

The assumption of both positive and negative tax rates aims at depicting the whole of the 'income tax and redistribution' scheme, $\tau(i)$ being thus the net income tax rate.

In both countries, redistribution is reserved to national residents whereas positives taxes are levied on all residents, national or immigrants (see Section 4).

We suppose that living abroad induces an additional migration cost $C(i)$, which depends on the income i and is similar for the migrants in both countries. Hence, a national resident with a before-tax income i has the after tax and redistribution income $\left(1-\tau(i)\right)i$ if she lives in the Home country and $\left(1-\max\left\{\tau^*(i),0\right\}\right)\times i-C(i)$ if she migrates to the Foreign country. Symmetrically, a Foreign national with a before-tax income i has the after tax and redistribution income $\left(1-\tau^*(i)\right)i$ if she lives in her country and $\left(1-\max\left\{\tau(i),0\right\}\right)\times i-C(i)$ if she migrates to the Home country.

3.2. Taxation schedules

Definition 1. We call <u>*Taxation schedule*</u> on the income interval $\mathcal{I}$ a set of tax rates $\mathcal{T}=\left\{\tau(i),\ i\in\mathcal{I}\right\}$.

3.2.1. *Progressivity versus regressivity*

Definition 2. A taxation schedule is <u>*progressive*</u> in the income interval $\mathcal{I}$ if $i_2>i_1\Rightarrow\tau(i_2)\geq\tau(i_1)$, $\forall i_1,i_2\in\mathcal{I}$ and there is at least one couple of income $i'_1,i'_2\in\mathcal{I}$ such that $i'_2>i'_1\Rightarrow\tau(i'_2)>\tau(i'_1)$.[4]

[4] I When function $\tau(i)$ is continuous and derivable, a tax schedule is progressive in the income interval $\mathcal{I}$ if $\partial\tau(i)/\partial i\geq 0$, $\forall i\in\mathcal{I}$ and there is at least one $i'\in\mathcal{I}$ such that $\partial\tau(i')/\partial i'>0$.

Definition 3. Let $\bar{I}$ be the highest income. Then:

1) A taxation schedule is *regressive* in the income interval $\mathcal{I}$ if $i_2 > i_1 \Rightarrow \tau(i_2) \leq \tau(i_1)$, $\forall i_1, i_2 \in \mathcal{I}$ and there is at least one couple $i'_1, i'_2 \in \mathcal{I}$ such that $i'_2 > i'_1 \Rightarrow \tau(i'_2) < \tau(i'_1)$.
2) A taxation schedule is *weakly regressive at the top* iif there is at least one $i < \bar{I}$ such that $\tau(i) > \tau(\bar{I})$.
3) A taxation schedule is *strictly regressive at the top* if there is an income level $\tilde{I}$ such that the income tax is regressive for all incomes $i > \tilde{I}$.

The condition for a taxation schedule to be weakly regressive is that the highest tax rate applies to an income level which is lower than the highest income, and the condition to be strictly regressive at the top is that there is an income level above which taxation is regressive.

Definition 4. Assume two progressive taxation schedules $\mathcal{T}_1$ and $\mathcal{T}_2$ defined on the same income interval. Then, $\mathcal{T}_2$ is *strictly less progressive* than $\mathcal{T}_1$ if the highest income which is more taxed in $\mathcal{T}_2$ is lower than the lowest income more taxed in $\mathcal{T}_1$.[5]

Figure 8 illustrates such a situation.

Fig. 8. $\mathcal{T}_2$ is less progressive than $\mathcal{T}_1$

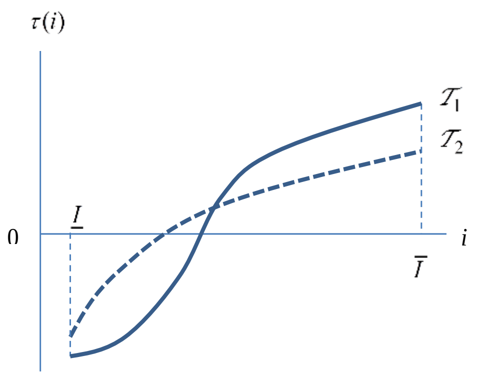
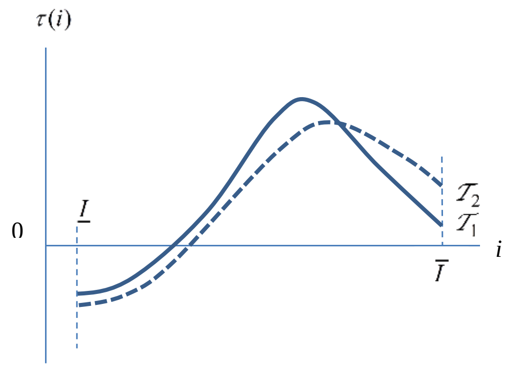


Fig. 9. $\mathcal{T}_1$ is more regressive than $\mathcal{T}_2$



Remark: Symmetrically, $\mathcal{T}_1$ is strictly more progressive than $\mathcal{T}_2$ if the lowest income which is more taxed in $\mathcal{T}_1$ is higher than the highest income which is more taxed in $\mathcal{T}_2$.[6] This straightforwardly means that if $\mathcal{T}_1$ is strictly more progressive than $\mathcal{T}_2$, then $\mathcal{T}_2$ is strictly less progressive than $\mathcal{T}_1$ (both features are equivalent).

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[5] Formally: $\mathcal{T}_2$ is *strictly less progressive* than $\mathcal{T}_1$ if the non-empty set of tax rates $\bar{\theta}_2 \subset \mathcal{T}_2$ such that $\tau_2(i) \in \bar{\theta}_2 \Rightarrow \tau_2(i) > \tau_1(i)$ and the set of tax rates $\underline{\theta}_2 \subset \mathcal{T}_2$ such that $\tau_2(i) \in \underline{\theta}_2 \Rightarrow \tau_2(i) < \tau_1(i)$ are such that $\max\{i,\ \tau_2(i) \in \bar{\theta}_2\} < \min\{i,\ \tau_2(i) \in \underline{\theta}_2\}$.

[6] Formally: $\mathcal{T}_1$ is *strictly more progressive* than $\mathcal{T}_2$ if the non-empty set of tax rates $\bar{\theta}_1 \subset \mathcal{T}_1$ such that $\tau_1(i) \in \bar{\theta}_1 \Rightarrow \tau_1(i) > \tau_2(i)$ and the set of tax rates $\underline{\theta}_1 \subset \mathcal{T}_1$ such that $\tau_1(i) \in \underline{\theta}_1 \Rightarrow \tau_1(i) < \tau_2(i)$ are such that $\min\{i,\ \tau_1(i) \in \bar{\theta}_1\} > \max\{i,\ \tau_1(i) \in \underline{\theta}_1\}$

Definition 5. Assume two regressive at the top taxation schedules $\mathcal{T}_1$ and $\mathcal{T}_2$ defined on the same income interval. Then, $\mathcal{T}_1$ is *strictly more regressive* than $\mathcal{T}_2$ if the lowest income which is less taxed in $\mathcal{T}_1$ is higher than the highest income which is less taxed in $\mathcal{T}_2$.[7]

Figure 9 illustrates such a situation.

3.2.2. *Migration cost*

We assume a migration cost $C(i)$ *which is identical in the Home and the Foreign country* and such that

$$C(i) = C \times i^{\beta}, \quad C > 0, \ \ \beta < 1. \tag{1}$$

Function (1) allows for a large range of migration costs, going from a cost which decreases with income ($\beta < 0$) to a cost increasing with income ($\beta > 0$), with however a decreasing marginal cost ($\beta < 1$). The cost is the same whatever the income for $\beta = 0$.

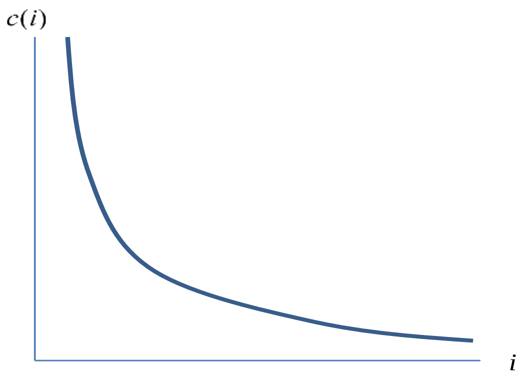
Henceforth, C will be called the *unit migration cost* and we assume that *the globalization process is characterised by a decrease in the unit migration cost C*.

We define the *relative cost of migration* as $c(i) = C(i)/i$. Hence:

$$c(i) = C \times i^{\beta - 1} \tag{2}$$

As $\beta - 1 < 0$, then $\partial c / \partial i < 0$ and the relative migration cost $c(i)$ exhibits the following shape:

Figure 10. The relative migration cost $c(i)$ in relation to income i



[7] Formally: $\mathcal{T}_1$ is *strictly more regressive* than $\mathcal{T}_2$ if the non-empty set of tax rates $\underline{\theta}_1 \subset \mathcal{T}_1$ such that $\tau_1(i) \in \underline{\theta}_1 \Rightarrow \tau_1(i) < \tau_2(i)$ and the set of tax rates $\overline{\theta}_1 \subset \mathcal{T}_1$ such that $\tau_1(i) \in \overline{\theta}_1 \Rightarrow \tau_1(i) > \tau_2(i)$ are such that $\min\{i,\ \tau_1(i) \in \underline{\theta}_1\} > \max\{i,\ \tau_1(i) \in \overline{\theta}_1\}$.

3.3. Tax-related migration

Consider the Home country's individual with income *i*. She decides to migrate if her income after tax and migration cost is higher in the Foreign country than in the Home country, i.e. $\tau(i)\times i > \max\{\tau^*(i),0\}\times i + C(i)$. This establishes the following condition to leave the country:

$$\tau(i) > \max\{\tau^*(i),0\} + c(i) \tag{3}$$

Proposition 1: *All the Home individuals with an income i such that* $\tau(i) > c(i) + \max\{\tau^*(i),0\}$ *migrate from the Home country to the Foreign country, and all those such that* $\tau(i) < c(i) + \max\{\tau^*(i),0\}$ *stay in the Home country.*

Corollary: *All the Foreign individuals with an income i such that* $\tau^*(i) > c(i) + \max\{\tau(i),0\}$ *migrate from the Foreign to the Home country, and all those such that* $\tau^*(i) < c(i) + \max\{\tau(i),0\}$ *stay in the Foreign country.*

Suppose that both $\tau(i)$ and $\tau^*(i)$ are positive. Because of Proposition 1 and its corollary, the condition for no tax bases migration between the two countries is:[8]

$$\left|\tau(i) - \tau^*(i)\right| \le c(i) \tag{4}$$

Definition 6. We call <u>*Migration-free taxation gap*</u> for income *i* the largest gap $\left|\tau(i) - \tau^*(i)\right|$ between the two countries' tax rates which is consistent with no-migration between them.

Straightforwardly, any gap $\left|\tau(i) - \tau^*(i)\right|$ which is smaller than the migration free taxation gap results in no-migration between the two countries. Hence:

Lemma 1. *The Migration-free taxation gap for income i is equal to c(i), and:*

1) *The migration-free taxation gap decreases with income i.*
2) *All migration-free taxation gaps decrease with globalization.*

Proof. The migration-free taxation gap is equal to *c*(*i*) because of (3) and (4). As $\partial c(i)/\partial i < 0$, the gap diminishes with the income. As $\partial c(i)/\partial C > 0$ and since globalization comes with a decrease in *C*, then globalization reduces this gap.

[8] By combining the conditions for no tax bases migration between the two countries $\tau(i) \le \tau^*(i) + c(i)$ and $\tau^*(i) \le \tau(i) + c(i)$.

Lemma 1 shows that if both countries want to prevent the migration of tax bases, then:

1) The higher the income, the lower their maximum difference in the related tax rates.

2) Globalization tends to reduce the difference in tax rates between the two countries.

3) Globalization makes the migration-free taxation gap to vanish first for high incomes.

This reveals that, as regards high incomes, the social planner is critically constrained in his taxation by the taxation schedule of the other country whereas this is not the case for low or medium incomes. In addition, this constraint strengthens when globalization increases.

4. Governments' objectives, optimal taxation and redistribution

4.1. Objectives

All governments (social planners) have a hierarchic twofold objective which determines a sequential choice behaviour. The government's primary goal consists in achieving a certain level of redistribution in favour of the national residents. Once this goal is achieved, the government targets the highest disposable income of national residents. This two-level objective permits to focus on redistribution and to subsequently choose the policy which allows achieving the expected redistribution with the lowest loss (or the highest gain) in terms of disposable (i.e., after tax) income. It will be shown that, even so, the social planner will prefer to reduce redistribution than to let tax bases leave the country. In addition, the fact that the social planner's secondary objective is to maximise total national residents' disposable income ensures that he prefers to fund redistribution with levies on the rich immigrants than with levies on national residents. This is because the increase in national residents' disposable incomes is reached by (i) preventing their emigration and (ii) favouring immigration of bases the taxation of which is redistributed to national residents, increasing thereby their income.

A shortcoming of this choice scheme is that it could eventually lead to very large losses in income for very low gains in redistribution. We shall however show that this never happens because a decrease in disposable income cannot reduce redistribution, quite the contrary.

We assume that the median voter's rule applies. In our framework, this means that the individual with an income below the median income $\underset{\sim}{I}$ have a non-positive tax rate:

$$\tau(i) \leq 0, \qquad i \leq \underset{\sim}{I}$$

Redistribution consists in providing a certain amount of redistribution $\overline{R}$ to the national residents with an income below $\underset{\sim}{I}$.

Denoting N_R the set of national residents and i_k resident k's income of, redistribution can be written:

$$\overline{R} = \sum_{i_k \leq \underset{\sim}{I}, k \in N_R} \tau(i_k) \times i_k \tag{5}$$

Here, redistribution is defined by two elements, i.e., its amount $\overline{R}$ and the median income $\underset{\sim}{I}$ below which it applies. The negative tax rates selected by the social planner, $\tau(i) < 0,\ i < \underset{\sim}{I}$, are obviously key elements of the redistribution scheme. We do not consider this structure of rates here because it has no impact upon the forthcoming analyses.

At this stage, we make no particular assumption on the progressivity of the tax schedule which is chosen by governments. This is because our goal is precisely to determine the set of possible tax schedules, particularly in terms of progressivity, which are consistent with the government's objectives.

By considering the sole national residents in the allocation of redistribution and in the calculation of disposable income, the government ignores both the foreign immigrants' welfare and the welfare of those nationals who have migrated abroad. In contrast, the government considers in its calculations the levies paid by the immigrants as well as the loss in income related to the migration of nationals.

The disposable income of national residents Y can be divided in two components. First, it comprises all the national residents' pre-tax incomes $\sum_{k \in N_R} i_k$ since all taxes are redistributed. Second, it includes the taxes paid by immigrants $\sum_{m \in \mathcal{M}} \tau(i_m) \times i_m$, with $\mathcal{M}$ the set of immigrants, which are redistributed to the nationals. Hence:

$$Y = \sum_{k \in N_R} i_k + \sum_{m \in \mathcal{M}} \tau(i_m) \times i_m \tag{6}$$

We firstly suppose that the government is not allowed to reverse the income hierarchy through redistribution. This means that for any couple of pre-tax incomes (i_1, i_2) such that $i_1 < i_2$ the post-tax incomes are such that $\left(1 - \tau(i_1)\right) i_1 \leq \left(1 - \tau(i_2)\right) i_2$.This is in line with the assumption that households only differ in their incomes. This also means that the government does not tax the incomes above $\underset{\sim}{I}$ at rates which make them move below this threshold:

$$\tau(i) \leq \underset{\sim}{\tau}(i) = \frac{i - \underset{\sim}{I}}{i}, \quad i > \underset{\sim}{I} \tag{7}$$

where $\underset{\sim}{\tau}(i)$ is the tax rate which exactly brings the after-tax income $\left(1 - \tau(i)\right) i$ to threshold $\underset{\sim}{I}$.

We assume that the redistribution objective $\bar{R}$ is achievable without migration of tax payers. Without migration, the maximum amount of taxes consistent with condition (7) is $\sum_{i>\underset{\sim}{I}} \underset{\sim}{\tau}(i) \times i = \sum_{i>\underset{\sim}{I}} (i - \underset{\sim}{I})$. We can thus write:

$$\sum_{i>\underset{\sim}{I}} (i - \underset{\sim}{I}) > \bar{R} \tag{8}$$

To achieve his goal, the government levies the taxes $\sum_{i_k > \underset{\sim}{I}, k \in N_R} \tau(i_k) \times i_k + \sum_{m \in \mathcal{M}} \tau(i_m) \times i_m$ which are used for redistribution $\bar{R} = \sum_{\tau(i_k)<0, k \in N_R} \tau(i_k) \times i_k$. Balanced budget implies:

$$\sum_{k \in N_R} \tau(i_k) \times i_k + \sum_{m \in \mathcal{M}} \tau(i_m) \times i_m = 0 \tag{9}$$

In summary the government firstly attempts to achieve its redistribution goal $\bar{R}$ and subsequently chooses the highest disposable income consistent with its optimal redistribution, this hierarchical two-fold objective being subject to the budget constraint (9), the migration constraint (2), and the tax rate constraint (7).

Lemma 2. *Given the migration constraint (2), the maximum rate constraint (7) and the median income* $\underset{\sim}{I}$ *:*

1) All taxation schedules must be such that $\tau(i) \le \min\{\underset{\sim}{\tau}(i), c(i)\}$, $i > \underset{\sim}{I}$, *and the schedule with the highest possible tax rates is* $\{\tau(i) = \min\{\underset{\sim}{\tau}(i), c(i)\},\ i > \underset{\sim}{I}\}$.

2) All the progressive taxation schedules must be such that $\tau(i) \le \min\{\underset{\sim}{\tau}(i), c(\bar{I})\}$, $i > \underset{\sim}{I}$, *and the progressive taxation schedule with the highest possible tax rates above* $\underset{\sim}{I}$ *is* $\{\tau(i) = \min\{\underset{\sim}{\tau}(i), c(\bar{I})\},\ i > \underset{\sim}{I}\}$.

Proof. Feature 1) is straightforward and feature 2) derives from the facts that (1) $\{\underset{\sim}{\tau}(i)\}$ is progressive and (2) $c(i)$ is decreasing with i, implying that from the income $\underset{\sim}{I}\left(1 - c(\bar{I})\right)^{-1}$ such that $\underset{\sim}{\tau}(i) = c(\bar{I})$, the only tax rate consistent with no-emigration and progressivity is $\tau(i) = c(\bar{I})$.

Given the social planner's objective, migration is detrimental to social welfare because it lowers the disposable income Y and lessens the levies available for redistribution. Consequently, the social planner prefers lowering the individual's tax to letting her emigrate. This establishes the following:

Lemma 3. *In both countries, for any* $i > \underset{\sim}{I}$, *the social planner always prefers to lower the tax rate* $\tau(i)$ *(and* $\tau^*(i)$ *) to a positive or nil level which prevents the exit of taxpayers rather than to let the tax base i migrate*.

As a consequence, the tax rates selected by the Home and Foreign social planners are such that $\tau(i) \leq \tau^*(i) + c(i)$ and $\tau^*(i^*) \leq \tau(i^*) + c(i^*)$, which implies that the above relation (4) is always true: $\left|\tau(i) - \tau^*(i)\right| \leq c(i)$.

4.2. Optimal taxation

In this section, we determine and analyse the optimal taxation schedules corresponding to a given redistribution target. The changes in the governments' redistribution goals are analysed in the next section.

4.2.1. *Optimal taxation schedules and migration*

A taxation schedule is optimal if it minimises the redistribution gap $\left|\bar{R} - R\right|$ and it maximises the national residents' disposable income for this minimum gap.

Following Lemma 2, any taxation schedule with at least one income *i* such that $\tau(i) > c(i) + \max\{\tau^*(i), 0\}$ is sub-optimal. Then:

Lemma 4. *An optimal taxation schedule comes with no tax-driven migration*.

Taxation schedules are converging if the migration-free taxation gaps $\left|\tau(i) - \tau^*(i)\right|$ are decreasing at the optimum taxation. Then:

Proposition 2. *Globalization induces a convergence of taxation schedules*.

Proof. All migration-free taxation gaps decrease with globalization (Lemma 1, feature 3).

Consider the Home social planner who takes as given the Foreign taxation schedule $\mathcal{T}^* = \{\tau^*(i),\ i > \underset{\sim}{I}\}$. He firstly determines the set of schedules permitting to achieve his redistribution goal $\bar{R}$. He subsequently selects those (or that) among the so-determined schedules which maximise the national residents' disposable income *Y*.

It is clear that such behaviour can generate a large number (infinity) of optimal taxation schedules. This is because, when achieving $\bar{R}$ is possible, there are typically an infinite number of taxation sets $\left\{\tau(i) \le \min\left\{\underset{\sim}{\tau}(i), \tau^*(i) + c(i)\right\},\ i > \underset{\sim}{I}\right\}$ such that $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \bar{R}$.

4.2.2. *Optimal taxation with two identical countries*

Let us assume two countries which are identical in all respects: same population, same income distribution in the interval $\left[\underline{I}, \bar{I}\right]$, similar social planners with the same objective $\bar{R}$.

We analyse the Nash equilibria resulting from the optimal behaviours of the Home and Foreign social planners who take as given the taxation schedule of the other country.

Lemma 5. *Assume a given unit cost C, two identical countries with identical social planners pursuing the objectives as defined in Section 4.2. Then:*

1) *All the schedules* $\left\{\tau(i) \le \min\left\{\underset{\sim}{\tau}(i), c(i)\right\},\ i > \underset{\sim}{I}\right\}$ *such that* $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \bar{R}$ *are equilibria.*
2) *There are progressive equilibrium taxation schedules which permit to achieve redistribution* $\bar{R}$ *if and only if* $\bar{R} < \sum\limits_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\} \times i$.
3) *There are equilibrium taxation schedules which permit to achieve redistribution* $\bar{R}$ *and are all regressive at the top if* $\sum\limits_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\} \times i < \bar{R} < \sum\limits_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i$.
4) *There is no equilibrium optimal taxation schedules if* $\bar{R} > \sum\limits_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i$.

Proof. Appendix A.

The following figures 11 and 12 illustrate the results of Lemma 5. Figure 11 depicts the set of equilibrium taxation schedules and Figure 12 the set of progressive equilibrium schedules.

In Figure 11, the curve in bold formed by the functions $\underset{\sim}{\tau}(i)$ from $\underset{\sim}{I}$ to $\tilde{I}$ and $c(i)$ from $\tilde{I}$ to $\bar{I}$ in the positive quadrant is the upper limit of all the equilibrium taxation schedules such that both the no-migration constraint ($\tau(i) \le \tau^*(i) + c(i)$) and the no-move below the median income constraint ($\tau(i) \le \underset{\sim}{\tau}(i)$) are fulfilled. In consequence, all these optimal schedules belong to the dimmed surface, such as $\mathcal{T}_1$ and $\mathcal{T}_2$ in Figure 11, the first schedule being progressive and the second regressive at the top.

In Figure 12, the bold curve formed by the functions $\underset{\sim}{\tau}(i)$ from $\underset{\sim}{I}$ to $\hat{I}$, and $c(\bar{I})$ from $\hat{I}$ to $\bar{I}$ is the upper limit of all the progressive equilibrium taxation schedules. Both $\mathcal{T}_1$ and $\mathcal{T}_2$ belong to this set, the first being more progressive than the second.

Finally note that, when the two social planners are perfectly identical, they select the same equilibrium schedule $\{\tau(i) \le \min\{\underset{\sim}{\tau}(i), c(i)\},\ i > \underset{\sim}{I}\}$ provided that $\bar{R} \le \sum_{i>\underset{\sim}{I}} \min\{\underset{\sim}{\tau}(i), c(i)\} \times i$. If the two social planners only share the same redistribution goal $\bar{R}$, they can select different schedules such that $\tau(i) \le \min\{\underset{\sim}{\tau}(i), c(i)\},\ i > \underset{\sim}{I}$.

Figure 11. Equilibrium Taxation schedules

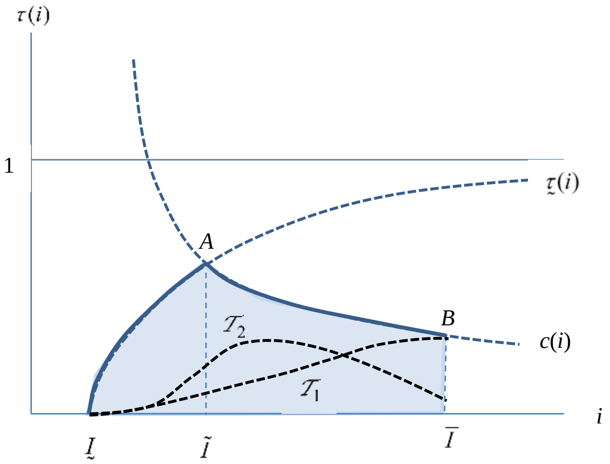
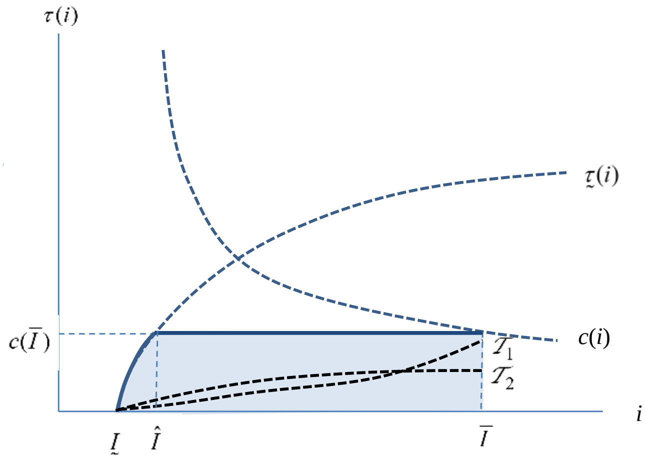


Figure 12. Progressive equilibrium schedules



Proposition 3. *There is a couple of unit migration costs* (C_1, C_2) *with* $C_2 < C_1$ *such that the optimal taxation schedule selected by the social planner:*

1) can be progressive if $C > C_1$

2) cannot be progressive if $C_2 < C < C_1$

3) cannot be an equilibrium and does not eradicate poverty if $C < C_2$.

Proof. Appendix B.

Proposition 4. *Both thresholds* C_1 *and* C_2 *are decreasing functions of redistribution* $\bar{R}$.

Proof. Appendix B.

Proposition 3 shows that, as globalization comes with a decrease in the unit cost *C*, the countries move from a first phase ($C > C_1$) in which both redistribution $\bar{R}$ and progressivity are possible, to a second phase ($C_2 < C < C_1$) where redistribution $\bar{R}$ requires regressive taxation, and finally to a third phase ($C < C_2$) in which the redistribution goal cannot be attained and there is no equilibrium schedule.

Proposition 4 shows that, the higher redistribution, the sooner the country attains thresholds C_1 and C_2 during the globalization process.

4.3. Redistribution-progressivity tradeoff

We now introduce the fact that social planners select their redistribution goal, $\bar{R}$ and $\bar{R}*$.

Social planners do have the same hierarchic twofold objective as defined in Section 4.1, but they can diverge in their redistributive orientation.

Firstly note that the results described in Lemmas 2, 3 and 4 still hold. This is because the decrease in the tax rates towards the limit $\min\{\underset{\sim}{\tau}(i), c(i)\}$ is independent from the redistribution goal, provided that $\bar{R} > 0$.[9] In contrast, the migration cost thresholds which separate the three taxation regimes (progressive, regressive, no achievement of the redistribution goal) directly depend on the targeted level of redistribution (Proposition 4): for a given pre-tax income distribution, more redistribution implies higher thresholds C_1 and C_2.

We call <u>*redistribution-progressivity tradeoff*</u> a situation in which more redistribution implies less income tax progressivity and more progressivity implies less redistribution.

Proposition 5. *Assume an optimal progressive tax schedule* $\{\tau(i)\}$ *which permit to achieve the redistribution goal* $\bar{R}$ *and such that* $\tau(\bar{I}) = c(\bar{I})$ *. Then, any decrease in the unit migration cost C generates a redistribution-progressivity tradeoff.*

Proof. Appendix C.

The rationale of proposition 5 is simple. The decrease in migration cost makes $\tau(\bar{I}) = c(\bar{I})$ to decrease and, for a given redistribution goal, this decrease must be offset by an increase in the taxation of incomes below $\bar{I}$. This reduces tax progressivity (Definition 4). As globalization comes with a continuous decrease in *C*, it *ipso facto* generates and amplify a redistribution-progressivity trade-off given that $\tau(\bar{I}) = c(\bar{I})$. Hence, globalization implies that the simple maintaining of the redistribution level means a lasting decrease in progressivity.

Finally suppose two countries with identical income distributions, but which differ in their redistribution preferences. The Home country is more redistribution-oriented than the Foreign country. Then, thresholds C_1 and C_2 are attained sooner in the redistribution-oriented Home country, and the redistribution-progressivity tradeoff appears sooner in the Home country than in the Foreign country.

[9] The values $\underset{\sim}{\tau}(i)$ are nevertheless modified.

5. Discussion and conclusion

From a simple model in which (i) governments perceive income taxes for their primary goal which is redistribution and also care about the disposable income of national residents, (ii) individuals can migrate to escape from taxation and (iii) globalization lessens the migration costs, we have shown that globalization significantly modifies the shape of optimal fiscal policies. First, globalization leads to a reduction in the maximum tax rates and to a convergence in the countries' taxation schedules. As the migration-free taxation gap is small for high incomes but not for lower incomes, this primarily leads to a reduction and a convergence of the top marginal income tax rates. Second, the taxation-redistribution scheme experiences three successive stages. Above a certain level of migration costs, the redistribution goal can be combined with a progressive taxation. Below this level but above a second level of costs, the redistribution objective requires income taxation to be regressive at the top. Below this last level of costs, the expected redistribution cannot be achieved even if it is the first concern, and there is no equilibrium in the successive optimal decisions of the social planners.

In addition, the reduction in migration costs tends to generate and intensify a trade-off between tax progressivity and redistribution. This trade-off logically derives from the necessity to augment the levies to increase redistribution. As the tax rate cannot exceed the relative migration cost which decreases with income, a pro-redistribution rise in levies cannot affect the highest incomes and the increase in redistribution must thereby be financed by middle incomes, which in turn lessens progressivity. Finally, the reduction in migration costs (globalization) magnifies this trade-off and its effect on progressivity.

The above findings are in line with the observed facts highlighted in section 2. It has been shown that, even when progressivity is possible ($C > C_1$), globalization results in a convergence in taxation schedules which leads sooner or later to a decrease in the marginal income tax rates. This is typically what has been observed (Figures 1 in section 2).

As regards the progressivity-redistribution tradeoff, we have observed that progressivity has decreased whereas redistribution has broadly remained unchanged. The maintaining of relative redistribution has however not prevented the increase in both disposable income inequality and poverty (Figures 2-4 in section 2). In fact, on top of tax competition, globalization combined with technological change typically fosters income inequality and tends to significantly increase the share of the top incomes in total income (Chusseau et al, 2008, for a review). This generates the so-called compensation effect: the governments tend to increase social expenditures so as to insure the workers against the new risks and to offset the losses in unskilled wages due to globalisation. The increase in public social spending has not been sufficient to fund the increase in redistribution necessary to offset the pro-inequality distortion in income distribution, and the decrease in the top income tax rates could have played an important role in this respect.

But the progressivity-redistribution tradeoff has another consequence. It typically leads to a middle class curse and a social-democracy curse in advanced countries.

Even if it has been insufficient to prevent growing inequality, the increase in public social spending had to be funded. The decline in progressivity has then moved the related tax burden from the richest to the middle class. This middle class curve has already been highlighted by several works, both empirical and theoretical (e.g., Simula & Trannoy, 2005, 2010 and 2012). The replacement of levies on top incomes by levies on sales (VAT) typically transfers the tax burden towards the middle class.

In addition, the progressivity-redistribution tradeoff typically jeopardises the position of social-democracy on the political exchequer because the traditional social-democrat project consisted in redistributing in favour of low incomes by taxing the highest incomes. This permitted to realise an implicit political alliance between the lower and the middle class. The gain for the lower class was redistribution. The gain for the middle class was threefold. First, tax progressivity shrunk the income differential between the middle and the upper class. Second, a share of redistribution was captured by the lower and middle parts of the middle class through social insurance and education. Third, redistribution made part of the lower class' children escape from their social group and integrate the middle class, which reinforced the weight of the middle class in the society. The progressivity-redistribution tradeoff destroys the bases of social democracy because it makes the interests of the lower and the middle class to diverge. On the one hand, if the public decider does not want to increase the tax burden of the middle class, it must accept the lower class' impoverishment, which is what has occurred in the US (Alvaredo et al., 2018). On the other hand, if redistribution towards the lower class is augmented to limit poverty, this has been detrimental to the middle class which has suffered an increase in its tax burden, as in several European countries.

Certain predictions of the model could nevertheless be seen as controversial.

First, tax-related migration does exist in several advanced countries at the top of the income ladder. Two major reasons can explain this. In a democracy, the reduction of taxes in favour of the richest and a clearly regressive taxation can be politically harmful for the party in power, and political deciders may prefer to let a limited number of rich leave the county than to lose the elections. In addition, certain countries have set a twofold income tax scheme, where the rich immigrants are less taxed than the national residents.

Second, the statutory taxation schedules remain progressive in almost all advanced countries, even if the cost of migration has become very small for the richest (the globalized elite). It must firstly be noted that, even if income taxation is still progressive at the countries' level, a large part of them are now regressive at the state and local levels inside the United States (ITEP, 2015). In addition, there exists a large range of tax niches which permit to lower the tax paid by the rich while apparently maintaining income tax progressivity. Tax optimisation and tax evasion also permit to lessen the taxes effectively paid by the rich even with progressive statutory rates.

Finally, the emergence and development of a global elite with no national tie typically result in the fact that countries cannot avoid the migration of some tax bases.

Appendix A. Proof of Lemma 5

We firstly determine the Nash equilibria linked to the secondary goal of the social planners (maximising the national residents' disposable income), and we subsequently introduce the primary goal so as to determine the equilibria generated by the twofold objective.

Assume identical Home and Foreign schedules $\{\tau(i)=\tau^*(i),\ i>\underset{\sim}{I},\ \tau(i)\le\underset{\sim}{\tau}(i)\}$ and consider the only second objective of the social planners, i.e., maximising the national residents' disposable income, with however the following constraints: 1) no rates above $\underset{\sim}{\tau}(i)$, and 2) non-negative rates above $\underset{\sim}{I}$. Consider first the Home social planner. To increase disposable income, he lowers the tax rates $\tau(i)$ just below $\tau^*(i)-c(i)$, provided that $\tau^*(i)-c(i)\ge 0$ (there is no negative tax rates above $\underset{\sim}{I}$). Hence, the Home social planner's reaction function to $\{\tau^*(i),\ i>\underset{\sim}{I},\ \tau^*(i)\le\underset{\sim}{\tau}(i)\}$ is:

$$\tau(i)=\hat{\tau}\left(\tau^*(i)\right)=\begin{cases}\tau^*(i)-c(i), & \tau^*(i)>c(i)\\ \text{no change}\ , & \tau^*(i)\le c(i)\end{cases}$$

Similarly, the Foreign social planner's reaction function to the Home schedule $\{\tau(i),\ i>\underset{\sim}{I},\ \tau(i)\le\underset{\sim}{\tau}(i)\}$ is:

$$\tau^*(i)=\hat{\tau}^*\left(\tau(i)\right)=\begin{cases}\tau(i)-c(i)\ , & \tau(i)>c(i)\\ \text{no change}, & \tau(i)\le c(i)\end{cases}$$

Then, all the $\left\{\tau(i) \le \min\left\{c(i), \underset{\sim}{\tau}(i)\right\},\ i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$ and $\left\{\tau^*(i) \le \min\left\{c(i), \underset{\sim}{\tau}(i)\right\},\ i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$ are Nash equilibria of this game. If we assume that both social planners have the same preferences as regards tax rates, then the Nash equilibria are such that $\left\{\tau(i) = \tau^*(i) \le \min\left\{c(i), \underset{\sim}{\tau}(i)\right\},\ i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$.

Let us now introduce the primary goal, i.e., to reach the redistribution $\bar{R}$. Given the above-mentioned result, all the taxation schedules such that $\left\{\tau(i) \text{ and } \tau^*(i) \le \min\left\{c(i), \underset{\sim}{\tau}(i)\right\},\ i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$ and $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \sum_{i>\underset{\sim}{I}} \tau^*(i) \times i = \bar{R}$ are Nash equilibria.

Three cases are possible (and thus three successive stages during the globalization process because the decrease in C lessens both $c(\bar{I})$ and $c(i)$):

1) <u>Case 1</u>: $\sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\} \times i > \bar{R}$

As $c(\bar{I}) < c(i),\ \forall i < \bar{I}$, there is no incentive to lessen the tax rates to attract tax bases. As $\left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\},\ i > \underset{\sim}{I}\right\}$ is the progressive taxation schedule with the highest possible tax rates (Lemma 2, feature 2), $\bar{R}$ can be achieved with any progressive taxation schedule such that $\tau(i) \le \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\},\ i > \underset{\sim}{I}$ and $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \bar{R}$, and this schedule is not contestable by the other country. As the same reasoning can be made for the Foreign country, there is an infinite number of progressive equilibrium schedules in both countries.

2) <u>Case 2</u>: $\sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\} \times i < \bar{R} < \sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i$

Then, $\bar{R}$ cannot be reached with the progressive schedule with the highest possible tax rates $\left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\},\ i > \underset{\sim}{I}\right\}$, but it can be reached with schedules having some tax rates below those of $\left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(i)\right\},\ i > \underset{\sim}{I}\right\}$. Hence, the redistribution goal can only be reached by setting a regressive at the top taxation schedule, and this result applies to both countries.

3) <u>Case 3</u>: $\sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i < \bar{R}$

Redistribution $\bar{R}$ cannot be achieved with the schedule $\left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(i)\right\},\ i > \underset{\sim}{I}\right\}$, which is the one with the highest tax rates consistent with constraints (2) and (7) (Lemma 2, feature 1). Let us start from the situation in which $\left\{\tau(i)\right\} = \left\{\tau^*(i)\right\}$ and $\sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i = \bar{R}$. The decrease in C lessens all the $c(i)$ and leads to $\sum_{i>\underset{\sim}{I}} \min\left\{\underset{\sim}{\tau}(i), c(i)\right\} \times i < \bar{R}$. Then, the Home social planner can increase some $\tau(i)$ to a value lower than $\tau^*(i) + c(i)$ so as to raise the amount of tax perceived without outflows of tax bases. When both social planners act exactly in the same way, this can result in $\left\{\tau(i)\right\} = \left\{\tau^*(i)\right\}$, $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \bar{R}$ and $c(i) < \tau(i) \le \underset{\sim}{\tau}(i)$

for a number of $i > \underset{\sim}{I}$. But then, considering the Home social planner, there are typically tax schedules with some $\tau(i),\ i \in \mathcal{I}_1,$ such that $\tau^*(i) < \tau(i) < \tau^*(i) + c(i)$ and other $\tau(i),\ i \in \mathcal{I}_2 \neq \emptyset,$ such that $\tau(i) < \tau^*(i) - c(i)$, and with $\sum_{i>\underset{\sim}{I}} \tau(i) \times i = \bar{R}$. These schedules dominate the case $\{\tau(i)\} = \{\tau^*(i)\}$ because they permit both to reach redistribution $\bar{R}$ and to increase the national residents' disposable income by attracting all the $i \in \mathcal{I}_2$.[10] But the same reasoning can be made for the Foreign social planner who reacts to the new schedule decided by the Home social planner. This shows that there is no equilibrium in this case. Such a situation typically leads to perpetual moves in schedules which none of them ensuring the lasting achievement of redistribution $\bar{R}$. This can also result either in no ex post achieving of redistribution $\bar{R}$, and/or in ex post public deficit.

Appendix B. Proofs of Propositions 3 and 4

<u>*Determination (existence and uniqueness) of* $\underline{C_1}$</u>

C_1 is the unit cost of migration under which any optimal taxation schedule is not progressive.

Consider function $F_1(C) = \sum_{i=\underset{\sim}{I}}^{\underset{\sim}{I}(1-c(\bar{I}))^{-1}} (i - \underset{\sim}{I}) + C\bar{I}^{\beta-1} \sum_{\underset{\sim}{I}(1-c(\bar{I}))^{-1}}^{\bar{I}} i - \bar{R}$, which measures the net taxation (taxes – redistribution) for the migration cost *C*, for the taxation schedule $\mathcal{T}_1 = \left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\}, i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$ and the redistribution scheme $(\bar{R}, \underset{\sim}{I})$. $\underset{\sim}{I}\left(1 - c(\bar{I})\right)^{-1}$ is the income such that $\underset{\sim}{\tau}(i) = c(\bar{I})$.[11]

$\mathcal{T}_1 = \left\{\tau(i) = \min\left\{\underset{\sim}{\tau}(i), c(\bar{I})\right\}, i \in \left[\underset{\sim}{I}, \bar{I}\right]\right\}$ is the progressive taxation which brings the highest possible amount of levies (Lemma 2, feature 3). Any taxation schedule which brings a higher amount of taxes is not progressive in $\left[\underset{\sim}{I}, \bar{I}\right]$. Then, by definition of C_1, $F_1(C_1) = 0$.

We now show that C_1 exists and is unique. To do so, it is sufficient to show that 1) $F_1(C)$ is continuously increasing with *C*, 2) $F_1(C) < 0$ for $C = 0$, and 3) there is a value of C such that $F_1(C) > 0$.

1) Function $F_1(C)$ continuously increases with *C*. Indeed, an increase in *C* has two effects. It firstly increases $C\bar{I}^{\beta-1}i$ for all the incomes which are taxed at rate $c(i) = C\bar{I}^{\beta-1}$. It secondly makes some incomes move from the tax rate $c(\bar{I})$ to $\underset{\sim}{\tau}(i)$, because $c(\bar{I})$ becomes

[10] Among those schedules, the optimal answer determining the Home reaction function is that which maximises $\sum_{i \in \mathcal{I}_2} i$.

[11] $\underset{\sim}{\tau}(i) = c(\bar{I}) \Leftrightarrow (i - \underset{\sim}{I}) / i = C \times \bar{I}^{\beta-1} \Leftrightarrow i = \underset{\sim}{I}\left(1 - c(\bar{I})\right)^{-1}$.

higher than $\underset{\sim}{\tau}(i)$ whereas it was lower before the rise in C, which means that all those incomes are now more taxed than before. Finally, there is no effect on the levies on the incomes that were taxed at rate $\underset{\sim}{\tau}(i)$ before the increase in C. Hence, an increase in C entails an increase in $F_1(C)$.

2) $C=0 \Rightarrow F_1(C)=-\bar{R}<0$.

3) $c(\bar{I})=C\times\bar{I}^{\beta-1}>\underset{\sim}{\tau}(\bar{I})\Rightarrow F_1(C)=\sum_{\underset{\sim}{I}}^{\bar{I}}(i-\underset{\sim}{I})-\bar{R}$ and hence $F_1(C)>0$ because of (8).

It can be easily checked that C_1 is an increasing function of $\bar{R}$. This is because C_1 is such that $F(C_1)=0 \Leftrightarrow \sum_{i=\underset{\sim}{I}}^{\underset{\sim}{I}/(1-C_1\bar{I}^{\beta})}(i-\underset{\sim}{I})+C_1\bar{I}^{\beta-1}\sum_{\underset{\sim}{I}/(1-C_1\bar{I}^{\beta})}^{\bar{I}} i=\bar{R}$, which shows that and increase in $\bar{R}$ must come with an increase in C_1 .

<u>*Determination (existence and uniqueness) of* C_2</u>

C_2 is such that $\sum_{i\geq\underset{\sim}{I}}\min\{\underset{\sim}{\tau}(i),c(i)\}\times i=\bar{R}$, with $\underset{\sim}{\tau}(i)=1-\underset{\sim}{I}/i$ and $c(i)=C_2\times i^{\beta-1}$. This can be written:

$\sum_{i=\underset{\sim}{I}}^{\tilde{I}}(i-\underset{\sim}{I})+C_2\bar{I}^{\beta-1}\sum_{i=\underset{\sim}{I}}^{\tilde{I}} i=\bar{R}$, with $\tilde{I}$ such that $c(\tilde{I})=\underset{\sim}{\tau}(\tilde{I})\Rightarrow\tilde{I}-C\times\tilde{I}^{\beta}-\underset{\sim}{I}=0$. $\tilde{I}$ is the root of function $i-C\times i^{\beta}-\underset{\sim}{I}=0$, and $\dfrac{\partial\tilde{I}}{\partial C}=\dfrac{\tilde{I}^{\beta}}{1-\beta C\tilde{I}^{\beta-1}}>0$.

Consider function $F_2(C)=\sum_{i=\underset{\sim}{I}}^{\tilde{I}}(i-\underset{\sim}{I})+C\sum_{\tilde{I}}^{\bar{I}} i^{\beta}-\bar{R}$. $F_2(C)$ measures the net taxation (taxes – redistribution) for the set of tax rates $\{\tau(i)=\min\{\underset{\sim}{\tau}(i),c(i)\},\ i>\underset{\sim}{I}\}$, the migration cost C and the redistribution goal $\bar{R}$. $F_2(C_2)=0$ by definition of C_2. We must show that C_2 exists and is unique.

Function $F_2(C)$ continuously increases with C. Indeed, an increase in C has two effects. It firstly increases $C\times i^{\beta}$ for all the incomes which remain at tax rates $c(i)=C\times i^{\beta-1}$. It secondly makes some incomes move from the tax rate $c(i)$ to $\underset{\sim}{\tau}(i)$, because $\partial\tilde{I}/\partial C>0$, and all those incomes are now more taxed than before. Finally, there is no effect on the levies on the incomes that were taxed at rate $\underset{\sim}{\tau}(i)$ before the increase in C. Hence, $F_2(C)$ is monotonously increasing with C. Now, (i) $F_2(0)=-\bar{R}<0$ and (ii) from $C=\dfrac{\bar{I}-\underset{\sim}{I}}{\bar{I}^{1+\beta}}$ on,

$F_2(C)=\sum_{\underset{\sim}{I}}^{\bar{I}}(i-\underset{\sim}{I})>0$ because of (8). Hence, there is a unique value C_2 such that $F_2(C_2)=0$, and $F_2(C_2)<0$ for $C<C_2$ and $F_2(C_2)>0$ for $C>C_2$.

It can be easily checked that (i) C_2 is an increasing function of $\bar{R}$ and (ii) $C_2<C_1$.

Appendix C. Proof of Proposition 5

Assume that, with a unit migration cost C_1, the (equilibrium) taxation schedule $\{\tau_1(i)\}$ selected by the social planner is progressive and such that $\tau(\bar{I})=c(\bar{I})$, $\bar{R}=\bar{R}_1$ and $\underset{\sim}{I}=\underset{\sim}{I}_1$. Hence, the social planner is progressivity-oriented and Figure C1 depicts such a situation.

A downward move in the migration cost from C_1 to $C_2<C_1$ makes $c(\bar{I})$ decrease from $c_1(\bar{I})=C_1\times\bar{I}^{\beta-1}$ to $c_2(\bar{I})=C_2\times\bar{I}^{\beta-1}<c_1(\bar{I})$, which lessens the amount of taxes available to fund redistribution. Then, two outcomes are possible:

1) Not to set a less progressive schedule, which imply to reduce at least at level $c_2(\bar{I})$ all the taxation rates which are such that $\tau_1(i)>c_2(\bar{I})$.[12] This corresponds to a decrease in redistribution $\bar{R}$.

3) To maintain redistribution at level $\bar{R}=\bar{R}_1$, to reduce at level $c_2(\bar{I})$ all the taxations rate which are such that $\tau_1(i)>c_2(\bar{I})$, and to increase the taxation rates for incomes in interval $\left]\underset{\sim}{I},\min\{i,\text{ s.t. }\tau_1(i)>c_2(\bar{I})\}\right]$. This corresponds to a decrease in progressivity.

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[12] Definition 5 (section 3.2): $\mathcal{T}_2$ is less progressive than $\mathcal{T}_1$ if the highest income which is more taxed in $\mathcal{T}_2$ is lower than the lowest income more taxed in $\mathcal{T}_1$.

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