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ABSTRACT

This paper quantifies the unequal welfare effects of tax competition. I derive the optimal tax and transfer schedules in a free mobility union composed of countries that can either compete or set a uniform federal tax rate. In the absence of fiscal coordination, governments internalize that any decentralized tax reform can lead to the out-migration of taxpayers at the top of the income distribution while increasing the in-migration of transfer recipients. As a result, the optimal level of redistribution is always lower in the tax competition equilibrium. Numerical calibrations show that being in a competition union rather than in a federal union decreases poorer individuals' welfare by up to -20 percent. In contrast, the rich experience higher welfare in the tax competition equilibrium due to lower tax rates.

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A data appendix is available at http://www.nber.org/data-appendix/w31920

1 Introduction

Despite the expectation that international integration would lead to increased economic growth and aggregate welfare gains, a significant political backlash against globalization has emerged in many developed economies, primarily driven by the concerns of the most economically disadvantaged workers (Rodrik, 1998).

The emergence of an anti-globalization sentiment has generated considerable interest among researchers, who are actively investigating the underlying factors and drivers contributing to this phenomenon. Often, economists have focused on the way globalization shapes pre-tax earnings inequalities, for instance by investigating the role of international trade and migration for labor markets (Autor et al., 2013) and the distribution of earnings (Goldberg and Pavcnik, 2007).

In this paper, I explore an additional and complementary explanation: globalization also shapes the distribution of post-tax earnings because of tax competition. Specifically, the lack of fiscal coordination in an open economy reduces redistribution in the equilibrium. This mechanism disproportionately hurts the poor by reducing transfers while favoring the wealthiest individuals who pay less taxes. To study this, the paper derives the optimal tax and transfer policies chosen by the government in an open economy with tax competition or tax cooperation, and calibrates the welfare that citizens would get in those different tax regimes.

I base my analysis on a stylized world where taxation and redistribution are residence-based. Individuals have heterogeneous skills and preferences; wages are exogeneously given. Their utility is increasing in consumption but decreasing in their effort from working. Given their preferences and skills, individuals choose their labor supply. The government taxes labor income generated by its residents and redistributes it through a universal transfer. Redistribution is fully consumed, which means that public spending does not produce anything else than immediate consumption.

Individuals live in an open economy that is composed of perfectly symmetric countries, and citizens can freely move from one country to the other. Without tax cooperation, each country sets its own tax rate on labor income. In the federal union, countries commit to set the same uniform tax rate. The main difference between the competition and the federal union is tax-driven migration.

In the federal union, individuals' location choices cannot be affected by tax differentials. But when countries engage in tax competition, individuals can react to unilateral changes in tax rates by changing their country of residence. The magnitude of tax-induced migration is captured by the migration elasticity. This elasticity captures the change in the number of residents at a given income level following a change in the net-of-tax rate (that affects consumption).

I derive the optimal tax and transfer schedule in the presence of such migration responses to taxation. My theoretical approach builds on Mirrlees (1982) and Lehmann et al. (2014), although I model more explicitly the transfer side of the optimal tax schedule and the welfare preferences of the government.[1] In the model, the government chooses the level of taxes and transfers that maximizes the weighted sum of utilities in the country. Welfare weights are defined following Saez and Stantcheva (2016). I focus on a linear tax rate for the main derivations to transparently show the channels through which tax competition shapes redistribution and welfare, but all results are qualitatively and quantitatively similar when extending the analysis to a non-linear tax schedule.

In the absence of tax cooperation, migration responses to taxation reduce the optimal level of redistribution through two channels. Any increase in tax rates leads to more out-migration of taxpayers at the higher end of the income distribution, meaning that the government can raise less tax revenue in the tax competition equilibrium. Since higher tax rates are redistributed through transfers, any attempt to increase taxes also leads to additional in-migration of individuals at the bottom of the income distribution, for whom consumption increases when transfers increase. This increases the absolute number of transfer beneficiaries in the country, leading to a lower level of transfer per capita. This transfer channel also means that the revenue-maximizing and transfer-maximizing tax rates are not equivalent in a world with open borders but decentralized tax policies.

I then take the optimal tax and transfer formulas to the data to quantify how individuals' welfare is changed between a tax competition union and a federal union. I show that even when migration elasticities are small, and far below unity as estimated in Kleven et al. (2020), the welfare costs of tax competition for poor individuals are sizeable. My results show that the bottom fifty percent always loses from tax competition: being in a competition union rather than in a federal union decreases poorer individuals welfare by up to -20 percent. On the contrary, individuals at the top

[1] There is a vast literature on optimal taxes starting with Mirrlees (1971) and based on the sufficient statistics approach (Piketty, 1997; Saez, 2001).

of the income distribution always benefit from tax competition since it lowers their tax liabilities. Furthermore, the welfare losses of poorer individuals are higher when the redistributive tastes of the government are lower in the first place. This means that the welfare losses from globalization without tax cooperation are larger in countries where the welfare state is weaker to start with.

Contribution The main contribution of the paper is to propose a quantification of the welfare implications of globalization without tax cooperation. There is a large theoretical literature on fiscal federalism (Tiebout, 1956; Oates, 1999) and on the mechanisms of tax competition (Kanbur and Keen, 1993; Devereux and Griffith, 2003; Gordon and Hines, 2002; Agrawal et al., 2022). Most of those studies derive theories of countries' best response in terms of tax policy when tax cooperation cannot be enforced. There is also a growing empirical literature showing that workers and firms avoid taxation by shifting their tax residence or tax base across borders (Kleven et al., 2014; Agrawal and Foremny, 2018; Muñoz, 2019; Egger et al., 2013; Tørsløv et al., 2023). Recent studies have thus showed that globalization led to a drop in effective top tax rates on labor at the top of the income distribution (Egger et al., 2019) and to lower tax rates on capital in high-income countries (Bachas et al., 2022). This paper proposes a simple and tractable methodology to compute the welfare consequences of the empirical and theoretical mechanisms documented by previous studies. This methodology could be applied to other contexts and questions, for instance the welfare implications of tax heavens or minimum corporate taxes. Antràs et al. (2017) also propose a framework to evaluate the welfare implications of trade openness but consider the effects of trade on before-tax income instead of the effects of globalization on tax progressivity itself.[2]

2 Linear Tax Schedule

The baseline analysis uses a simple linear tax framework that considerably simplifies the derivation of the optimal tax formulas and transparently illustrates the equity-efficiency trade-offs at the heart of the optimal taxation problem in the presence of migration.

[2] In their trade model with taxes, trade increases the dispersion of before-tax income which increases the efficiency cost of redistribution as more individuals are pushed into the top tax bracket.

2.1 Individuals' Problem

I consider individuals who are heterogeneous with respect to their preferences and skills. I follow Piketty and Saez (2013). Individual i has an utility $u_i(c_i, y_i)$ that is increasing in consumption and decreasing in earnings, as earnings require labor supply. Individuals have heterogeneous skills w_i that are continuously distributed in the economy. A type-i individual receives a pre-tax income y_i that is a combination of his exogeneous ability w_i and his amount of effort l_i, such that $y_i = l_i w_i$. There is a mass N_i of type-i individuals who are characterized by the same preferences and skills $u_i(c_i, y_i)$. The total number of taxpayers in one country is $\sum_i N_i = N$ and the aggregate income is $Y = \sum_i N_i y_i$. The government observes pre-tax earnings, but the abilities of individuals are private information. The government sets a linear tax rate τ on observed earnings that is universally redistributed through a lump-sum transfer T_0, thus $T_0 = \tau \times Y/N$. Individuals' budget constraint is given by $c_i = (1-\tau)y_i + T_0$.

2.1.1 Labor Supply Decisions

Given their preferences and characteristics, individuals choose their labor supply at the intensive margin, which corresponds to their optimal amount of work l_i . Formally, they choose pre-tax earnings y_i that maximize $u_i(c_i, y_i)$. Assuming no income effects, type-i individual utility $u_i(c_i, y_i)$ can be written as:

$$u_i(c_i, y_i) = (1-\tau)y_i + T_0 - v_i(l_i) \tag{1}$$

The disutility from effort $v_i(l_i)$ is increasing and convex in effort l_i, and thereby in pre-tax earnings y_i. The individual-level optimality condition determines the earnings function $y_i(1-\tau)$, and the compensated labor supply elasticity captures the change in individual's earnings caused by a change in the net-of-tax rate $1-\tau$:

$$e_i = \frac{\partial y_i}{\partial(1-\tau)} \times \frac{1-\tau}{y_i} \tag{2}$$

The first order condition is simply given by $1-\tau = v_i'(y_i)$. The differentiation of the first order condition allows to link the definition of the elasticity of earnings e_i to the structure of individuals

preferences such that $\frac{1-\tau}{y_i} \times \frac{\partial y_i}{\partial(1-\tau)} = \frac{v_i'(y_i)}{y_i v_i''(y_i)}$. By definition of the disutility of labor, the elasticity of gross earnings with respect to the net-of-tax rate is always positive.

2.1.2 Location Choices

In a free mobility union, individuals can move from one country to another. I assume that individuals make the decision to migrate conditionally on their labor supply decision. I consider two perfectly symmetric countries A and B that constitute the entire world economy. Individuals have an idiosyncratic taste for residing in one country that is captured by the parameter θ_i^A for country A and θ_i^B for country B. They have to pay a migration cost m if they decide to migrate.

Individuals move from country A to country B if and only if they receive a higher utility in country B. Therefore, any individual residing in A has to satisfy the following conditions:

$$u_i^A = (1-\tau^A)y_i + T_0^A - v_i(l_i) + \theta_i^A - m \tag{3}$$

$$u_i(c_i^A, y_i, \theta_i^A, m) \geq u_i(c_i^B, y_i, \theta_i^B, m) \tag{4}$$

Equation (3) and (4) define the number of individuals in country A, N_i^A. From Equation (4) we see that the decision to locate in country A is affected by the *overall tax liability* of individuals in this country, which combines the amount of taxes paid and transfers received. In contrast, labor supply choices are only driven by marginal tax rates (in the absence of income effects).

We can directly derive from Equation (4) that the density of individuals with type-i preferences can be written as a function of the net-of-tax rate in this country such that $N_i^A(1-\tau^A)$ and $N_i^B(1-\tau^B)$.[3] The density of type-i individuals can be increasing or decreasing in the net-of-tax rate in the country depending on how type-i individuals' consumption is affected by the linear tax rate. Formally, the consumption of type-i individuals can be rewritten as $c_i = y_i + \tau(Y/N - y_i)$.

I follow Saez (2002) and define the *break-even point* as the income level $y_i = Y/N$ where transfers net of taxes are equal to zero. For any i such that $y_i < Y/N$, consumption is a *decreasing* function of the net-of-tax rate $1-\tau$, and N_i is decreasing in the net-of-tax rate. For any individual with $y_i > Y/N$, consumption is increasing in the net-of-tax rate and N_i is increasing in $1-\tau$.

[3] In the linear model, writing the density function with respect to the net-of-tax rate rather than the consumption level considerably eases exposure without loss of generality.

Migration elasticities Migration responses to taxation can be fully summarized in terms of elasticity concepts. I define the migration elasticity as the change in the number of residents in one country when the net-of-tax rate is increased in this country:

$$\varepsilon_i = \frac{\partial N_i}{\partial(1-\tau)} \times \frac{1-\tau}{N_i} \tag{5}$$

The sufficient statistic ε_i summarizes the migration response of type-i individual to a change in the overall tax and transfer schedule at the income level y_i, through a change in $1-\tau$.

The differential effects of changes in net-of-tax rates on individuals' consumption levels enter in the model through the sign of ε_i. An increase in the net-of-tax rate that translates into an increase in the level of transfers induces the in-migration of individuals below the break-even point ($\varepsilon_i < 0$), and the out-migration of individuals above ($\varepsilon_i > 0$). Therefore, the migration elasticity can either be positive or negative, depending on how individuals' earnings relate to the break-even point. If all individuals exhibit the same migration responses to a given change in consumption levels, the migration elasticity will have the same value in absolute along the income distribution, but will be of opposite sign on each side of the break-even point.

In addition to taxation, location choices are of course determined by the distribution of migration costs and idyosyncratic preferences. In the model, these parameters are taken as exogeneous to tax policy and are not affected by changes in the net-of-tax rate.

2.2 Government Problem

The government sets the linear tax rate τ and redistributes the collected revenue through a universal demogrant T_0. Summing individual earnings functions $y_i(1-\tau)$ over the total number N of taxpayers in the economy allows to obtain the aggregate earnings $Y = \sum_i N_i y_i$. Total income in the economy is thus determined by individuals' earnings and the number of taxpayers at each income level in the country, that are both a function of $1-\tau$. It follows that the government budget constraint can be written as $R = Y(1-\tau)\tau$. The guaranteed income level T_0 is determined in equilibrium by the total amount of tax revenue R and the linear tax rate set by the government.

2.2.1 Social Preferences

The government chooses the level of taxes τ to maximize a social welfare function. I follow Saez and Stantcheva (2016) and use the concept of *generalized social marginal welfare weights*, where g_i measures how much the government values the marginal consumption of individual i. This formulation is conveniently very general and the welfare weights are only defined up to a multiplicative constant. Therefore, the overall spectrum of possible preferences for redistribution, from low to infinite, will be loaded in the distribution of the weights g_i across earnings levels.

2.2.2 Tax Systems

I consider a free mobility union where symmetric countries can either compete or cooperate regarding the collection of their tax revenue. Symmetric countries are characterized by the same exogeneous distribution of skills and population size. For simplicity, I assume that there is no mobility outside the free mobility union.

In this model, I call federal union a union where all countries are constrained to set the same linear tax rate. The federal governemnt sets a uniform tax rate τ^f that is paid by everyone regardless of its residence in A or in B. Note that because countries are perfectly symmetric in every aspect, it does not matter for the analysis if the revenue collected by the federal rate is redistributed at the union or the country level.

Of course, this definition of the federal union is restrictive and rules out any considerations linked to the fact that individuals may want to sort themselves in different countries because they have different tastes for public goods, which in turn may affect their welfare. For instance, Alesina and Spolaore (1997) outline a trade-off between the benefits of large jurisdictions and the costs of heterogeneity of large and diverse populations. Importantly, mobility and trade are as free in the federal union than in the competition union: this means that all other determinants of welfare that are linked to globalization (prices of goods, innovation, etc.) are kept constant in the two systems.

Reconsidering Equation (4) when countries are forced to impose the same federal rate, the difference in utility levels is only driven by migration costs or individuals' preferences. It follows that in the federal union, the mass of taxpayers in each country is exogeneous to tax rates, as any change in the federal rate τ^f translates to a symmetric change in utility levels in both country,

keeping the migration condition unchanged. The only behavioral response to taxes in the federal union is captured by labor supply responses to tax reforms.

Rather than being part of a federal union, countries can choose to compete within the free mobility union. Tax competition means that countries set their respective tax rates and redistribute transfers separately. Because of tax competition, the population of taxpayers in each country is no longer independent from taxes. Note that because countries are perfectly symmetric, they will set the same tax rate in the competition Nash equilibrium.

2.3 Optimal Linear Tax rates

In this section, I derive the optimal linear tax rate of the government in the two systems: tax competition and federal union. I present the derivations following the small tax perturbation approach but the formulas can also be derived by fully specifying the welfare maximization problem. The optimal linear tax rate is such that around the optimum no small reform can generate a welfare gain. The welfare gains from any tax deviation are quantified by weighting the money metric of welfare gains or losses to each individual using welfare weights.

Proposition 1. *Optimal Linear Tax rate of the Federal Government:*

$$\tau^f = \frac{1-\bar{g}}{1+e-\bar{g}} \tag{6}$$

Proof. Where e denotes the income weighted average labor supply elasticity $e = \sum_i \frac{e_i N_i y_i}{Y}$ and $\bar{g}$ captures a weighted average of welfare weights $\bar{g} = \left(\sum_i N_i g_i y_i\right).\left(\sum_i N_i\right) / \left(\sum_i N_i g_i . \sum_i N_i y_i\right)$. The proof is formally derived in the Appendix, and intuitively below. □

Proposition 2. *Optimal Linear Tax Rate of the Competing Government:*

$$\tau^c = \frac{1-\bar{g}}{1-\bar{g}+e+\bar{\varepsilon}} \tag{7}$$

Proof. Where e denotes the income weighted average labor supply elasticity $e = \sum_i \frac{e_i N_i y_i}{Y}$, $\bar{\varepsilon}$ is a combination of the *income weighted* and *population weighted* average mobility elasticity such that $\bar{\varepsilon} = \sum_i \frac{\varepsilon_i N_i y_i}{Y} - \sum_i \frac{\varepsilon_i N_i}{N}$ and $\bar{g}$ captures a weighted average of welfare weights $\bar{g} =$

$(\sum_i N_i g_i y_i) . (\sum_i N_i) / (\sum_i N_i g_i . \sum_i N_i y_i)$, The proof is formally derived in the Appendix, and intuitively below. □

To derive the optimal tax rate, I consider an infra-marginal deviation in the tax rate $d\tau$ with no other effect on individuals' welfare than the effect on post-tax earnings. This is because of the classical envelop theorem argument. The argument is the same for migration decisions.

The first effect of $d\tau$ on individuals' welfare is given by the increase in taxes paid by everyone $-\sum_i N_i g_i y_i d\tau$. The second effect on welfare is the change in transfers $\sum_i N_i g_i dT_0$. When N is exogeneous to the tax reform, the change in the universal demogrant is $dT_0 = dR/N$. In the federal union, we can normalize the total population $N = \sum_i N_i$ to one without loss in generality, and use $dR = dT_0$. The small tax reform creates a mechanical increase in tax revenue $d\tau Y$. As pre-tax earnings are endogeneously determined by the labor-leisure trade-off, $d\tau$ causes an additional change in pre-tax earnings because of behavioral responses to taxation. Using the definition of the labor supply elasticity, the change in tax revenue due to labor supply responses is $-\sum_i \frac{\tau}{1-\tau} N_i y_i e_i d\tau$. I rewrite this effect $-e\frac{\tau}{1-\tau} Y d\tau$ where $e = \sum_i \frac{N_i y_i e_i}{Y}$ is the income weighted labor supply elasticity. The total effect on tax revenue is therefore $dR = Y d\tau (1 - e\frac{\tau}{1-\tau})$. Using the expression for dR derived before, and the fact that at the optimum the net welfare effect of $d\tau$ is zero, gives $\sum_i N_i g_i y_i d\tau = \sum_i N_i g_i (1 - e\frac{\tau}{1-\tau}) Y d\tau$, which is equivalent to $1 - e\frac{\tau}{1-\tau} = \bar{g}$ with $\bar{g} = (\sum_i N_i g_i y_i) . (\sum_i N_i) / (\sum_i N_i g_i . \sum_i N_i y_i)$, which is a simple discretization of the standard formula in (Saez and Stantcheva, 2016) with population normalized to one.

When countries are competing, the total number of taxpayers becomes endogeneous to the tax system. Therefore, the total mass of individuals in the economy cannot be normalized to one without making the restrictive assumption that migration decisions change the composition of the population, while keeping the total number of taxpayers constant. I show formally in the Appendix A.1 how the *revenue-maximizing rate* differs from the *transfer-maximizing rate* because of this *transfer channel* that changes the absolute number of individuals who share the government revenue. Below, I develop the same intuition by using the small tax deviation approach.

The change in the mass of type-i taxpayers after a small tax reform is $-\sum_i \frac{N_i}{1-\tau} \varepsilon_i d\tau$. The migration response of type-i individuals generates a change in taxes collected equal to $-\sum_i \frac{N_i}{1-\tau} \varepsilon_i d\tau \times y_i \times \tau$ because individuals come or leave with their overall tax liability $y_i \times \tau$. This term captures

what I call the *revenue effect* of tax-induced migration: any change in the linear tax rate changes the amount collected by the government because of changes in the tax base (e.g number of taxpayers). But the amount of revenue redistributed to individuals in the country also changes because the number of transfers' beneficiaries becomes endogeneously affected by the reform. The tax reform generates a change in the absolute number of transfers' beneficiaries $\sum_i \frac{N_i}{1-\tau}\varepsilon_i d\tau \times T_0$. For individuals below the break-even point, this term is negative ($\varepsilon_i < 0$) and captures the additional fiscal cost implied by bottom earners who move to the country when transfers increase (as taxes increase). This is what I call the *transfer effect* of tax-driven migration. This channel has not been described nor discussed in the previous literature on optimal taxation.

The overall effect of tax-induced migration on redistribution to everyone remaining in the country is therefore given by $-\left(\sum_i \frac{\tau}{1-\tau}\varepsilon_i N_i y_i d\tau - \sum_i \frac{\tau}{1-\tau}\frac{N_i}{N}\varepsilon_i Y d\tau\right)$. Summing this to the mechanical change in tax revenue $Y d\tau$ and the labor supply effect $\sum_i \frac{N_i}{1-\tau} e_i d\tau \times y_i \times \tau$ gives the total change in the amount that can be redistributed to the total mass of residents: $d\tau \times Y \times (1 - \frac{\tau}{1-\tau}\sum_i \frac{e_i N_i y_i}{Y} - \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i y_i}{Y} + \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i}{N})$. Each individual remaining in the country after the reform faces a change in transfers equal to $\frac{1}{N}$ of this term.

I call $\varepsilon = \sum_i \frac{\varepsilon_i N_i y_i}{Y}$ the income-weighted average migration elasticity, $e = \sum_i \frac{e_i N_i y_i}{Y}$ the income-weighted labor supply elasticity, and $\varepsilon_p = \sum_i \frac{\varepsilon_i N_i}{N}$ the population-weighted average migration elasticity. The transfer maximizing rate is such that $\frac{1}{N} \times d\tau \times Y \times (1 - \frac{\tau}{1-\tau}e - \frac{\tau}{1-\tau}\varepsilon + \frac{\tau}{1-\tau}\varepsilon_p) = 0$, which is equivalent to $\frac{\tau}{1-\tau} = \frac{1}{e+\bar{\varepsilon}}$ where $\bar{\varepsilon} = \varepsilon - \varepsilon_p$. I discuss later the underlying economic forces captured by this aggregate sufficient statistic.

Let's finally consider the welfare maximizing linear tax rate such that the welfare gain of $d\tau$ is zero. I derive as a baseline the welfare maximizing linear rate as the linear tax rate that maximizes the welfare of current residents. The small tax deviation generates a loss in welfare for individuals remaining in the country after the reform due to the increase in taxes paid equal to $\sum_i N_i y_i g_i d\tau$, and a change in welfare due to the change in transfers received equal to $\sum_i N_i g_i \frac{1}{N} \times d\tau \times Y \times (1 - \frac{\tau}{1-\tau}\sum_i \frac{e_i N_i y_i}{Y} - \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i y_i}{Y} + \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i}{N})$. The total welfare effect of the small tax deviation is therefore $\sum_i N_i g_i d\tau \times Y \times \frac{1}{N} \times (1 - \frac{\tau}{1-\tau}\sum_i \frac{e_i N_i y_i}{Y} - \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i y_i}{Y} + \frac{\tau}{1-\tau}\sum_i \frac{\varepsilon_i N_i}{N}) - \sum_i N_i g_i y_i d\tau$. Summing the two welfare effects to zero yields the optimal linear tax formula with

welfare weights described in Proposition 2 and derived formally in Equation (12) (see Appendix A.3). Importantly, the averaged welfare weight $\bar{g} = (\sum_i N_i g_i y_i) . (\sum_i N_i) / (\sum_i N_i g_i . \sum_i N_i y_i)$ is a function of the density of residents N_i, taken as given for the aggregation of welfare.[4]

2.4 The Role of Tax Competition on Redistribution

I now discuss the economic mechanisms underlined by Proposition 2. The optimal linear tax rate in the competition union is a function of the mobility parameter $\bar{\varepsilon}$ that is a combination of the income-weighted and the population-weighted mobility parameters. In the special case where a tax reform does not change the *absolute* number of taxpayers, that is $\sum \varepsilon_i \frac{Ni}{N} = 0$, we are back to a standard inverse elasticity rule where the optimal tax rate is only a function of the income-weighted migration elasticity. In this specific case only, the revenue-maximizing rate is equivalent to the transfer-maximizing rate.

In the more general case, the effect of tax-induced migration can be decomposed into two terms. The net effect of type-i individuals' location choices on tax revenues depends of the size of their relative income compared to their relative weight in the population. Said differently, the government weights the mobility responses of type-i individuals by taking the difference between type-i individuals' additional fiscal gains (tax payments) and costs (transfer receipts).

I illustrate the implications of the weighting of the migration elasticity ε_i by making two extreme assumptions on the distribution of the mobility parameter ε_i. Let's first assume that only individuals with zero earnings react to taxation through migration. The stock of bottom earners N_b is a *decreasing* function of the net-of-tax rate and it follows that ε_b is negative. With mobility responses concentrated at the bottom of the income distribution, the uniform mobility parameter is thus $\bar{\varepsilon} = -\frac{\varepsilon_b N_b}{N}$. Since ε_b is negative, $\bar{\varepsilon}$ is positive and the resulting optimal linear tax rate in competition is lowered by tax-driven migration coming from the bottom of the distribution.

What happens in the opposite situation, when tax-induced migration only comes from the very top of the income distribution? The consumption of top earners is a decreasing function of the linear tax rate and their migration elasticity ε_t is always positive. If the country considered is large enough, the population weight of very high earners becomes negligible and the mobility parameter

[4] I discuss in the Appendix A.3 the normative challenges related to the aggregation of welfare in the open economy.

entering in the optimal tax formula can be approximated by $\bar{\varepsilon} = \frac{\varepsilon_t N_t y_t}{Y}$ that is always positive. Hence, the optimal linear tax rate in the competition union is lowered by migration coming from the top of the distribution too.

The key takeaway from these two examples is that regardless of the skewness of ε_i towards any side of the earnings distribution, the optimal linear tax rate in a competitive setting is consistently reduced by tax-driven migration. This results in less redistribution in the competition union when compared to the federal union. The mechanisms leading to less redistribution in these two extreme cases are different, and both emphasize the trade-offs faced by governments competing in a free mobility union with no fiscal cooperation.

3 The Welfare Effects of Tax Competition

3.1 Methodology

I now turn to the quantification of the welfare effects of tax competition. As described before, individuals derive an utility $u_i(c_i, y_i)$ that is decreasing with earnings due to disutility for work, and increasing in consumption. The welfare effect of tax competition compared to the federal union will be given by the change in individuals' utility from one system to another. This change in tax system will affect individuals' utility through three channels.

First, different tax systems will affect individuals' pre and post tax earnings. The optimal tax rates established in each of the two systems differ due to the migration parameter, resulting in different amounts of taxes paid for a given level of income. Furthermore, because of labor supply responses, the disparities in tax rates between the two systems will also lead to differences in individuals' pre-tax income (because of differences in the number of hours worked). Second, because individuals supply different number of hours of work in tax competition or in the federal union, this will affect individuals' welfare in each system through disutility of work. Third, individuals will receive different transfers in the two systems, because the rate at which aggregate earnings can be taxed will be different, and because the number of transfers' beneficiaries will also change.

I consider two *perfectly symmetric* competing countries, hence those countries set the same optimal tax rate in the decentralized competition equilibrium. This means that the density of tax-

payers in each country is unchanged because the neighboring country implements the same policy. In the symmetric decentralized equilibrium, there are no welfare costs of tax competition coming from an actual change in the number of taxpayers and transfers' beneficiaries. The only difference between the federal union and the symmetric competition equilibrium is the different optimal linear tax rate. This is because the decentralized government must internalize individuals' propensity to migrate in responses to taxes. The actual welfare cost in the Nash equilibrium therefore corresponds to the welfare effects of *migration threat*. This point was also illustrated by Lehmann, Simula, and Trannoy (2014). The symmetric equilibrium analysis is therefore useful to estimate a *lower bound* for the welfare effects of tax competition.

Functional Forms I need three empirical moments to implement my welfare calibrations: the behavioral labor supply and migration elasticities, the redistributive tastes of the government, and individuals' underlying preferences that determine the behavioral elasticities.

To quantify the welfare effects of tax competition, I must make some functional form assumptions regarding the primitives of the model, e.g individuals' utility functions. I use a standard quasi-linear utility function with no income effects:

$$u_i(c_i, l_i) = c_i - \frac{l_i^{1+k}}{1+k} \tag{8}$$

The compensated labor supply elasticity is equal to $\frac{1}{k}$, and the value of parameter k is chosen in order to be consistent with empirical values of e. Individuals have heterogeneous abilities. Formally, they are endowed with skills w_i such that for every individual $y_i = w_i l_i$. Using the first order condition of the individual problem, earnings can be expressed as a function of the labor supply elasticity, the tax rate and individuals' ability:

$$y_i = w_i^{e+1}(1-\tau)^e$$

I follow Saez (2001) and I retrieve the exogeneous distribution of skills using the observed distribution of earnings, the current tax rate and a chosen distribution of e. I use data on the distribution of earnings in France and an approximation of the actual linear tax rate of 50 percent, that corresponds to the share of the French national income that is taxed.

With the calibrated exogeneous distribution of skills at hand, I can compute the welfare of individuals under different tax systems (federal or competition), and scenarios (varying elasticities values and distribution and government redistributive tastes), taking the distribution of skills as fixed conditionally on the distribution of labor supply elasticities.

Numerical calibrations I use a constant value of 0.25 for the labor supply elasticity e. This is in line with the value widely used and estimated in the literature.

Regarding preferences for redistribution, a first useful benchmark is the most redistributive government e.g the Rawlsian government that only values the welfare of the bottom fifty percent. I also consider two alternative types of government: a *highly redistributive government* that values the welfare of each individual in the bottom fifty percent five times more than the welfare of individuals in the other deciles, and a *moderately redistributive government* that values the welfare of each individual in the bottom fifty percent two times more than individuals in the other deciles.

The last parameter needed, and the most important in this analysis, is the migration elasticity parameter. The policy-relevant parameter is ε_i, the elasticity of the *stock* of type-i individuals with respect to the net-of-tax rate. As emphasized by Kleven et al. (2020), there is a lack of empirical evidence on the empirical value of ε_i, especially for broad labor market segments and low levels of income. Furthermore, the migration elasticity is affected by many environmental factors, such as the size of jurisdictions, current differences in tax rates, and levels. This means that the values of the elasticity ε_i may be varying over time, and across countries.

While evidence of cross-border migration responses to taxes remains scarce, existing evidence focusing on top earners suggests estimates between 0.2 and 0.4.[5] In recent work, Muñoz (2019) estimates migration elasticities for the top ten percent employees in 26 European countries. The results show that the location choices of European top ten percent employees are significantly affected by variations in top income tax rates with resulting migration elasticities that are between 0.1 and 0.4 on average. The estimated elasticities are presented in Table B.I for a given set of European countries. For France, the migration elasticity for the top decile is in the range [0.30;0.45].

[5] Kleven et al. (2013) estimate that the elasticity of the number of football players with respect to the net-of-tax rate (the *uniform* elasticity) is between 0.1 and 0.4 on average. Akcigit et al. (2016) find estimates in the same ballpark. Focusing on within-country variations, Moretti and Wilson (2017) estimate a stock elasticity between 0.4 and 0.5 (top inventors moving across U.S. states); Agrawal and Foremny (2018) estimate a stock elasticity of 0.8 (top 1% earners moving across Spanish regions).

There are even fewer empirical studies of migration responses of bottom earners to transfers. One noticeable exception is Agersnap, Jensen, and Kleven (2020) that estimate large migration responses to a change in migrants' income through an increase in transfers in Denmark. Interestingly, their estimated migration elasticity for low-income migrants (defined with respect to a change in transfer) is similar in magnitude to the elasticity estimated for top earners in other contexts (with respect to a change in the net of tax rate).

Given the results of the empirical literature described above, I consider an interval for the value of ε_i of [0.1;0.4]. These values are small and are below unity. I will investigate various scenarios regarding the distribution of the mobility elasticity with income (e.g the semi-elasticity).

3.2 Results

I implement the numerical calibrations using the French earnings distribution. My baseline computation uses a constant labor supply elasticity of 0.25 and a migration elasticity that is constant across all earnings types (ε_i has the same *absolute* magnitude for all types i). This means all individuals exhibit the same migration responses to a change in their consumption level, except that tax changes have an opposite effect for individuals' consumption if they are on different sides of the break-even point. Using the theoretical formulas derived before, I compute the optimal linear tax rates in the federal and the competing union for different redistributive tastes and various values for the migration elasticity. Given these optimal tax rates, I use the first order condition of the individual's problem and the exogeneous distribution of skills to compute the optimal labor supply and pre-tax earnings under each tax system. The universal transfer is then determined by the sum of the pre-tax earnings and the optimal tax rates at the optimum.

The welfare of individuals under each tax system is computed using the utility specification presented in Equation (8). The welfare effect of tax competition is given by the change in welfare that individuals experience when going from a federal union to a competition union. These changes are summarized, for the bottom ten and fifty percent, in Table 1. I show the full distribution of welfare gains and losses in Figure 1. The results show that individuals in the bottom fifty percent of the income distribution always lose from tax competition, and would always be better off in a federal union. Their loss in welfare ranges on average from -10 to -20 percent, depending on

the redistributive tastes of the government and the strength of mobility responses to taxation. By contrast, higher income earners benefit from tax competition, as taxes are lowered by mobility responses to taxation when countries engage in tax competition.

The results of the numerical calibrations show that even with very small migration elasticities (e.g far below unity), the welfare effects of tax competition at the bottom of the income distribution are sizeable. Furthermore, the welfare losses of poorer workers are higher when the redistributive tastes of the government are lower. When the level of redistribution is already low because of the low redistributive tastes of the government, any additional decrease in redistribution because of tax competition has a large effect on poor individuals' welfare. By contrast, if the government has strong redistributive tastes, the effects of tax competition on welfare are mitigated by the high level of redistribution, even in the decentralized equilibrium. This result is important to emphasize that poor citizens may be more exposed to globalization when located in countries with lower redistributive tastes to begin with.

In Table B.III, I relax the assumption of constant elasticities and investigate the special case where tax-induced migration is only present at the top of the income distribution. The results show substantial although smaller welfare losses from tax competition when migration elasticities are constrained to zero for most taxpayers. Nevertheless, individuals in the bottom decile of the income distribution experience substantial welfare losses. For instance, in the intermediate scenario with moderately redistributive government and an elasticity of the stock of top earners of 0.3, moving from the federal union to the tax competition equilibrium is associated with a welfare loss of 6.7% for the poorest individuals.

Overall, those calibrations emphasize the unequal effects of globalization for welfare: the absence of tax coordination when borders are open disproportionately disadvantages the poor, while the wealthy benefit from lower taxes and fare better in such a scenario.

Extension: Non-linear Tax Schedule In the Appendix, I consider as an extension a non-linear tax system with discrete tax brackets a la Saez (2002). Like in the simplest linear tax example, migration responses to taxation reduce the optimal tax rates. Tax competition also implicitly modifies the redistributive preferences of the government. When individuals can respond to taxation (and transfers) through migration, the government's overall welfare weight on top earners is in-

creased (because their tax revenue effects is large) while the implict weight on the poor is lowered (because of the transfer channel that reduces transfers per capita in the open economy). Using a fixed-point algorithm, I solve for the optimal non-linear tax schedule and distribution of earnings that satisfy the government first order condition. I show that the welfare of the poorest individuals is substantially lowered by tax competition with this alternative tax function, with welfare losses that can go up to 10 percent.

4 Conclusion

This paper quantifies the welfare effects of tax competition. The results show that, everything else being equal, individuals in the bottom fifty percent of the income distribution always lose from tax competition, and would always be better off in a federal union. Their loss in welfare ranges on average from -10 to -20 percent, depending on the redistributive tastes of the government and the strenght of mobility responses to taxation. By contrast, higher income earners benefit from tax competition, as taxes are lowered by mobility responses to taxation when countries engage in tax competition.

These welfare estimates are based on restrictive assumptions that imply that they are a lower bound for the real welfare effects of tax competition. For instance, redistribution is viewed as not productive, as the government only reallocates consumption across individuals. In the case where public spending would generate externalities, say through investment in education or health, the welfare effects of tax competition may be larger. Another important assumption is that wages are assumed exogeneously fixed. When tax-driven mobility changes pre-tax earnings, individuals' welfare will be affected by tax-competition through the effects of mobility on pre-tax earnings. Relaxing those assumptions provides a fruitful avenue for future research.

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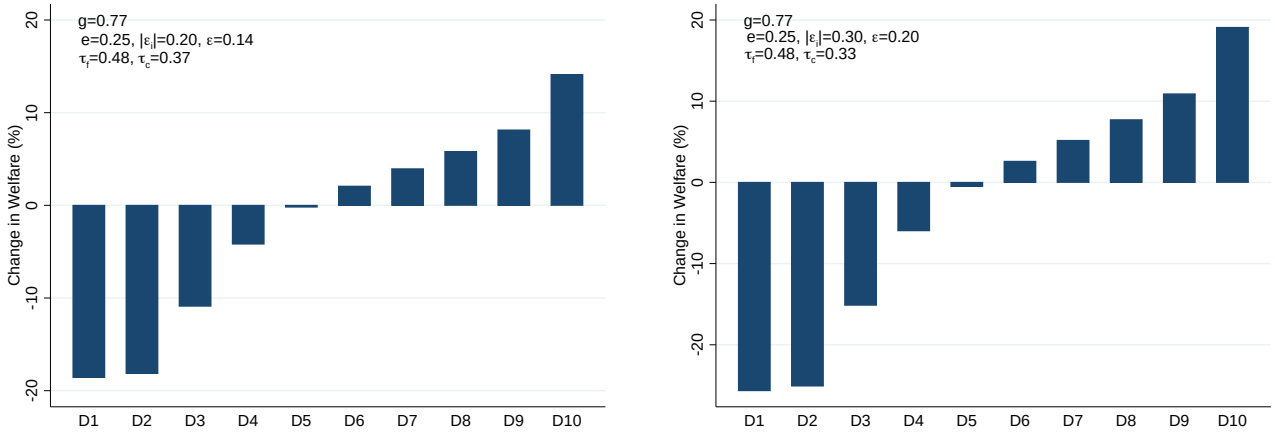
Table 1: **Effects of Tax Competition on Optimal Taxes and Welfare With a Linear Tax Schedule**

	Scenario 1 Elasticities e=0.25 $\bar{\varepsilon}$=0.07 $\lvert\varepsilon_i\rvert$=0.1		Scenario 2 Elasticities e=0.25 $\bar{\varepsilon}$=0.14 $\lvert\varepsilon_i\rvert$=0.2		Scenario 3 Elasticities e=0.25 $\bar{\varepsilon}$=0.20 $\lvert\varepsilon_i\rvert$=0.3		Scenario 4 Elasticities e=0.25 $\bar{\varepsilon}$=0.27 $\lvert\varepsilon_i\rvert$=0.4	
I- Optimal Linear Tax Rates								
	Federal	Competition	Federal	Competition	Federal	Competition	Federal	Competition
Rawlsian	0.73	0.68	0.73	0.64	0.73	0.60	0.73	0.57
Highly Redistributive	0.65	0.59	0.65	0.54	0.65	0.50	0.65	0.47
Mod. Redistributive	0.48	0.42	0.48	0.37	0.48	0.33	0.48	0.30
II- Welfare effect of Tax Competition (%)								
	Bottom 10	Bottom 50	Bottom 10	Bottom 50	Bottom 10	Bottom 50	Bottom 10	Bottom 50
Rawlsian	-2.7	-0.7	-6.0	-1.9	-10.3	-4.0	-12.8	-5.2
Highly Redistributive	-5.4	-2.5	-10.7	-5.3	-15.7	-7.9	-20.1	-10.5
Mod. Redistributive	-10.2	-5.7	-18.6	-10.5	-25.7	-14.5	-31.7	-18.0

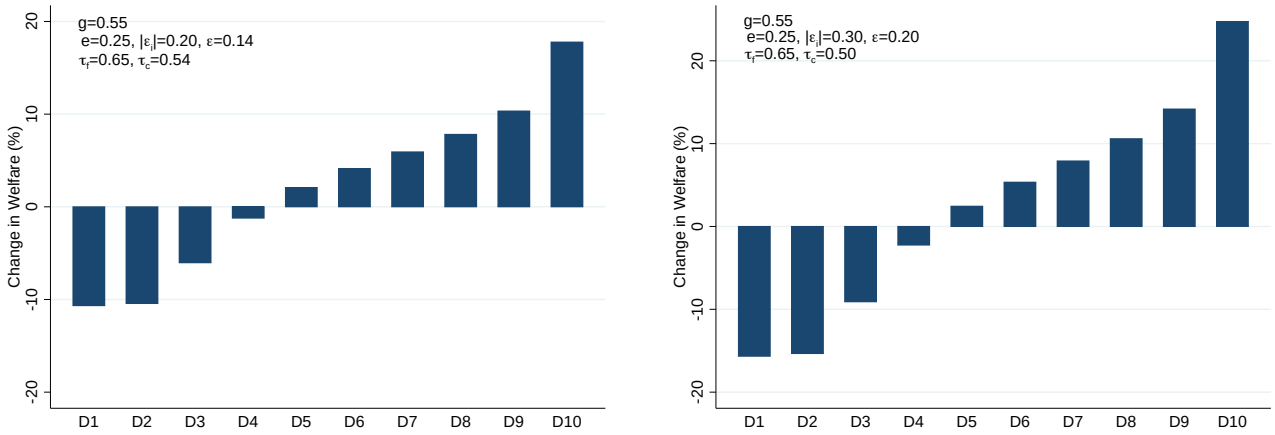
Notes: This Table summarizes the effects of tax competition on optimal tax rates and welfare. The optimal linear tax rates are computed following the formulas presented with more details in the text and presented in Proposition x and Proposition x. The elasticity e_i is the elasticity of type-i individuals gross earnings y_i with respect to the net-of-tax rate $1-\tau$. The elasticity ε_i is the elasticity of the number of type-i residents N_i with respect to the net-of-tax rate $1-\tau$. As described with more details in the text, ε_i is negative for all individuals who have an income level that is lower than the average income in the economy (break-even point). For the calibrations presented in the Table above, the migration responses to taxation are assumed to be constant across all earnings levels: all individuals in the population have the same migration response to an increase of their consumption through a change in taxes. The parameter e is the income weighted average labor supply elasiticity $\sum_i((N_i y_i)/Y)\times e_i$ and the parameter $\bar{\varepsilon}$ is the combination of the income weighted and population weighted average mobility elasticity $\bar{\varepsilon}=\sum_i((N_i y_i)/Y)\times\varepsilon_i-\sum_i(N_i/N)\times\varepsilon_i$. The average welfare weight $\bar{g}$ captures the redistributive preferences of the government. The moderately redistributive government values the welfare of individuals in the bottom fifty percent two times more than the welfare of individuals in the other deciles with a corresponding $\bar{g}=0.77$. The highly redistributive government values the welfare of individuals in the bottom fifty percent five times more than the welfare of other deciles with a corresponding $\bar{g}=0.55$. The Ralwsian government only values the welfare of individuals in the bottom fifty percent. The welfare of each individual is computed using the utility specification $u_i=(1-\tau)y_i+T_0-1/(1+1/e_i)\times l_i^{1+1/e}$. Pre-tax earnings are endogeneously determined and follow the first order condition of the individual $y_i=w_i^{1+e}(1-\tau)^e$ using an exogeneous distribution of skills for w_i calibrated using the current distribution of French labor earnings combined with a current linear tax rate of 50 percent, displayed in Table B.II. The welfare effect of tax competition is the variation in percentage of individuals' welfare from a federal union to a competition union. A negative welfare variation means that individuals would be better off in a federal union.

Figure 1: **Distribution of Welfare Gains and Losses from Tax Competition with a Linear Tax Schedule**

Panel A. Moderately Redistributive Government



Panel B. Highly Redistributive Government



Notes: This graph shows the distribution of the welfare effects of tax competition across labor earnings' deciles. The welfare effect of tax competition is the variation in percentage of individuals' welfare from a federal union to a competition union. A negative welfare variation means that individuals would be better off in a federal union. The moderatively redistributive government values the welfare of individuals in the bottom fifty percent two times more than individuals in higher income deciles. The highly redistributive government values the welfare of individuals in the bottom fifty percent five times more than individuals in the higher deciles. The tax system consists in a linear τ paid on income and a universal demogrant redistributed to everyone. The parameter ε_i is the elasticity of migration with respect to the net-of-tax rate, while $\bar{\varepsilon}$ is a combination of income-weighted and population-weighted average migration elasticity. See the note below Table 1 for more details on the computation of the optimal tax rates and individuals' welfare.