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Do European Top Earners React to Labour Taxation Through Migration?

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Abstract

This paper studies the effects of top earnings tax rates on the mobility of top ten percent employees within Europe. I use a novel detailed micro-level dataset on mobility built from the largest European survey (EU-LFS), representative of the entire population of 21 European countries. My estimation strategy exploits the differential effects of changes in top income tax rates on individuals of different propensities to be treated by these changes. I find that top ten percent workers' location choices are significantly affected by top income tax rates. I estimate a rather low but significant elasticity of the number of top earners with respect to net-of-tax rate that is between 0.1 and 0.3. The mobility response to taxes is especially strong for foreigners, with an estimated elasticity of the number of foreign top earners with respect to net-of-tax rate that is above one. Turning to tax policy implications, I uncover large heterogeneities within Europe, that translate into large differences in incentives to implement beggar-thy-neighbour policies across member states. These findings suggest that despite the overall moderate estimated mobility elasticity, tax competition entails substantial welfare costs.

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1 Introduction

The public debate on tax progressivity is often dominated by mobility responses to higher taxes, rather than standard labour supply effects. Most of top income tax reforms are therefore usually followed by vivid debates on expected top earners' emigration. There are simple reasons that explain why top earners' mobility responses to taxation have become such a central topic for policy makers. The first reason is that top earners' tax driven mobility increases the efficiency cost of taxation, and lowers the ability of governments to redistribute. Because it is more salient than other margins of responses to taxes, tax-driven mobility sheds light on the behavioural burden that may be caused by tax changes. Accordingly, the threat of high wage earners' emigration has been one of the main argument against more progressive tax schedules. The second reason lies in the lack of tax cooperation within the European Union, despite freedom of movement. As members states maximise their tax revenues by setting their tax policies independently, expected mobility responses to taxation had sometimes lead to fear a "race-to-the-bottom" in national top taxation rates.

Is this public debate obsession with top earners' migration responses to taxation justified by the empirical evidence that top earners' significantly react to taxation through mobility? To what extent do taxpayers *vote with their feet*, and what are the implications of such responses in the absence of tax cooperation? In this paper, I use the unique laboratory provided by the European Union, an integrated union with low internal barriers to mobility but substantially different taxation levels, to answer these questions. This paper provides the first evidence on *international* migration responses to personal income tax rates for a representative, non-occupation specific, population of top taxpayers.

Despite the growing attention devoted to top earners' tax-driven mobility in the public debate, there is still very little empirical evidence on the effect of taxation on the international mobility of individuals. The first explanation lies in the lack of international micro data with joint information on individuals' tax residence choices and taxes paid. The second reason is that identifying the causal effect of taxes on location choices is challenging, because of the endogeneity of tax reforms and migration decisions. Three contributions in the literature

managed to overcome these challenges, either by focusing on very specific occupations for which individual-level data on residence and income are available, or by focusing on a specific reform targeted on high skilled immigrants. Kleven et al. (2013) study the migration responses to income tax differentials of football players in 14 European countries for the period 1996-2008 and find significant elasticity of the number of soccer players with respect to personal income tax rates. Akcigit et al. (2016) use individual data on inventors for height OECD countries for the period 1977-2000 and find that top one percent inventors' location choices are significantly affected by top personal income taxes. Kleven et al. (2014) finally use a specific tax scheme targeted on rich immigrants in Denmark to estimate how foreigners responded to the reform. These papers take a first step to fill the gap in the literature on international migration responses to taxation, and establish that superstars' location choices are significantly affected by personal income tax rates, for both domestic and foreigners. However, these studies focus on very specific occupations and the extension of their estimates to the entire top earners population can be challenged. As emphasized by the recent contribution of Kleven et al. (2019), there is still a lack of evidence on tax-driven migration for broader populations, that could be used to better assess the general policy implications of migration responses of taxpayers. This paper aims to fil this gap, and to propose an estimation of migration responses to taxation for a much broader definition of top earners, and for a larger set of countries. In this paper, I quantify migration responses to top earnings tax rates for the entire top ten percent population of 21 European countries, in order to estimate sufficient statistics that are relevant for general policy implications, that are not focused on specific occupations, or specific countries. I show that the representativity of the population used to estimate extensive margin elasticities to taxation matters, and has implications for the calibration exercises. I also demonstrate that studying migration responses to taxation within the entire set of European countries is important for tax policy discussions because it allows to capture mechanisms driven by large heterogeneities that translate into large differences in incentives to engage into tax competition across member states.

The main contributions of this paper are threefold. I first provide new empirical facts on within-EU mobility, using novel measures that overcome the lack of data on international

mobility. I then document the link between income taxation rates and top earners mobility flows at the aggregated level in Europe. I finally estimate a discrete choice model of migration location choices. I use my estimates to compute sufficient statistics relevant for tax policy: the elasticity of the number of top earners with respect to top income taxation. I lay out a simple conceptual framework with a revenue-maximizing government in an open economy, using my estimates to calibrate the efficiency costs of top tax reforms in Europe. My analysis is based on a novel detailed individual-level dataset on mobility covering a representative sample of the overall European population, based on the largest European survey (European Labor Force Survey). The data allows me to track residence choices of taxpayers of different earnings levels in the European Union over the period 2009-2015. I combine this dataset with collected data on top marginal taxes built from the OECD Taxing Wages.

In the first part of the paper, I propose two measures that allow to track yearly flows and stocks of EU residents since 1998. Importantly, as the residence definition used by the EU-LFS is based on the tax-residence concept, these measures are accurate to investigate how the population of taxpayers is affected by taxes. I show that the share of foreign-born citizens in EU-countries is relatively high, and has been continuously increasing since 2004. Accordingly, within-EU mobility flows have been multiplied by two since 2000, without being explained by structural changes in demographics nor labor market transitions. I show that this empirical fact is robust and opposed to what has been observed in the US for the same period (Figure 4). The overall increase in residence mobility over the last decade masks large heterogeneities in mobility levels and trends across member states, that are likely to translate to heterogeneous effects of tax changes on mobility patterns within the EU. Exploiting additional administrative and survey data, I perform extensive consistency and comparison checks to show that my EU-LFS based measure of within-EU mobility is consistent and provide a useful tool to overcome the lack of international micro data on mobility.

In the second part of the paper, I turn to the analysis of the effect of top tax rates changes on top earners' mobility. There are many challenges that arise when trying to identify the causal effect of income tax differentials on top earners' mobility behaviours. The first important issue is that migration decisions are driven by unobserved determinants, such as coun-

terfactual income that an individual could receive in each potential location. This issue is especially salient when considering location choices among a large and heterogeneous set of countries, like the European Union. I address this challenge by exploiting the richness of the EU-LFS, that provides extremely detailed information on individual's occupation and labor market outcomes. I use a large set of precisely measured individual-level characteristics that are directly linked to individuals' labor market performance to proxy top earners' ability in each potential location. Unobserved abilities and skills' prices heterogeneities across member states are thus well captured in my estimation.

Another issue lies in imperfect selection of top earners and bad top tax treatment assignment for the estimation. Exploiting administrative tax data merged with the French part of the EU-LFS, I provide evidence that ranking based on self-reported income is consistent with ranking based on tax register income and find no evidence of systematic underreporting of income, nor systematic correlation between measurement bias in income and decile of income. I use a second European dataset with information on income (EU-SILC) to document propensity to be treated by top tax rates in my estimation sample.

In addition to measurement and omitted variables biases, estimating the causal effect of taxes on location choices is challenged by identification issues. This is because tax reforms are likely to be endogeneous, and correlated with other migration determinants, or migration patterns themselves. My estimation strategy controls for such confounders by exploiting the differential impact of country-by-year variations of top marginal tax rates on individuals with different propensity to be treated by these changes. This approach is similar to the one implemented by Akcigit et al. (2016) who use differential effects of top earnings tax rates on mobility of inventors of different earnings level. It allows to filter out common country-specific time varying shocks and to isolate the causal effect of being treated by the top marginal tax rate. This methodology is close in spirit to a difference-in-difference approach that would compare individuals in the treated tax bracket with individuals of lower propensity to be treated by changes in top tax changes.

I start the empirical analysis with simple correlations between labor taxation and top earners' migration choices at the macroeconomic level. I estimate an aggregated location

choice model, following the approach developped in Moretti and Wilson (2017). The model allows to express the differences in top earners' migration flows between two countries by differences in the net-of-tax rates between these countries, controlling for time-unvariant origin-destination factors. The results show that higher differences between destination and origin retention rates lead to higher emigration from origin to destination country, which is consistent with the prediction of the aggregate location choice model. I estimate a reduced form elasticity of top earners flows with respect to the net-of-tax rate of about 1.5(0.5).

As the decision to migrate is made at the individual level, a large part of mobility patterns are likely to be driven by unobserved heterogeneity and individuals' characteristics. To control for micro-level determinants of mobility decisions, I exploit the individual dimension of the data and turn to a more structural approach. Specifying a discrete choice model with a random utility specification, I estimate a multinomial model of location choice to quantify the elasticity of migration with respect to taxation for top earners in Europe. My identification comes from differential impacts of top marginal tax rates variations on the mobility of individuals with different propensity to be treated by these changes. Differences in propensity to be treated by top marginal tax rates come from differences in individuals' earnings levels, and thus tax brackets. The main identifying assumption is that top earners and the pseudo control group are affected by similar country-specific unobserved contemporaneous changes that are correlated with top marginal tax rates changes. My estimation strategy proceeds in two steps. I first exploit country-by-year variations in top income tax rates, controlling for country fixed effects and country-specific linear trends, that differentiate-out country-level trends in migration and taxation. Importantly, this strategy allows me to investigate plausible general equilibrium effects of taxation on location choices' of all individuals across the earnings distribution. I then turn to a preferred specification including country-year fixed-effects, allowing to filter-out all country-year variations, and solely exploit the differential effect of top income tax rates on individuals of different propensity to be treated by these changes.

My results show that top earners' location choices are significantly affected by top marginal income tax rates. I find no evidence of equilibrium nor spillover effects of top tax payers tax-driven migration choices on lower earnings mobility decisions. My results suggest that

considering the overall European labour market rather than specific occupations with more rigid demand, top earners' tax-driven location choices are not large enough to generate sorting or displacement effects. To take into account the comparability-treatment trade-off in the choice of the control group, I estimate sufficient statistics' intervals, rather than arbitrary point estimates. I compute lower bounds using individuals in the 8th decile of the earnings distribution as the control group, with high comparability properties, but who can also be partially treated by top marginal tax rates changes. I compute upper bounds using individuals in the 5th decile of the earnings distribution as the control group, who are less comparable to top earners, but who have very low probability to be treated by top marginal tax rates. I estimate that the elasticity of the number of top earners with respect to the net-of-tax rate is significant and lies between [0.15(0.04);0.25(0.04)]. I find that the elasticity with respect to the net-of-tax rate is significantly larger for foreigners (defined as movers), and lies in the interval [0.67(0.26);1.5(0.28)], which is consistent with the elasticity in terms of flows estimated in my aggregated location model. With these results at hand, I discuss the importance of estimating top earners' migration responses to taxation within a large set of countries, representative of the current European Union, by contrast to previous studies. The larger the number of countries in the structural estimation of mobility responses, the higher the number of foreigners potentially attractable, compared to domestics. This mechanically leads the migration elasticities to be scaled up by the number of countries in the estimation set, which underlines the challenges related to a large mobility union with tax competition.

I use the sufficient statistics estimates from the structural analysis to discuss the policy implications of my results. I uncover large heterogeneities in top earners' tax driven mobility across European member states, driven by countries' size and top earners' tax base composition, that could translate into very different outcomes of tax competition. To investigate the overall tax revenue effects of my estimates, I lay out a simple theoretical model of labor supply that takes into account extensive migration responses to taxation. I use the revenue maximizing-approach to derive and calibrate formulas on the behavioural deadweight burden created by the implementation of a top tax reform in a free movement area as a function of my estimated sufficient statistics. I estimate that a cut in the top marginal tax rate generates

a mechanical decrease in tax revenue that is not compensated by top earners' behavioural responses to the reform, as uniform elasticities are far below unity. However, when governments are able to target foreigners with a specific top income tax rate, they can unilaterally increase their tax revenue by cutting the top taxation rate on top earners located abroad.

I finally turn to the analysis of drivers and mechanisms related to top earners' tax driven mobility within the European Union. In particular, I investigate wether labor market channels affect top earners' migration responses to taxation. I complement my baseline residence location choice estimation with employers level controls and interaction effects; and find no effects of labour market channels on top earners' location sensitivity to top marginal tax rates. However, restricting the analysis to movers only, I uncover substantial heterogeneities in location choices' sensitivity to taxes across occupations. Location choices of top earners working in constrained occupations such as civil servants are much less sensitive to tax differentials compared to migration decisions of top earners working in finance and insurance industries.

Related Literature This paper contributes to the scarce, but growing, literature on migration responses to taxation, that has recently been summarized by Kleven et al. (2019). On international migration responses to taxation, Kleven et al. (2013), Akcigit et al. (2016) and Kleven (2014) found that superstars location choices are significantly affected by personal income tax rates. This paper adds to these studies by showing that this finding holds for a more general definition of top earners, and by providing sufficient statistics estimates that can be used for much broader policy recommendations. This paper is also closely related to the small but growing literature on within-country migration, that exploits local variations in tax rates to estimate the causal effect of tax differentials on location choices. Liebig et al. (2007) and Schmidheiny and Slotwinski (2018) use discontinuities in Swiss cantons' income tax rates to estimate the effects of income tax differentials on high skilled and top earners mobility, showing that individuals significantly react to tax differentials through mobility across regions. Similarly in the United States, Young and Varner (2011); Young et al. (2016) investigate the effect of federal income tax differentials on millionaires migration, and find very

limited effects. A recent study by Agrawal and Foremny (2018) also finds significant effects of income tax differentials on top tax payers' location decisions within Spain. Moretti and Wilson (2017) provide a central contribution by studying the effects of personal and corporate income tax rates across US states on top inventors location choices within the country. In a recent study leveraging historical data on taxes and inventors, Akcigit et al. (2018) show that inventors' location choices within the US were affected by changes in personal income tax rates.

As top earners might not react solely to taxation on income, there is a very scarce literature on the effect of wealth, property and inheritance taxes on mobility. Bakija and Slemrod (2004) show that higher state taxes have a small effect on the mobility of wealthy individuals across states in the United States. In a recent paper, Moretti and Wilson (2019) find that location choices of very wealthy taxpayers in the US are significantly affected by the estate tax. There also exist few papers that have investigated the effect of income tax rates on multinational location choices, such as Egger et al. (2013) who find that firms tend to locate their headquarters where top income tax rates and tax progressivity are lower, suggesting that top earners migration may also embed firms' side response to variations in labor taxation rates.

This paper finally connects to the theory that dates back the seminal contribution of Tiebout (1956) with the idea that individuals choose their location according to taxes and amenities. This work is more generally related to the broad literature on behavioural responses to taxation, extensively reviewed by Saez et al. (2012). The workhorse Mirrlees (1971) model extended to an open economy with mobility shows that the extend to which individuals react to taxation through migration affects the standard optimal tax formula. This theoretical result underlines the need for empirical estimates of the elasticity of migration with respect to taxation[1], as emphasized by the seminal contribution of Lehmann et al. (2014).

The paper is structured as follows. In Section 2, I detail a basic theoretical framework to analyse mobility responses to taxation, describe the mobility dataset that I use for the em-

[1] See Hamilton and Pestieau (2005), Piaser (2007) and Lipatov and Weichenrieder (2010) for the Stiglitz (1982) version of the Mirrlees with discrete types of agents in an open economy and Seade (1977), Diamond (1998), Brewer et al. (2010) for a Mirrlees open economy with continuous distribution of skills.

pirical analysis and document stylized facts regarding within-EU mobility and perform some consistency checks on the EU-LFS-based measures of top earners' mobility, documenting potential misreporting and measurement biases. In Section 3, I present reduced-form evidence on the elasticity of migration with respect to taxation at the macro level. In Section 4, I present the results from multinomial micro-level regressions controlling for unobserved counterfactual income and differences in propensity to be affected by top tax changes. I use the coefficients estimated from these regressions to compute migration elasticity of top earners. I lay out a theoretical framework that accounts for mobility responses to taxation, and I compute the behavioural effects of tax reforms on governments' revenue using my estimated parameters. I finally run robustness checks on my baseline estimation, and investigate further labour market mechanisms in top earners' migration decisions.

2 Framework, Data and Strategy

2.1 Basic Framework for Top earners Mobility

I base my empirical analysis on a very simple model of top earners mobility within Europe. I consider an integrated zone with N members states, where $n \in 1...N$. Member states set at each time period t the top marginal tax rate τ_{nt} that applies to their top tax bracket taxpayers. In the simple case where the European labor market of top earners is perfectly competitive, the before-tax wage is entirely determined by individual's ability w. An individual receives an individual-specific utility benefit of locating as a tax resident in country n at time t. I denote this idiosyncratic taste term for country n θ^k_{nt}. This benefit could include a preference for home (home bias), the goodness of fit of top earners and country n labor market, or country-level characteristics such as the language, the quality of life or the distance to the origin country. A tax resident in country n gets the utility $u(w^k_{nt}(1-\tau_{nt)})+\theta^k_{nt}$. It follows that the individual k chooses to live in country n at time t if and only if :

$$u(w^k_{nt}(1-\tau_{nt)})+\theta^k_{nt} \geq \max_{n'} u(w^k_{n't}(1-\tau_{n't})+\theta^k_{n't} \tag{1}$$

I assume for simplicity that all the countries are small, and that the change in labour-tax rate in any country $n' \neq n$ will only affect the number of individuals locating in n through the migration between n' and n. On the other hand, changes in τ_{nt} will affect country n top earners' population through top earners' flows between country n and every other country n'. Therefore, the number of individuals locating in country n is a function of (1-$\tau_{n,t}$) and this relationship should be increasing in the top retention rate.

2.2 Data

2.2.1 The Mobility Data

My analysis is based on a large individual dataset on top earners mobility built from the largest European survey covering persons in private households: the European Labor Force Survey (EU-LFS). The EU-LFS is conducted every year, in 33 participating countries for the most recent years, and the participation in the EU-LFS for surveyed individuals is compulsory for fourteen participating countries.[2] Labour force surveys (LFS) are implemented at the country level by national statistcs institutes, and are then yearly aggregated by Eurostat, which also corrects for non-response and applies yearly weighting methods allowing to use the survey at the yearly level for cross-country comparisons. The EU-LFS is enforced by an European regulation since 1973 and these legal grounds are a central element to ensure the quality of these data[3]. The European regulation stipulates explicit rules and common methodology to ensure the comparability of the results across member states. As LFS are used by countries to compute central economic indicators, such as the unemployment rate, a very high attention is devoted to the quality of the data reported. As a result, the reliability and the representativity of the EU-LFS is remarkably high. To complement these data quality requirements, some member states use register data to complete and check the consistency

[2]The EU-LFS is implemented in the 28 members of the Union, the three EFTA countries (Switzerland, Norway and Iceland) and two candidate countries (former Republic of Macedonia and Turkey), and is compulsory in Belgium, Germany, Greece, Spain, France, Italy, Cyprus, Malta, Austria, Portugal, Slovakia, Norway, Switzerland and Turkey.

[3]Regulation (EC) No 577/98. The implementation of a Labour Force Survey harmonized with European criteria is one of the requirement to enter as a new member state in the European Union.

of the data collected, especially regarding demographic variables such as the gender, the age, the marital status or the nationality of individuals. The EU-LFS dataset is described with more details in the Data Appendix.

The EU-LFS is a repeated cross-section database, where the sample of individuals surveyed each year is randomly drawn. It provides detailed information on demographic and social characteristics at the individual level for the year of the survey, and the year before. Individual information in the data include age, country of residence, occupation, marital status, country of birth, nationality, country of work, level of education from 1998 to 2015. Since 2009, the EU-LFS also provides the decile of labour earnings for employees. The EU-LFS uses a very robust definition of residence, that makes it suitable for the analysis of mobility. The survey is intended to cover the whole of the resident population, that are all persons whose usual place of residence is in the territory of the Member States of the European Union. Importantly, a person belongs to the resident population of a given country if he is staying, or intend to stay, on the economic territory of that country for a period of one year or more. This question ("How long do you intend to stay in this country") has to be explicitly asked to surveyed individuals who are new in the country where they are surveyed. If the intended length of stay is lower than one year, the individual is removed from the resident population and is not included in the survey. The EU-LFS therefore allows to capture permanent change in residence based on the 12-months rule, and to define movers as individuals who change their residence country between the year of the survey and the year before. Using administrative French tax data merged with the EU-LFS, I show in Sub-Section 2.4 that the residence-based measure of the EU-LFS survey performs very well, as almost all migrants are matched to an income tax declaration after their change of residence.

Top earners Since 2009, information on the level of monthly labor earnings is collected during the interview, and this information is only available for employees. Individuals are asked to show payslips to confirm the information they provide during the interview. The national statistics institutes use the collected information on labour earnings to compute the earnings distribution for employees in each country, correcting for non response biases, sur-

vey sample weights and information on national income distribution, and attribute decile of income to each employee surveyed in the EU-LFS. I am therefore able to observe European employees of different earnings levels for the period 2009-2015. I define as top earners individuals with labour income in the top decile of the earnings distribution of their residence country[4]. It has been well documented that survey data may under-sample individuals at the very top of the income distribution (Kolsrud et al. (2017)). Hence, the measure of top earners based from the EU-LFS and used in this paper can be viewed as the top decile of employees excluding individuals located at the very top of the labour income distribution. Table 1 provides descriptive statistics for the full population covered by the EU-LFS for the estimation period 2009-2015. Table 2 gives summary statistics for the sample of top earners surveyed inthe EU-LFS for the same period.

2.2.2 Top Income Tax Rates

I merge the EU-LFS with collected data on national income tax rates at the top of the income distribution. I build a dataset of European top marginal income tax rates using data from the OECD Taxing Wages database. The final merged dataset on tax rates and mobility contains information for 21 European countries: Austria, Belgium, Denmark, Croatia, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Slovakia, Spain, Switzerland, United Kingdom.[5]

As outlined by the theoretical framework described in Sub-Section 2.1, the relevant tax rate for migration decisions is the average tax rate on earnings. However, the EU-LFS does not provide information on exact level of earnings, that would allow to compute effective tax rates for each income level. Computing the effective tax rate of individuals included in the estimation sample would require an extensive number of detailed information on individuals'

[4]The decile of labour earnings computed by the LFS does not include any other source of income than labor income, such as capital income or rents. More precisely, the decile of income is computed relative the monthly (take-home) pay that is the pay from the main job after deduction of income tax and National Insurance Contributions. It includes regular overtime, extra compensation for shift work, seniority bonuses, regular travel allowances and per diem allowances, tips and commission, compensation for meals.

[5]Norway, Sweden and Ireland did not provide suficient information either on income decile level or past residence and are therefore not included in the estimation sample. More details on the dataset creation are provided in the Data appendix.

sources of income, wealth and characteristics that are not available in my data. These limitations would be especially salient at the bottom of the distribution, where transfers largely account for individuals' tax burden, explaining partially why the literature has for now focused on migration responses of individuals at the top of the income distribution, where the inference of effective tax rates is easier.

I follow the literature and use top marginal tax rates on personal income as a proxy for effective tax rates. The justification is that if top marginal tax rates are in general not equal to average tax rates because of the nonlinearity of the tax system, they should be strongly correlated to effective tax rates, and this correlation should be increasing with the intensity of treatment by the top marginal tax rate. The elasticity of migration with respect to top marginal tax rate can therefore be interpreted as a reduced-form estimate of the structural elasticity of migration with respect to the effective top tax rate.

My baseline measure of taxation is therefore the top marginal tax rate on personal income, that is the combined central government and sub-central government marginal personal income tax rate at the earnings threshold where the top statutory personal income tax rate first applied, and that is collected by the OECD Taxing Wages Database[6].

The first important advantage of the top marginal tax rate measure is to be exogeneous to earnings, by contrast to the average tax rate. Since actual and counterfactual earnings are not observable, using an exogeneous measure of taxation allows, to a certain extent, to get rid of issues related to correlation between earnings in the destination country and effective tax rates paid in this country. The top marginal tax rate on personal income also presents the advantage to be a very salient tax instrument, which makes it a good tax measure for migration decisions. If individuals may be perfectly able to estimate their overall tax burden in their country of residence, they may be less likely to do so regarding potential destination countries. By contrast, levels of marginal tax rates on personal income in the top tax bracket are very comparable across countries. The final advantage of using the top marginal tax rate on income is that it allows to identify very clearly the threshold of top marginal tax rate treatment across

[6]Data are directly made available to researcher through the OECD Taxing Wages Database https://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP.

member states. As my estimation strategy exploits differences in propensity to be treated by tax changes across individuals, identifying country-level earnings thresholds of treatment by the changes in the tax instrument is central for the analysis, and the interpretation of the results.

An alternative measure of the top marginal tax rate would combine top marginal tax rate on income with employer and employee social security contributions in the top tax bracket. To take into account social security contributions rates in the measure of top income tax rates, I use an alternative measure of top income tax rates that combines the top marginal income tax rate on income with marginal social security contributions rates paid by employees and employers at the top of the income distribution, also collected from the OECD Taxing Wages Database. I present the results using this broader measure of τ for all the estimation results of the individual-level analysis. This approach however implies to treat social security contributions as pure taxes, without taking into account how individuals may perceive the transfers linked to these contributions. Tax-benefit linkages could greatly vary across countries regarding the large heterogeneities across social insurance systems, and be correlated to location choices.

2.3 Sample Selection, Descriptive Statistics and Stylized Facts

Identification of Mobility I use the information on current and past residence to track individuals' mobility flows and stocks within Europe for the period 1998-2015.

A first good measure of within-EU mobility can be captured by the evolution of foreign-born resident population in Europe, that measures the stock of individuals who have been mobile at some point in time.[7] The share of foreign-born residents in Europe is rather high (on average 10%) and has been continuously increasing since 2004 and the EU enlargement (Figure 1). Interestingly the share of foreigners in the overall European population is not very different from what is observed for specific occupations like football players for which

[7]It could also be possible to document non-national population by using the information provided on citizenship. However, this measure underestimate the stock of foreign residents, because individuals who acquired the nationality of their residence country would appear as nationals in the data. As a result, the data shows that the share of non-nationals is systematically lower than the share of foreign-born.

roughly 10% of workforce is foreign born according to Kleven et al. (2013). Panel B of Figure 1 shows that mobility in terms of stock is not necessarily focused at the top of the income distribution since the share of foreign-born residents among bottom earners is larger than the share of foreign-born residents at the top of the income distribution. European countries are very heterogeneous in terms of foreign population size and evolution as showed by Figure 2. Some small countries like Luxembourg have especially large stocks of foreign taxpayers, by contrast to countries like Italy where this share is significantly lower.

To go deeper in the analysis of within-EU mobility, I exploit the information on individuals' past residence to build a flow measure of individuals' mobility. I define as movers individuals who have been resident of another country the year before the year of the survey. As the residence definition used by the EU-LFS requires an intention to stay larger than 12 months, this definition of cross-border mobility allows to robustly capture long term migrants. Figure 3 depicts trends in within-EU cross-border mobility for the period 1998-2015. The figure shows the increase in within-EU migration rate since 1998, where I define the migration rate as the share of individuals in the overall European working age population who changed their residence country between year t and year t-1, from a member state to another. This continuous increase in within-Europe mobility contrasts with what has been observed in the US. One advantage of the EU-LFS based migration measure is that it is directly comparable with within-US inter-state migration rate, computed from the CPS data using information on individuals who changed their state of residence between march of year t and march of year t-1. The large decrease in inter-state mobility in the US observed since 2000 has been interpreted by the literature as a sign of regional convergence (Molloy et al. (2011)). In Figure 4, I show that Europe followed a very different path. Of course, internal migration rates remain substantially different in levels, because of average size differences between European countries and American states, and because of larger migration costs related to crossing countries borders, compared to within-US mobility. However, in terms of trends, Figure 4 suggests tha within-union mobility has been converging over the past ten years. One natural explanation for the increase in within-EU migration rate could be structural changes in demographic trends in Europe, such as changes in age structure or education

level. To asses the importance of demographics changes in observed mobility patterns, I estimate an individual-level regression that includes year fixed effects. I plot in the Panel B of Figure 3 the estimated coefficients on year fixed effects, that give average mobility in each period, after accounting for individual-level covariates. The graph shows that controlling for changes in demographics does not affect the upward trend in within-EU migration rates. I interpret the results of these regressions as the evidence that compositional changes in European demographics account for very little of the observed increase in within-EU migration rates[8].

2.4 Adressing Measurement Bias and Consistency

Because it is built on the basis of a survey, the mobility dataset could be affected by measurement bias. I rely on external data sources to document the consistency of mobility and income measures that I build from the EU-LFS.

2.4.1 International Data on Migration

I start by comparing my mobility measures to other available international statistics on migration in Europe. Very few harmonized measures of migration flows are made available by governments and statistics institutes. I use the OECD measure of foreign immigrants flows, which is based on population registers, and the Eurostat measure of yearly immigration flows, based on the Eurostat demographic database. The comparison between measured mobility flows across the three sources show some discrepancies, that are very limited for some countries, and more important for others (Panel A of Figure A.V). However, discrepancies in measured mobility flows do not only arise between the EU-LFS-based measure of mobility and other sources, but also between OECD and EUROSTAT measures of flows, suggesting that migration flows are probably difficult to extensively measure. This is consistent

[8]Another logical explanation for increase in within-EU mobility could be an upward trend in labor market transitions, such as changes of employers or changes of occupations. In Figure A.IV, I show the evolution of job and occupation transition rates within the EU for the overall period 1998-2015. I see no evidence of an increase in labor market transitions since the 2000s that could explain the increase in migration and labor mobility rates for the same period.

with similar discrepancies in yearly inter-state within-US migration measures across sources that have been emphasized by Molloy et al. (2011). Turning to the measures of foreign residents stocks, the EU-LFS-based measure is fully consistent with others available sources, suggesting that the data measures accurately country-level population of residents. In the next subsection, I leverage French administrative data in order to confirm the EU-LFS based mobility measure accuracy in terms of flows.

2.4.2 French Administrative Data

I use the special features of the French data to document the consistency of my EU-LFS-based measure of mobility and income. The French Statistic Institute (INSEE) proceeds to a yearly matching between the French labor force survey (enquete emploi) and the universe of tax declarations of French residents (declarations 2042), in a database known as the ERFS (enquete sur les revenus fiscaux et sociaux). It is thus possible to obtain precise admnistrative data on income for individuals surveyed in the French part of the EU-LFS, the French labour force survey (F-LFS). The match between the F-LFS and the adminsitrative tax files is only done for individuals who have been surveyed during the last quarter of the survey (march). Therefore, I am able to obtain administrative individual tax files for about 25 percent of the individuals surveyed in France in my European-level estimation sample.

The matching procedure used by INSEE is the following: each year, they have the exhaustive sample of individuals surveyed in the F-LFS, where the set of information includes individuals' exact address[9], their full names, and their family structure. The French tax system is not a pay as you go system: individuals surveyed during the last quarter of year t are matched with the tax file they file at year t+1, that determines the amount of taxes they have to pay on income earned during year t. The INSEE matches the labor force survey with the individual's tax file using individual's address, name, and family structure for individuals who file a joint declaration. The information used being very precise, they are able to match a large majority of the individuals surveyed in the F-LFS, and the number of observations given

[9]The sampling of the French Labor survey is based on housing taxation files, which implies that INSEE detains the exhaustive information on individuals' address.

by Eurostat and by the ERFS is thus very close. As a result, the share of new residents in the French population measured in the EULFS (last quarter) and the matched dataset (ERFS) is similar, as showed by Figure 5. This shows that the EU-LFS measure of mobility in terms of flows is consistent, as it allows to only capture new residents who file a tax declaration after their migration. If my mobility measure would capture non-permanent migration flows, where new residents would not pay their taxes in France, there would be a discrepancy between the ERFS and the EU-LFS, as these individuals would not be matched to income tax files and would therefore be dropped from the ERFS.

I use the special features of the ERFS to evaluate misreporting and measurement bias of income in the F-LFS. As my estimation strategy exploits differences in propensity to be treated by taxes along the income distribution, misreporting of income would threat the validity of the estimation only in the case where it would bias my selection of top earners. This would happen if outliers in terms of administrative-survey wedge are over represented at the top of the income distribution, or if misreporting is systematically correlated with the rank in the income distribution. I conduct two exercises to evaluate this possibility[10]. First, I rank individuals in the ERFS according to their survey and administrative based measure of income, conditional on the fact to observe both measures of income for these individuals. I then evaluate the probability to define an individual as a top earner using the administrative-based ranking, while the administrative-based measure of income would yields a different decile. Figure A.VII shows the share of ranking mistakes by decile of survey-based income. The top decile is characterized by the lowest gap between register-based and survey-based ranking. Among the 25%- percent of individuals allocated to the top ten percent of the survey-based income distribution but not to the top ten percent of the administrative-based income distribution, 80% would be allocated to the ninth income decile using the administrative-based ranking. Hence, when ranking mistakes at the top of the income distribution arise, these

[10]Note that the survey-based measure and the administrative-based measure are not really comparable in terms of level of earnings declared. This is because the survey-based measure of earnings is restricted to labor earnings coming from the main job, including bonuses, travel compensations and other additional allowances, and is net of social contributions and income tax rate, while the administrative-based measure include all sources of labor earnings but is not net of the income tax. Therefore, the value of the wedge is not informative per se, while the correlation between the bias and the earnings level is.

mistakes are limited in magnitude, and do not contaminate the control group selection. This however indicates that 8th-9th decile could partially be treated by top tax rates on income because their overall true adminsitrative income would actually rank them in the top decile. I finally show that there is no endogeneity between misreporting bias and the level of earnings. I plot in Figure A.VI the average misreporting bias by decile of survey based income and show that there is no strong correlation between the level of earnings and the extent to which individuals misreport these earnings in the survey compared to their tax files.

2.5 Identification Strategy and Measurement

The estimation strategy aims to isolate the causal effect of changes in top income tax rates differentials on top earners' mobility location choices within the European Union. I identify three main counfounders that are likely to affect the causal inference of the estimation: the omitted determinants of migration, the endogeneity of tax changes and the partial treatment bias. I discuss these issues and how they are adressed in my empirical specification in the following sub sections.

2.5.1 Omitted Determinants of Mobility

Migration not only depends on top retention rates individuals face in the country where they choose to locate, but also on the set of counterfactual earnings that they could receive in each country included in their choice set. These counterfactual earnings are never observable, and neither are the counterfactual average tax rates. Hence, estimated responses to taxation through mobility could partially load a part of migration that is purely driven by counterfactual earnings, in particular if counterfactual wages are correlated with top retention rates. The richness of the labor force survey allows to control precisely for individuals' ability in the labor market, and thus to control for unobserved heterogeneities in abilities. I use a large set of individual characteristics as proxy for individual's ability in the labour market. I interact these detailed ability measures with country fixed effects, to allow the effects of these individual-level abilitiy proxies to vary along each potential destination. The structural

estimation therefore captures differences in abilities' prices across European labor markets.

Top earners' residence choices might also be partly, or totally, determined by taxation of non-labor income, as showed by Moretti and Wilson (2017) or Moretti and Wilson (2019). If top earners earn capital income and own large amounts of wealth, taxes on capital gains and net wealth may significantly affect their choices of tax residence. Therefore, the estimated effect of top marginal earnings tax rates could load the effects of changes in other tax rates, especially if the variations in differentials of top earnings tax rates are strongly correlated with the variations in differentials of capital and wealth tax rates. If capital income taxes and labor income taxes vary in the similar direction and are both correlated with top earners mobility, the estimated elasticity will capture the overall effect of the top tax burden variation on top earners mobility, which is an interesting and relevant parameter *per se*. In the case where capital tax rates and top income tax rates vary in opposite directions, my estimation of top earners' reaction to taxation could be biased. If one member state increases its labor income tax rate, decreases its capital tax rate at the same time, and top earners' mobility is correlated with both tax changes, I will underestimate the elasticity of taxation with respect to migration. Fortunately, it is likely that contemporaneous variations in capital and income tax rates happen in the same direction, which is almost always verified during my estimation period[11]. Finally, as the top earners sample solely includes top earners who are employees, the bias coming from omitted changes in capital tax rates are expected to be limited, because individuals' main source of income is expected to be labour in this case.

2.5.2 Validity of Top Tax Rates Assignment

One potential worry is that the selected top ten percent of employees is not effectively treated, or only partially, by top marginal income tax rates. I document this potential confounder in two steps. First I use a second European-level dataset to document the propensity to be treated by top tax rates in the top decile across member states. Second, I provide additional evidence on propensity to be treated by top marginal tax rates in the top decile using French

[11]The OECD Taxing Wages provides useful data for personal capital tax rates in order to proceed to this type of checks.

administrative data with register-based information on income.

The European Survey on Income and Living Conditions (EU-SILC) is a detailed annual European survey that gives precise information on various sources of income, such as monthly labor earnings, gross household income, capital income and wealth taxes, for the period 2005-2015. The EU-SILC dataset shares most of its variables with the EU-LFS. These common variables are defined and labeled in the exact same way in the two surveys, which allows to identify exactly similar individuals among the two datasets. I use the EU-SILC to evaluate the propensity of top earners' defined in the EU-LFS to be treated by the top marginal tax rate. In the EU-LFS, the decile of income is computed according to information collected on individuals' monthly earnings. This variable is also collected in the EU-SILC, the difference being that the exact level of monthly earnings is not made available in the EU-LFS, but is available in the EU-SILC. I use this special feature to select in the EU-SILC the top ten percent of the labour earnings distribution according to the EU-LFS methodology. I use this artificial top decile built following the EU-LFS method to evaluate treatment intensity for top earners, and present two examples in 6.In some cases, like Ireland, Belgium or Hungary, individuals below the top ten percent are treated by the top marginal tax rate on income, implying partial treatment in lower brackets. In other countries, like Austria, France or Spain, only a part of the top ten percent is treated by the top marginal tax rate on income. Therefore, the propensity to be treated by top marginal income tax rates does not only differ within-countries across income levels, but also within-brackets across countries. Variations in country-level progressivity of tax system is part of the challenges related to studying tax-driven migration within a large and heterogeneous free movement area. To take into account differences in treatment threshold across countries, I exploit differences in propensities to be treated across earnings levels, rather than pure treated and control criteria. As a result, the estimated coefficient will reflect treatment intensity, rather than treatment eligibility.

I finally exploit the ERFS to investigate top marginal tax rate treatment in the top ten percent of the income distribution in France using administrative measure of income. I finally use the EU-LFS-based income measure to rank individuals within the ERFS. I plot the distribution of administrative and survey income of the selected top ten percent of earnings

distribution in Figure A.I. The average reported individual labour income of the EU-LFS top earners sample in France is 170,000 euros. Roughly 30% of the selected sample have an annual individualwage below 70,000 euros, which is the top tax threshold in 2009.

2.5.3 Endogeneity of Top Marginal Tax Rates

I finally turn to the main potential confounder when estimating the effects of top earnings tax rates on top earners location choices: the endogeneity of top earnings tax rates. The simplest identification strategy exploits variations in top marginal tax rates across countries and time (country-by-year variations) on mobility patterns. Because income tax rates may be correlated with omitted variables correlated with top earners' mobility, the estimates could load other effects than migration responses to tax changes. I first address this challenge using systematic controls for country time unvarying characteristics through the inclusion of country fixed effects. Even though country fixed effects differentiate-out all the permanent factors that can affect supply and demand of top earners at the member state level, the identification strategy could still be affected by time varying shifts. I thus complement the country fixed effects specification with the systematic inclusion of year fixed effects, that control for any year specific shocks that would be correlated with top earners' mobility patterns and top income tax rates changes. This leaves me with a last source of endogeneity that lies in country-specific shocks correlated with tax changes and mobility patterns within the EU. For instance, a local recessionary shock could be correlated with a top income tax reform implemented in response to this shock, but also to simultaneous changes in top earners' migration to and from this member state.

To address this issue, I follow Akcigit et al. (2016) and exploit the differences in propensity to be treated by changes in top tax rates across individuals. This allows me to exploit within-country variations in top marginal income tax rates by exploiting variations in the effects of taxes at the individual level. This approach is conceptually close to a differences-in-differences strategy where I compare treated individuals in the top tax bracket to individuals who do not face the top marginal tax rate, but are comparable.It enables to completely filter-out time-varying shocks that could be correlated with location choices and top tax rates

changes, to isolate the effects of taxes on individuals' migration decisions.

3 Macro-Level Analysis of Migration and Taxation

3.1 Overview on Top Tax Rates and Top Earners Migration

I start by presenting some basic correlations between top marginal earnings tax rates and mobility at the country-year level. I investigate the correlation between the level of top marginal tax rate and the stock of foreigners (both measured in terms of stocks and flows) in the top decile over the period 2009-2015 (Figure A.II). There is no significant correlation between the two, but the exercise illustrates the large heterogeneities across European countries. Eastern Europe countries are characterized with low level of top tax rates but low level of foreigners among top taxpayers. By constrast, some countries like France or Belgium are characterized by much higher levels of top tax rate but also more important population of foreigners in their population. Of course, these differences are likely to be driven by countries specific characteristics. The analysis needs to make use of more variations, and to control for any simultaneous factor that could affect the variation in levels of top tax rates in one hand, and the levels of foreign top taxpayers in another hand.

I complement the basic level-level correlations by studying country-year variations in top marginal tax rates and top earners migration flows, controlling for country and year fixed effects in order to eliminate time-invariant and time-specific factors that could affect top tax rates and top earners mobility flows. The results show a positive correlation between the log share of new resident within the top decile and the log net-of-tax rate, while the correlation is flat when reproducing the same exercise for individuals in the bottom earners, who are not affected by top tax rates changes (A.III). The reduced-form elasticity with the country-year level specification is 0.7, but is not significant, as showed by the results presented in B.I.

3.2 Aggregate Location Choice Model

To make use of more variations in the effects of top tax rates on top earners location choices, I turn to the cross-country analysis of migration flows and taxation, going back to the migration condition described in Equation (7). I follow Moretti and Wilson (2017) and consider an aggregate location choice model that relates the differentials in top tax rates with top earneres' migration flows between two countries. This approach not only controls for country and time specific characteristics, but also for country of origin and destination specific factors that can affect migration decisions. The utility of a top earner in a given country depends on the after-tax earnings in that state, country-specific amenities, and individuals' idiosyncratic preferences for this country. Mobility may be costly, and for each country of past residence (o) and of destination (d), the utility of an individual k who move to country d at time t and was living in country o in previous year is:

$$U_{kodt} = \beta log(1-\tau_{dt}) + \beta log w_{dt} + Z_d + e_{kodt} - M_{od} \tag{2}$$

Where w_{dt} is wage in the current country of residence, τ_{dt} is the top marginal personal income tax rate in the country of residence, Z_d captures specific characteristics of the country of residence and M_{od}represents some cost of moving from country o to country d. The term e_{kodt} is the idiosyncratic taste for location, and represents how much the individual likes country d net of other characteristics. The utility gain of moving is given by:

$$U_{kodt} - U_{ioot} = \beta[log(1-\tau_{dt}) - log(1-\tau_{ot})] + \beta log(w_{dt}/w_{oot}) + [Z_d - Z_o] + [e_{kodt} - e_{koot}] - M_{od} \tag{3}$$

In this model, individuals move only if $U_{kodt} > max(U_{kod't})$ for each $d \neq d'$, that is to say for idiosycnratic factors captured by e_{kodt}. If the idiosycnratic components follow an i.i.d Extreme Value Type I distribution, it is possible to write the logg odds ratio as linear in the difference in utility levels in origin and destination country:

$$log(P_{odt}/P_{oot}) = \beta[log(1-\tau_{dt}) - log(1-\tau_{ot})] + \beta log(w_{dt}/w_{oot}) + [Z_d - Z_o] - M_{od} \quad (4)$$

Where P_{odt}/P_{oot} is the share of top earners that moves from one state to another relative to the population share that does not move. Note that this strategy differs slightly conceptually from the standard random utility one, where individuals decide at period t where to locate, irrespective or their origin location.[12] The estimated parameter β captures the effects of top marginal tax rates on top earners migration flows, and will therefore give an estimate of the elasticity of migration with respect to taxation in terms of *flows*. I estimate Equation (4) (1) controlling for all origin-level and destination level time-invarying characteristics through origin-country fixed effects and destination-country fixed effects, (2) filtering all time-varying factors through year fixed effects, (3) partially controlling for country time-varying variables (GDP per capita and overall population) and (4) controlling for migration costs at the origin-destination level through a dummy for contiguity and common language, that is further replaced by origin-destination fixed effects in an alternative specification. I also follow Moretti and Wilson (2017) by clustering the standard errors at the origin-country $\times$ year level.

$$log(P_{odt}/P_{oot}) = \beta[log(1-\tau_{dt}) - log(1-\tau_{ot})] + \gamma_t + \gamma_o + \gamma_d + \eta x_{od} + \delta x_{ot} + \xi x_{dt} + u_{odt} \quad (5)$$

In Figure 7, I plot the results of the estimation of Equation (5) and I present the estimated values of β across specifications in Table 3. The plot and the associated estimates show that higher destination-origin net-of-tax rate differentials are associated with higher origin-to-destination migration, consistently with the prediction of the theoretical model. The resulting estimated parameter is rather large and significant, and translate to a migration elasticity of

[12] However, in the micro-level estimation of location choices, it is possible to control for home bias using individuals' previous location. Therefore, the country of origin enters in the random utility model estimated in 4 through the home bias and the clustering of standard errors, making it close to the theoretical model exposed in this section. I discuss this point later in the analysis.

top earners migration flows of about 1.5 (0.5). The estimated elasticity in terms of flows is similar in magnitude to the counterpart estimate in Moretti and Wilson (2017), while being a little bit smaller, which is consistent with the prediction that within-country mobility may be more sensitive to tax changes, because of lower migration costs. If this approach allows to relate differences in top tax rates with differences in top earners' migration flows controlling for country-pair permanent factors in addition to country of origin, country of destination and time fixed effects, it has two main limitations. The first important limit is that this approach only make use of country-pair with non-zero migration flows, meaning that the effect of tax rates on top earners' location decisions is only estimated for country-pair and year that actually experienced top earners' migration flows. The second limitation is that in the international migration set up, this strategy requires to assume that that top earners' surveyed in the country of destination were in the top decile of their country of origin, and would therefore have been treated by the top marginal tax rate in this country.

4 Individual-Level Model of Mobility

The macro-level analysis is insightful as it allows to emphasize simple correlations between top marginal tax rates and top earners' mobility within Europe. As a significant part of the location choices are likely to be driven by unobserved heterogeneities across individuals, I turn to the estimation of an individual-level location choice model, that builds on the theoretical model described in Sub-Section 2.1. This micro-level analysis presents many advantages compared to the macro-level analysis: it controls for individual-level determinants of migration and exploit differences in propensity to be treated by top income taxes across individuals in a systematic way.

4.1 Estimation

The structural estimation is based on the assumption that individuals have an additive random-utility, which is increasing, concave, and additively separable in wage and taxes, such as an

individual k coming from country o and living in country n at time t has the utility:

$$\begin{aligned} U_{nt}^{k} &= u((1-\tau_{nt}^{k})w_{nt}^{k}) + \theta_{nt}^{k} \\ &= \alpha_k log(1-\tau_{nt}) + \beta_n x_t^k + \eta_n + \gamma_t + home_{not}^{k} + \phi x_{nt} + v_{nt}^{k} \end{aligned} \tag{6}$$

With the error term being error I extreme value distributed, the multinomial logit model can be estimated with a maximum likelihood. The utility derived by individual k from living in country n at time t depends on the net-of-tax wage he receives in this country, and on country-specific and year-specific characteristics. With this conceptual framework, the idyosincratic term θ_{nt}^{k} loads, among other factors, the migration cost term used in the aggregated model. Equation 6 controls for the idiosyncratic preference for home through a dummy equal to one if the individual was previously a resident in country n. This approach can be viewed as conservative, as it controls for the highest degree of idiosyncratic taste for home in location decisions. As emphasized by Kleven et al. (2013), it captures most of the home bias compared to control for foreign citizenship[13]. In Equation 6, I allow the effects of individual characteristics x_t^k to vary by member states through country-specific coefficients β_n, hence controlling for counterfactual wage earnings in each potential location. Regarding the effects of top marginal tax rate, α_k captures the effect of the top net-of-tax rate on individual's k location choice, and this effect varies with level of earnings, to reflect differences in propensity to be affected by top tax rates on income. Finally, unobserved characteristics of potential locations μ_n and time specific factors γ_t are controlled for using varying fixed effects and trends, such as country fixed-effects, time fixed-effects and country-year fixed-effects. The maximum likelihood estimation allows to predict P_{nt}^{k} the probability that individual k locates in country n at time t, and this for all the countries $n \in N$ available in individual k choice set.

Following Kleven et al. (2013) and Akcigit et al. (2016), I use the estimates of α_k and the

[13] A data limitation of the EU-LFS is that it is not possible to observe the exact country of birth, or citizenship, for foreign born individuals. Is is therefore not possible to control for the counterfactual home country by using the definition of foreigners in terms of citizenship or country of birth. Because of this data limitation, the national-based definition of home cannot be used in the conditional logit used to estimate the location choice model. I discuss this point later in the text.

individual-level predicted probabilities P_{nt}^k to compute individual-level elasticities of location with respect to the top net-of-tax rate such that:

$$\varepsilon_{nt}^k = \frac{dlogP_{nt}^k}{dlog(1-\tau_{nt})} = \alpha_k(1-P_{nt}^k) \tag{7}$$

Equation (7) allows to link the structural model based on the random utility assumption to the individual-level sufficient statistic ε_{nt}^k. The individual-level parameter captures how the probability that any individual k included in the sample of estimation locates in any country n changes when the net-of-tax rate in this country is changed. The individual elasticity is a function of the estimated mobility-parameter α_k that is allowed to vary with individual's income decile, and of the predicted probability that the individual locate in country n P_{nt}^k. Following Kleven et al. (2013), I report country-level aggregated such that:

$$\varepsilon_n = \frac{\alpha_k \sum_k P_{nt}^k(1-P_{nt}^k)}{\sum_k P_{nt}^k} \tag{8}$$

Where Equation (8) captures the uniform elasticity in a flexible demand model for country n as $\varepsilon_n = dlogP_n/dlog(1-\tau_n)$. This is equivalent to compute $\alpha_k(1-\bar{P_n})$ where $\bar{P_n}$ is the average probability weighted by P_{nt}^k to locate in country n.[14]

It would be possible to follow Kleven et al. (2013) and Akcigit et al. (2016) and to report separately the elasticity of foreigners ε_n^f from the elasticity of domestics ε_n^d in country n. Denoting I_n^d the set of domestic top earners in country n and I_n^f the set of non-domestics of country n:

$$\begin{cases} \varepsilon_n^d = \dfrac{dlog(\sum_{k\in I_n^d} P_{nt}^k)}{dlog(1-\tau_{nt})} = \dfrac{\alpha_{C_{kt}} \sum_{k\in I_n^d} P_{n,t}^k(1-P_{nt}^k)}{\sum_{k\in I_n^d} P_{nt}^k} \\ \varepsilon_n^f = \dfrac{dlog(\sum_{k\in I_n^f} P_{nt}^k)}{dlog(1-\tau_{nt})} = \dfrac{\alpha_{C_{kt}} \sum_{k\in I_n^f} P_{n,t}^k(1-P_{nt}^k)}{\sum_{k\in I_n^f} P_{nt}^k} \end{cases} \tag{9}$$

Note that structurally, the discrepancy between foreign and domestic elasticities comes from differences in tax bases. The main argument to document different elasticities of migra-

[14] In the case where the labour market is characterized by rigidities, displacement and sorting effects can arise. See a more precise discussion in the Appendix of Kleven et al. (2013).

tion with respect to taxation in terms of foreigners and domestic groups has been motivated by the fact that governments can discriminate between these two categories using sometimes different tax rates on these two subgroups of top earners. This distinction is however less relevant in the case where the population studied is broader, and not specifically the one targeted by specific migration tax schemes. In addition, because the information for home country of foreign-born is not available, the data does not allow to compute these sufficient statistics for domestic and foreigners defined in terms of birth country. The best definition of foreigners in my data allowing to compute the sufficient statistics relates to past-residence (the flow measure). My preferred reported parameter is the *uniform* migration elasticity, that measures how the number of taxpayers in one country -irrespective of individuals' past residence or citizenship- changes when the net-of-tax rate in this country changes.[15] This is the policy-relevant parameter that indicates the overall effect of top tax rates on location choices of all taxpayers, as emphasized by Agrawal and Foremny (2018). I also report the elasticity of foreign top earners with respect to the net-of-tax rate defined in terms of flows, for comparability purposes with previous studies, and to compare the micro and macro estimates of the flows migration elasticity. This parameter will structurally be high, as it relates to a smaller tax base and to individuals who are by definition mobile.

4.2 Exploiting Country-By-Year Variations in Top Income Tax Rates

My first identification strategy exploits country-by-year variations in top marginal tax rates on individuals with different propensity to be treated by top tax rates. Differences in propensity to be treated come from differences in individuals' income levels, that is to say in tax brackets. Naturally, the propensity to be affected by top marginal tax rates should increase with the level of income, reaching its maximum at the top of the income distribution. To allow for heterogenous effects of the top marginal tax rates on location choices of individuals with different earnings levels, I follow the approach of Akcigit et al. (2016) and I interact the

[15]This reported parameter is directly comparable to the uniform elasticity in the flexible demand model estimated in Kleven et al. (2013). Note that in my data, individuals with a foreign nationality represent on average 8% of the population, which is comparable to the numbers for football players or inventors.

log of the top retention rate with a dummy for being in each decile of the income distribution. Location choices of individuals' with different earnings levels are thus allowed to be affected differently by the top log retention rate, and these effects are capured by decile-specific coefficients α_k. As the first step of the estimation does not include country $\times$ year fixed effects, α_k loads general equilibrium and spillover effects of top income tax rates on location choices. In the absence of country-year fixed effects, the coefficients on log retention rates captures the differential effect of the top net-of-tax rate on individuals of different income level, rather than pure treatment effect of top tax rates. Importantly, without country-year dummies, the effects of simultaneous changes correlated with top tax rates and location choices may be loaded in the estimates. The decile-specific coefficients therefore capture a mix of partial treatment, spillovers and the effects of time-varying factors correlated with changes in top taxes.

To account for the bias loaded in the estimated coefficients, I compute the effect of the top marginal tax rate on top earners' location choices as $\alpha_{true} = \alpha_{treated} - \alpha_{control}$. The treated group refers to the top decile, where the expected propensity to be treated by top tax rates changes is the highest. Taking the difference of the two estimated coefficients theoretically allows to get rid of the bias loaded in $\alpha_{treated}$, assuming that this bias is well captured by $\alpha_{control}$. The control group refers to a group with a lowest propensity to be treated, but affected by similar country-year level policies. There is a trade-off in the choice of the control group, as comparable earnings' group will have a higher propensity to be treated by top tax rates changes, while lower earnings' levels are less comparable, but have lower propensity to be affected by changes in top taxation rates. To take into account this comparability-treatment trade-off, I present intervals for the estimates, rather than arbitrary points.

I view this approach as a first-pass only, as the exploitation of country-by-year variations in the estimation does not allow to disintingle the intensity of top tax rates treatment from spillovers and counfounders effects. I introduce country-year fixed effects as a second step to ensure the stability of the estimates and directly exploit differences in treatment intensity across earnings levels.

The baseline specification controls for the home bias through the home dummy and adds

country fixed-effects that enable to control for time-invariant country characteristics that could be correlated with top taxation rates and top earners' migration choices. As the multinomial logit filters out all the variables which are constant across alternatives destination, year fixed effects are automatically controlled for. Hence, any year-specific factor that could be correlated with top marginal tax rates and top earners' mobility patterns are filtered out. This specification corresponds to column (1) and (5) of Table 4.

To control for the counterfactual earnings w_{nt}^k, I add to the baseline specification rich controls for individuals' ability. I use an important number of individual-level characteristics given by the EU-LFS that proxy individual level ability, including individual's age, age squared, marital status and gender dummies, a dummy for being born outside the European Union and a dummy for having a managerial position. The effect of these individual characteristics are interacted with country fixed effects and proxy for counterfactual wages in every location included in individual's choice set. I also include an indicator for having a tertiary level of education, that controls for a structural and exogeneous measure of individuals' ability. This quality indicator is interacted with country fixed effect that therefore fully absorbs country-level wages variations at the top of the ability distribution. This specification corresponds to column (2) and (5) of Table 4.

I finally partially control for country-year variations that are correlated with variations in top tax rates and changes in top earners' mobility trends by including a year trend interacted with country fixed effects. This allows to capture part of the effect of unobserved country-specific shifts correlated with changes in net-of-tax rates and individuals' location choices. This specification corresponds to column (3) and (6) of Table 4.

Table 4 shows estimation of upper bounds elasticities using the median decile as the control group, and lower bounds using the 8th decile as the control group.[16] The estimated utility coefficient on the top retention rate is large and significant for top ten percent individuals, for all specifications. Individuals in the median and in the bottom deciles exhibit low and non

[16]Because of computational issues, it is not possible to include the full sample of individuals surveyed to obtain decile-specific α_k with the full range of income decile in the sample, that would lead to more than 100 millions of observations. However, I present the results of the estimation for the full range of deciles on a randomly selected subsample in Table 5.

significant reaction to retention rate. The coefficient on log net-of-tax rate declines monotonically with income, capturing well differences in propensity to be treated across earnings levels. As the estimation does not include country $\times$ year fixed effect, some general equilibrium effects could still be loaded in the estimated α_k, for both top earners and lower earnings levels. For instance, migration of top ten percent workers could have general equilibrium effects on housing prices that could negatively impact lower income individuals' location choices. Decrease in top marginal tax rates could also have aggregated effect through tax revenue or country-level policy that could also affect lower earnings groups negatively. However, the coefficient on top marginal tax rate for bottom earners is non significant, and this for all specifications. The results therefore indicate that there are no detectable general equilibrium effects created by top earners tax-driven migration on lower earnings levels location choices, by contrast to what has been found by Kleven et al. (2013). In my specification, location choices of individuals in the bottom decile do not seem to be affected by the variations in top marginal tax rates. This suggests that the overall European labor market is rather flexible, and is not affected by sorting nor displacement effects. Plausibly, top ten percent tax-driven location choices are not sizeable enough to affect lower earnings' levels location choices. As migrants account for a small fraction of the overall population, it is rather reasonable to think that top earners' tax-driven mobility choices do not cause average detectable general equilibrium effects. However, this conclusion may be different when considering specific geographic zones, such as border regions, or tighter sectors of the labour market with rigid demand.

Regarding lower bounds estimates presented in column (1)-(4), the coefficient of the log retention rate on the 8th decile as the control group location choices is positive and significant, suggesting a mix of spillover and partial treatment effects loaded in α, due to lower distance between the treatment and the control group. As outlined in Sub-Section section 2.5.2, in a significant number of European countries included in the estimation set, the 8th decile is treated by the top marginal tax rate on earnings, explaining the significant coefficient. As showed in section 2.5.2, 9th-8th deciles may also contain some individuals with administrative-measure of income in the top ten percent of the distribution, who would

therefore be treated by the top tax rate, thus explaining the partial treatment detected in the estimation. The magnitude of the coefficient is however lower, as individuals in the 8th decile are treated with less intensity than individuals in the top decile.

In the most detailed specification, uniform migration elasticities range from 0.15(0.04) to 0.25(0.04), and are significant at the one percent level. The magnitude of the elasticities are rather small, and in line with the literature on international migration responses to taxation, while being lower than the stock elasticities that have been estimated for within-country mobility. By contrast, the mobility elasticity of foreigners, defined in terms of movers, is rather large, and lies between 0.67(0.26) and 1.5(0.28). The elasticity of the number of foreigners with respect to the net-of-tax rate is structurally higher as it relates to a much smaller base. The magnitude of the micro estimate for the foreigners elasticity is reinsuringly very close to its macro counterpart that relates to the elasticity of top earners migration *flows*. Interestingly, the micro estimate of the foreign elasticity is bounded by the two estimates of the macro-analysis. The lower bound is equal to the macro-correlation presented in the cross-country approach at the year-level, while the upper bound is given by the flows elasticities estimated using the aggregate location choice model.

To verify the robustness of the estimation to the inclusion of various control groups, I reproduce the benchmark estimation presented for a randomly selected subsample of individuals, keeping the full range of income deciles. table 5 shows the result of the estimation, where the log retention rate is interacted with a dummy for being in the top ten percent, a dummy for being in 8th-9th deciles, a dummy for being in 6th-7th deciles, and a dummy for being in the bottom fifty percent of the income distribution. Results indicate that the coefficient on log retention rate is monotonically decreasing in the level of earnings, as the propensity to be treated by top marginal tax rates decreases. Estimated elasticities are increasing with the level of earnings of the control group, reflecting well the comparability-treatment trade-off in the choice of the best comparison group. It follows that the estimated elasticity is decreasing in the decile of earnings of the control group chosen.

4.3 Exploiting Within-Country Variations in Top Income Tax Rates

The second step of the estimation strategy consists in filtering-out any variations at the country-year level in order to solely exploit the differential impact of changes in top marginal tax rates on income on workers of different earnings levels. This can be acchieved through the inclusion of country $\times$year fixed effects that control for all contamporaneous country-varying factors. This estimation strategy presents the great advantage of ruling out all simultaneous policies that could be correlated with migration and taxation changes, solely allowing for within-country variations. With the inclusion of country-year fixed effects, the coefficients on log retention rates solely load the intensity of the treatment by top marginal tax rates on income on individuals of different earnings levels.

In this identification, the estimated values of the utility parameters α_k directly capture the differential impacts of top marginal tax rates on individuals with different propensity to be treated, ruling out correlated factors that were potentially previously loaded in the same coefficients. In this case, interacting the effect of top marginal tax rates with earnings level not only allow to exploit pure differences in treatment, but also the intensity of this treatment along earnings distribution. Compared to the previous estimation, the estimated coefficient allow to directly get a sense of the treatment intensity in each income bracket.

The only potential confounder left with this identification strategy is the case where top earners and lower earnings level are affected differentially by contemporaneous country-specific and top marginal tax rates variations. For instance, if a country-year level policy has very different implications for the top ten percent and the control group, $\alpha_{true} = \alpha_{treated} - \alpha_{control}$ may not allow to fully filter-out the effect of this unobserved shock.

Implementing this estimation strategy is challenging in several ways. The first challenge lies in the multiplication of country-level parameters included in the structural model, due to the important number of alternative location choices considered in the full-fledge multinomial model in one hand, and to the very large number of individual observations in another hand. The introduction of many non-linear variables through the inclusion of indicators dramatically increases the number of parameters and the computational burden of the estimation.

The second challenge relates to the fact that the data is by nature highly non-linear, with sometimes few observations by cell considered (for instance at the home $\times$ year $\times$ country $\times$ income decile level). Of particular sensitivity is the convergence of the likelihood function, that needs to be acchieved despite non linearities arising in the optimization, to present consistent estimates of the utility mobility parameter.

To get around the issues related to the computational burden and the convergence of the estimator, I first limit the number of alternative countries considered in the estimation including country-year fixed effects. To ease the convergence and the estimation of the structural model, I further normalize the effect of the log retention rate on location choices of individuals in the first earnings decile to zero. As the first estimation exploiting country-by-year variations systematically and consistently indicated a weak and non-significant coefficient on log retention rate for individuals in the bottom decile, this normalization is not restrictive. Conceptually, the estimation strategy is now close to a double differences-in-differences approach, where the treatment effect of top tax rates on the top and lower deciles used as control groups are estimated relative to a pure control group, for which the treatment effect is assumed to be zero by construction.

The first column of Table 7 repeats the preferred specification of Table 4 using the restricted sample of estimation and the double differences-in-differences approach. Column (2) replaces the interaction of country fixed effect and year trend with a country-year fixed effect, therefore filtering-out simultaneous country-year level variations. The estimated value of the mobility parameter is stable, and very close to the estimates relying on country-by-year variations identification presented in Table 4. The similarity of the estimates presented in column (1)-(2) suggests that the specification controlling for country $\times$year linear trend filtered-out most of the time-varying factors, and that the addition of country-year fixed effects does not significantly change the results compared to the country-by-year specification. Similarly than before, but perhaps more directly as the coefficient now load treatment intensities, the estimated coefficient indicates that individuals in the 8th decile are partially treated by top tax rates, while individuals in the median decile are not. As a result, using the 8th decile as a control group is not entirely satisfying, as the placebo coefficient will embed the

effect of top marginal tax rates changes caused by partial treatment. The estimated uniform elasticities range from 0.18(0.1) to 0.32(0.05), and from 0.7(0.4) to 2.0(0.84) for foreigners in the preferred specification, and are fairly similar to the estimated elasticies relying on the entire set of countries estimated before and showed in Table 4. As the within-country specification shows stable estimates compared to the preferred specification showed in column (3) and (7) of Table 4, I use these results as my baseline estimates for the rest of the paper that concerns policy implications discussions.

The results of the estimation presented in Table 4, table 5 and Table 7 show that location choices of European top ten percent earners are significantly affected by top marginal tax rates on income. The results of the literature on superstars tax-driven mobility therefore hold when considering a broader definition of top earners. The estimated foreign elasiticity is high, similarly to what has been estimated by Kleven et al. (2013), Kleven (2014); Kleven et al. (2014) and Akcigit et al. (2016). By contrast, the uniform top earners migration elasticity is much smaller, with values far below unity. These results are also in line with the previous literature, showing that if top earners' location choices are significantly affected by top income tax rates, the overall magnitude of the response is rather limited in size.

4.4 Tax Revenue Effects of Tax Reform

To cast light on the overall tax revenue implications of my estimates, I base my analysis on a very simple conceptual framework, where individuals face a classical trade-off between labour and leisure. In addition, as the economy is open, individuals respond to taxation through migration. Considering the simple case of a linear tax rate in the top tax bracket, I derive the optimal tax rate set by a revenue-maximizing government, using a small tax deviation approach detailed in Appendix B.

Proposition 1. ***(Revenue-maximizing tax rates)***

Let's denote e the labor supply elasticity of top earners and ε the elasticity of the number of top earners in country n with respect to net-of-tax rate in country n. Assuming that the government in country n seeks to maximize the tax revenue raised in its top tax bracket R,

the optimal top tax rate is such that:

(A) *When tax-payers cannot be discriminated on their past residence or nationality, the government sets the revenue-maximizing top marginal rate to:*

$$\tau_J^* = \frac{1}{1+e+\varepsilon} \tag{10}$$

(B) *When discrimination based on previous-residence status or nationality is allowed, the government sets the revenue-maximizing top marginal tax rates on foreigners such that:*

$$\tau_J^{f*} = \frac{1}{1+e+\varepsilon^f} \tag{11}$$

Proof. The derivation of the optimal tax formulas are derived in the Appendix B. □

Proposition 2. ***(Efficiency cost of tax reforms)***

I define the behavioural burden as the share of mechanical change in tax revenue that is cancelled out by behavioural responses to the tax reform. In an open economy, the efficiency cost of a top marginal tax reform is captured by:

(A) When the government uses an uniform top marginal tax rate, the cost of the reform is given by:

$$\Phi = \frac{\tau_J}{1-\tau_J}(e+\varepsilon) \tag{12}$$

(B) When the government implements a specific tax scheme targeted on foreigners, the cost of a reform is given by:

$$\Phi^f = \frac{\tau_J^f}{1-\tau_J^f}(e+\varepsilon^f) \tag{13}$$

I report as an efficiency measure the fraction of the mechanical change in tax revenue in the top tax bracket that is lost because of behavioural effects of the reform $\Phi = |dB1 + dB2|/dM$. Note that $dM = dB1 + dB2$ would imply maximisation of the government tax revenue. More generally, Φ proxies the side of the Laffer peak in the top tax bracket. As soon

as the behavioural deadweight burden does not perfectly cancel out mechanical effects, the tax reform has a positive effect on overall tax revenue raised in the top tax bracket.

I turn to a simple calibration exercise that allows to compute the efficiency costs of tax reforms in a free movement area with heterogeneous levels of taxes. I take a standard low estimate of labor supply elasticity of 0.1 combined with the migration elasticities estimated in the previous section. I show in Table 8 the optimal Laffer rates computed from Proposition 1. Note that these rates are very basic, as they do not take into account any redistributive preferences of the government[17].

Calibrated revenue-maximizing uniform tax rates lie between 50-80 percent, and are on average higher than the current top marginal tax rates. By contrast, calibrated top marginal tax rates targeted on top earners' who where previously located abroad are much lower. [18]. When the government is able to perfectly discriminate top earners with respect to their previous residence status, it therefore has incentives to implement large tax cuts on foreigners, that can be defined either in terms of citizenship, or past-residence[19]. These results therefore give a rationale the implementation of specific tax breaks for foreigners implemented in some member states, and that have been summarized in Kleven et al. (2019). Note that optimally, in order to properly derive the Laffer rates and the related efficiency costs created by tax-driven migration, individual-level migration elasticities should be weighted by individuals' respective wages. As the dataset does not provide information on top earners' wages level, the calibration does not take into account each taxpayers' weight in the actual tax revenue. In the case where the distribution of wages is strongly skewed towards the top among foreigners,

[17] A discussion on optimal linear and non-linear tax rate in the presence of tax-driven migration and social preferences is detailed in Muñoz (2019).

[18] Kleven et al. (2013) estimate significant sorting and displacement effects due to rigid labor demand in the football labor market. In this case, the optimal tax rate for foreigners is lowered by a term that captures such general equilibrium effects of tax-driven mobility. I do not find any evidence of general equilibrium effects in the estimation based on the overall European labor market, suggesting that the global top earners labor market is not tight enough to generate such sorting or displacement phenomenas. Therefore, the optimal tax rate on the overall top ten percent population does not take into account any spillover nor externalities of top earners' migration on lower earnings' individuals. However, these phenomena may arise in some specific labor markets where the demand is rigid.

[19] Note that most of the schemes targeted on foreigners have used a residence-based definition of foreigners, rather than a country of birth based definition. In that case, computing the elasticity of foreigners using the past-residence, or using the flow elastiticy, would make sense.

the revenue-maximizing uniform tax rate on both domestics and foreigners could be lower than the one given by the current calibrations, and could be much more heterogeneous across countries.

I report the efficiency cost of tax reforms that is directly related to the calibrated optimal tax rates, following expressions derived in Proposition 2. The behavioural burden is a function of the current top marginal rate, labor supply and migration elasticities. The main goal of the efficiency cost calibration exercise is to relate the potential economic gains, or losses, coming from top earners' behavioural responses, to the overall effects of reforms in terms of tax revenue raised at the top. When the government uses an uniform top marginal tax rate, the mechanical change in tax revenue of a small tax reform is not cancelled out by behavioural responses to taxation, because the uniform migration elasticity is lower than unity. When the government seeks to evaluate the effect of the tax reform on individuals coming from abroad, the expected behavioural burden very high.[20] Calibrated efficiency costs using the upper bounds shows that the behavioural burden coming from foreigners almost always cancels out the mechanical effect of the reform. Therefore, any tax cut targeted on foreigners will largely compensate the tax revenue loss on the foreign tax base through additional mobility flows. Again, there are large heterogeneities in efficiency costs of the reform targeted on foreigners across countries, reflecting well the differences in incentives to engage in tax competition to attract top earners located abroad. If unilaterally profitable, these types of preferential tax schemes are likely to be costly at the aggregated level. I gather in Table B.IIIsome descriptive statistics on the number of top earners benefiting of such tax schemes within Europe, that amounts to roughly 40,000 individuals per year.[21] On average, the tax exemptions lead eligible foreigners to face top marginal tax rates that are approximately 30 percentage points lower than the regular top marginal tax rate applied to top earners. Therefore, at the aggre-

[20]Note that we could also consider the case where policy makers make mistakes in estimating true domestic top earners' migration elasticities, inferring for instance than domestics are as sensitive as foreigners to domestic tax changes, they misperceive the Laffer peak and under estimate the net mechanical increase of tax revenues at the top. We could ultimately think of a model where domestic top earners are aware of governments' tax setting strategy and therefore try to impact governments' perception of the migration behavioural burden using bargaining or migration threat.

[21]This is a very imprecise and imperfect approximiation, as data sources on these types of tax regimes are scarce. This number is likely to be a lower bound.

gated level, the loss in European tax revenue caused by these tax schemes reaches around 1,200 millions of euros, ignoring labor supply effects.[22]

4.5 Firm-Level Effects on Location Choices

If the results show that top earners' location choices are affected by top income tax rates, they do not allow to say much about potential underlying mechanisms of tax-driven mobility. A first logical question is to ask what is the role played by employers on top earners' reaction to taxation differentials through mobility. Because the estimation sample includes only employees, employers could contribute, or even initiate, the migration decision. For each implicit employee-employer match observed in my data, firms could internalize a part of the income tax burden faced by employee, when hiring or allocating workers across the borders. As a result, the estimates of α_k may load a part of firm-side responses to income tax rates differentials in Europe.

The extent to which top earners' response to taxation is driven by employers' behaviour is a function of companies' bargaining power and wage setting process, and could therefore be more salient in some member states. In this section, I investigate two plausible channels through which employers could affect top earners' residence location response to taxation, which are size of the firm of work and the transition between jobs in the labor market. I finally investigate the effect of occupations on location choices sensitivity to taxes for movers.

It is likely that the type of companies for which individuals are working, in terms of size, activity abroad or industry, affect the way their employees may be able to react to taxation through mobility. In theory, individuals working in bigger firms could benefit from more opportunities to work abroad. I use the information on the size of the firm where the individual works and report in column (1)-(2) of Table 10 my benchmark specification adding an interaction term between the decile of income, the log retention rate, and a dummy equal to one if the employees works for a firm with more than 50 employees. Because of computational

[22]This estimated loss is a lower bound, as I make the simplistic assumption that individuals eligible to the scheme earn the average income of the top decile. As most of the tax breaks are targeted at the top of the top decile (top one percent for Denmark and Spain), the average earnings of eligible individuals are likely to be much higher.

issues, I conduct the estimation on a randomly selected subsample of the full estimation sample used in the baseline results of the estimation. Results indicate that there is no significant effect of working in a firm of bigger size on top earners' migration sensitivity to income tax differentials.

Another channel through which labor market may affect top earners' migration is job transition. A change in country of residence could either coincide with a change in employer-employee match, or employees could stay employed with the same initial employer. The effect of job transition on tax-driven migration is ambiguous. On one hand, keeping the employer-employee match constant could lower the sensitivity of location decisions to retention rates because it increases the attachment to a given a local labor market. On another hand, firms could allocate their employees across borders internalising taxation rates differentials, and in this case the interaction between a constant employer-employee match and the log retention rate in migration location decisions could be positive and significant. I report in column (2)-(3) the results from the benchmark estimation adding an interaction term between the decile of income, the log retention rate, and a dummy equal to one if the employee changes its employer match before and after migration. The coefficients on the interaction term is non significant, suggesting that changes in employees and employer matches on the labor market does not affect top earners tax sensitivity in location decisions.

I finally conduct an heterogeneity analysis by focusing on movers, that is presented in Table 11.To investigate plausible heterogeneity in sensitivity to taxes across occupations, I interact the log retention rate variable with dummies for occupations, and plot the interaction coefficients in Figure 8. Individuals' in more constrained occupations, such as civil servant, are less likely to choose their location according to the retention rate, by contrast to individuals working in banking and insurance. I also find that, consistently with the literature, single and young top earners males are more likely to be sensitive to tax differentials in their location choices.

5 Robustness Checks

In this section, I conduct robustness checks on my benchmark results.

5.1 Changes in Occupation

A potential channel that could affect top earners' location decisions are occupation transitions. Changes in occupations are likely to change the way individuals are treated by changes in top marginal tax rates when the change occurs between self-employment and employment. Top earners may react to taxation changes by switching their occupation from employee to self-employed, or from self-employed to employee. Therefore, occupation transitions could be significantly correlated with top earners' location choices and changes in top marginal tax rates, and could therefore affect top earners' tax sensitivity in location decisions. To take a simple example, a top earner who is an employee of his own company in France may switch his status from employee to self-employed if he moves to Belgium (where capital income rates are very low) after a large increase in income taxation in France. I use information on current and previous occupation status to build an indicator equals to one if the individual had a different occupation in year $t-1$, focusing on occupation changes within employee and self-employed categories.[23] I reproduce the benchmark specification adding an interaction term between top net-of-tax rate, the income decile of the individual and a dummy equal to one if the individual changed his occupation. Note that if the interaction term between occupation transition and log retention rate turns out to be significant, it would raise concerns about omitted determinants of migration in the estimation through non inclusion of capital income taxes. Results in Table 12 indicate no evidence that individuals who change of occupation status are more or less likely to significantly react to income taxation through migration.

[23] Note that I am able to tackle transitions from unemployment to employed and self-employed category. I focus on changes between employed and self employed because they are more likely to be initiated by the individual, while transitions from unemployment might be affected by various other factors.

5.2 Tax Schemes for Foreigners

A potential confounder of the analysis could be the existence of specific tax schemes targeted of foreigners. As the eligibility rules for this type of preferential tax schemes are very specific and depend on variables such as previous residence for a long period of time (up to ten years), wages or occupation, it is not possible to infer from the available data individuals' eligibility to such tax breaks. Therefore, the baseline estimation does not take into account these specific schemes in the estimation. Fortunately, no tax schemes targeted on foreigners have been *implemented* during the estimation period with the exception of Italy, limiting the risk of country-year level shock correlated with top marginal tax rates and top earners' migration patterns,if any. Table B.II shows some descriptive statistics gathered regarding the existing tax breaks in Europe during the estimation period and show that potentially eligible individuals to such schemes represent a very small fraction of the top ten percent population. In addition, these schemes apply to either specific people, or very high income, greatly limiting the risk of omission in the estimation sample.

For countries where preferential tax schemes for foreigners are in place during the estimation period, I attribute the preferential tax rate τ_n^f to all foreigners in the estimation, regardless of their characteristics.[24] I present the results in B.II. Estimates are fairly stable to the imputation of foreigners' tax schemes. Interestingly, the imputation of such schemes indicate some treatment on lower income groups location decisions, that seem to be negatively affected by the variation in top marginal income tax rate. This could be explained by the fact that by contrast to more regular reforms in top tax rates, the implementation of foreigners tax schemes is sometimes directly related to migration patterns, or economic shocks that may affect the treated and control group. For instance, the implementation in Italy of the inbound scheme in 2010 aimed to target top skilled immigration flows after that the recession led top skilled Italians to leave the country. If such recession is correlated with the implementation of the scheme but also with bottom earners migration patterns, it would be loaded in the estimation

[24]That is to say for Italy and France in the specification presented in B.II. More precisely, τ_n^f becomes the taxation rate faced by individuals who move to n, but also the counterfactual tax rate that individuals who stay in their home country $m \neq n$, or move to a different country than n, could have faced if they had decided to move to n.

of the control group coefficient.

6 Conclusion

In this paper, I study the effects of top personal income tax differentials on top earners' mobility in 21 European countries, a topic iof central importance for the European public debate on tax policy. I use a novel individual mobility dataset built from the largest European survey (EU-LFS) combined with collected data on top marginal tax rates on income to track top earners' location choices within the European Union over the period 2009-2015. I exploit variations in the top tax rate across time and countries, as well as its differential impact on top earners at different points in the earnings distribution. I first document stylized facts on European mobility and show macro-level evidence on top earners' mobility and top income taxation. In particular, I show that both stocks and flows of foreigners have been increasing in the EU over the past decade. While within-US migration rate was decreasing over the same period, the within-EU migration rate has been multiplied by two over the past ten years. To explore the effects of top tax rates on top earners' migration, I investigate how changes in origin-destination country pair affects bilateral migration flows. I find that higher destination-origin net-of-tax rate differentials are associated with higher origin-to-destination migration, consistently with the prediction of an aggregated location choice model, which translates to an estimated top earners' migration flows elasticity of 1.5(0.5). I then turn to a more structural approach and take advantage of the individual dimension of the data to capture the importance of unobserved heterogeneities in migration decisions. I estimate a multinomial model of location choices, using differences in propensity to be treated by top marginal tax rates across earnings level. My identification exploits the differential effects of country-by-year variations in top marginal tax rates on individuals of different earnings deciles. The preferred specification is close to a differences-in-differences design, where top earners are the treated group, and individuals in lower deciles are used as control groups. This approach allows to filter-out any unobserved country-year change that could be correlated with location choices and top tax reforms. To take into account the usual limitation of the differences-in-

differences approach where country-year level policies could affect differentially individuals of different earnings levels, I provide the estimates for various control groups. I find that top earners' location choices are significantly affected by top marginal tax rates, and this result is consistent across all specifications. I estimate that the elasticity of the number of top earners with respect to the net-of-tax rate is significant and lies between 0.15(0.04) and 0.25(0.04). The elasticity of foreigners -defined as movers- is especially high, lying between 0.67(0.26) and 1.5(0.28), where the upper and lower bounds corresponds to the estimates provided by my macro analysis of taxation and mobility. I also find evidence of heterogeneities in tax-driven migration behaviours regarding occupations. Top ten percent employees working in finance are for instance more sensitive to top tax rates in a country compared to top earners working in the public administration.

Overall, this paper emphasizes the effects of labor taxation on top earners' mobility, and aims to stress the challenges related to a free mobility area that is characterized not only by a lack of fiscal cooperation, but also by large heterogeneities across countries. The tax policy implications of the estimates point out plausible incentives within the European Union to implement tax cuts in order to attract top earners located across the border. However, this type of tax policy analysis relies on a partial equilibrium analysis, and does not take into account any general equilibrium nor spillover effects of top earners mobility, and residence, on growth, human capital accumulation or technology. An interesting direction for future research would be to quantify such effects of top earners' mobility and tax competition. A second important direction for reasearch is to tackle the potential welfare effects, and their distribution, of tax-driven mobility in a free movement area with uncoordinated tax policies. In a companion paper, I use these estimates to quantify the distribution of the welfare effects created by European tax competition.

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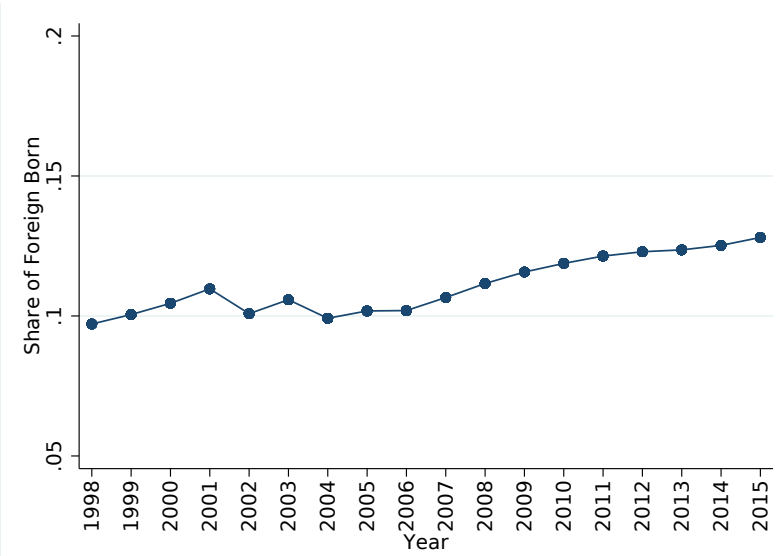
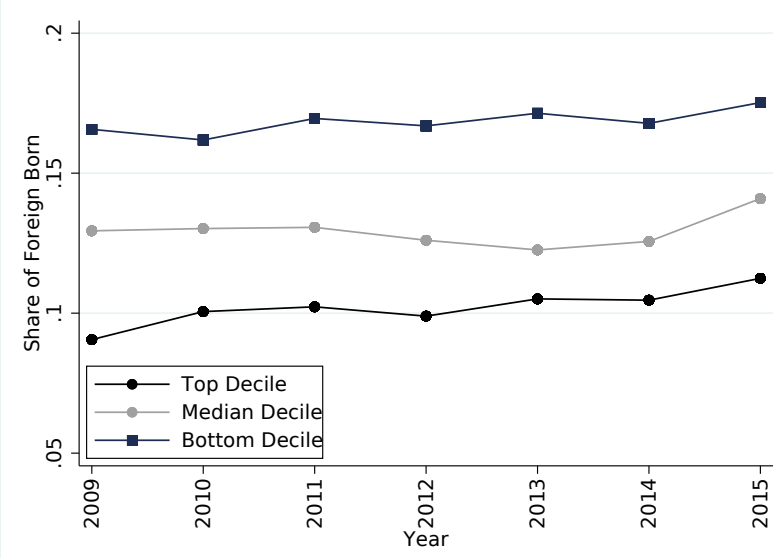
Figures

Figure 1: **Stock of Foreign-Born Residents in Europe**

A. Stock of Foreign Born Residents in the European Union

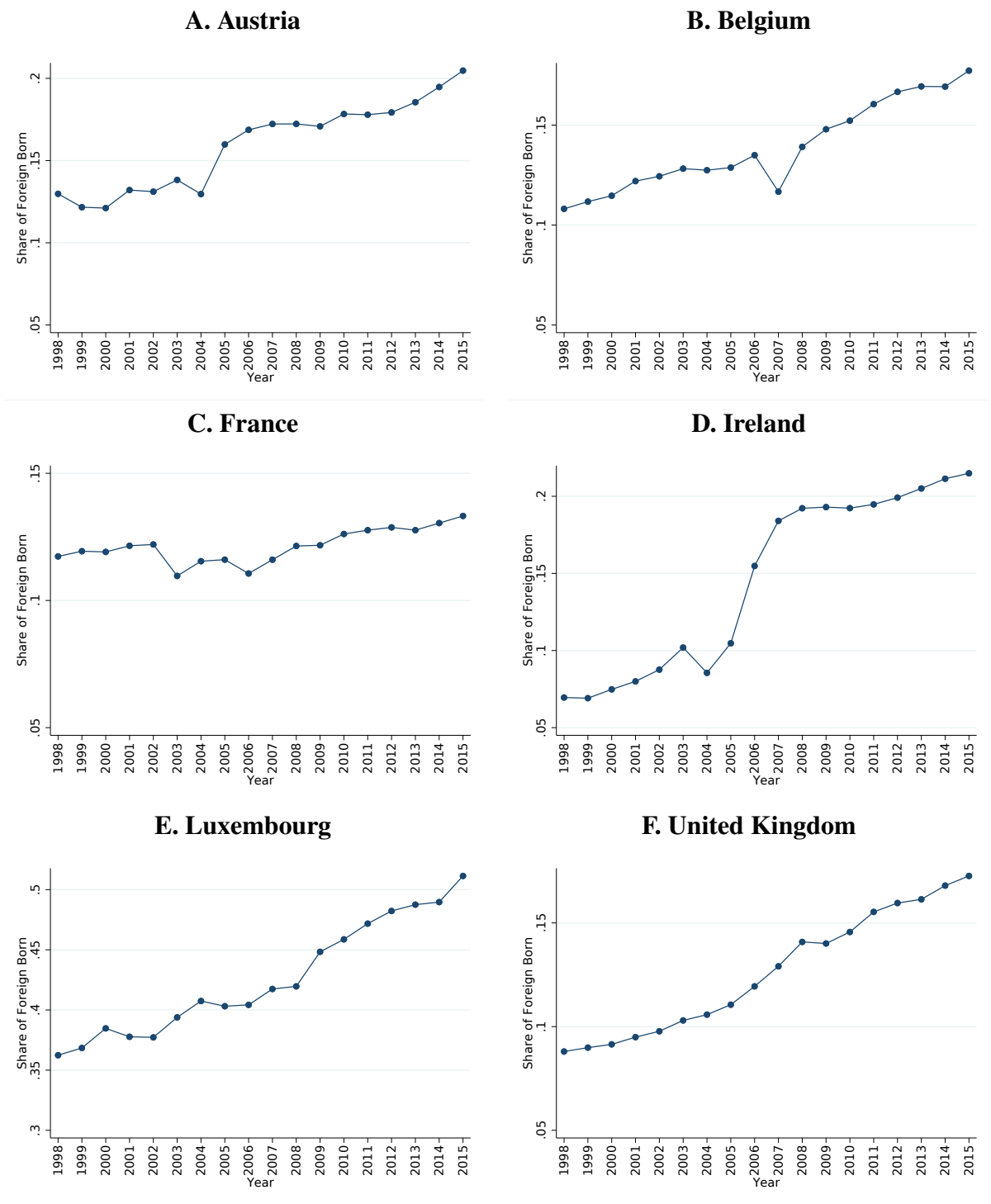


B. Stock of Foreign Born Residents by Income Decile



Notes: The Figure shows the evolution of the share of foreign-born residents in the working age population of the European Union. The European Union is defined over the entire period aregarding its current size, including countries in the free movement area such as Switzerland. Series are constructed from the EU-LFS, and more details on the sample construction are provided in the text and the data appendix. Panel A shows the evolution of the share of individuals whose age is between 18 and 6é years old who live in a country while being born in another country. Panel B shows the evolution of the share of foreign-born within income-decile population since 2009.

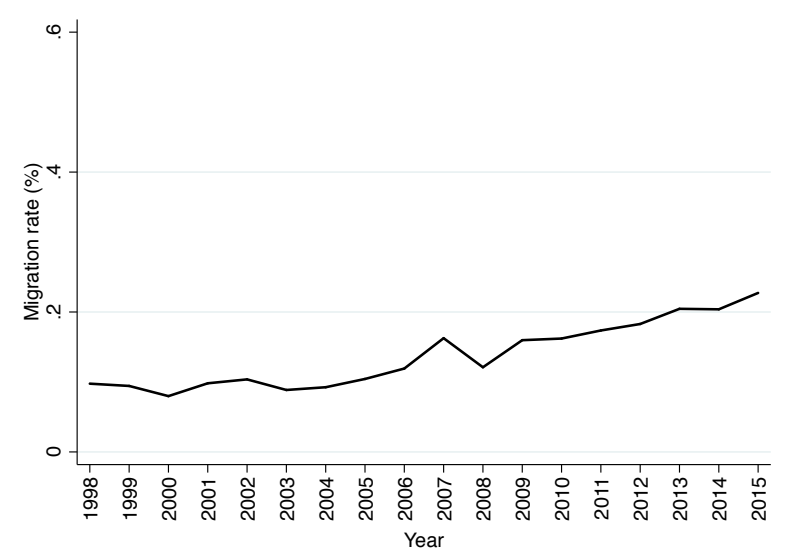
Figure 2: **Stock of Foreign-Born Residents Across European Countries Over Time**



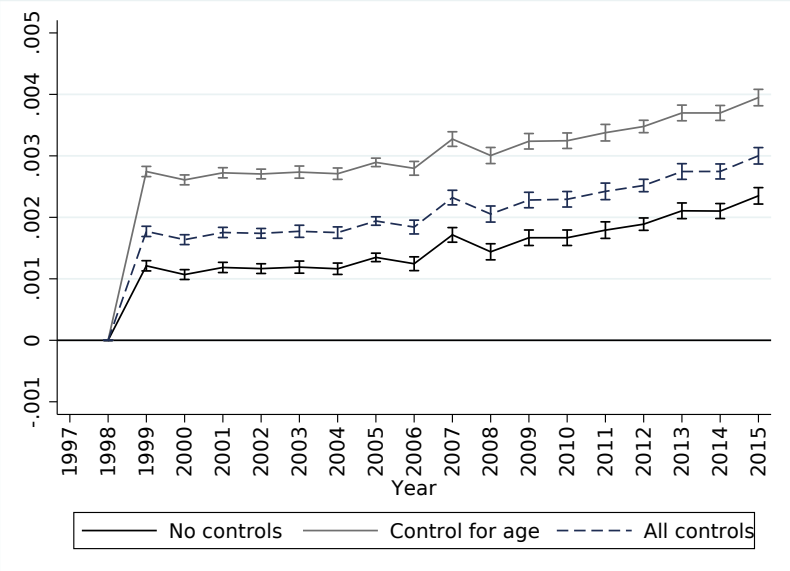
Notes: The Figure depicts the evolution of the share of foreign born residents in the working age population of a selected number of European member states. Sample is restricted to individuals between 18 and 62 years old. Series are built from the EU-LFS as described with more details in the text, and the data appendix.

Figure 3: **Evolution of Mobility in the European Union**

Panel A. Within-EU Migration Rates

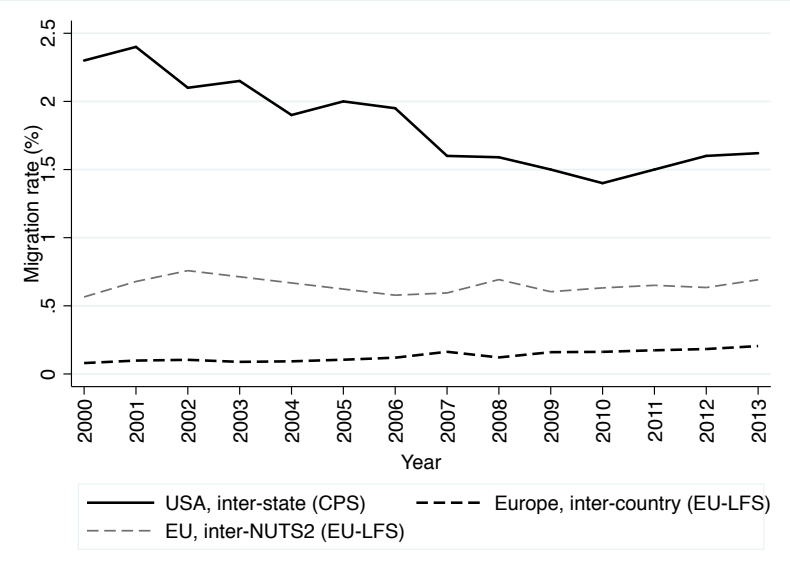


Panel B. Accounting for Demographic Changes



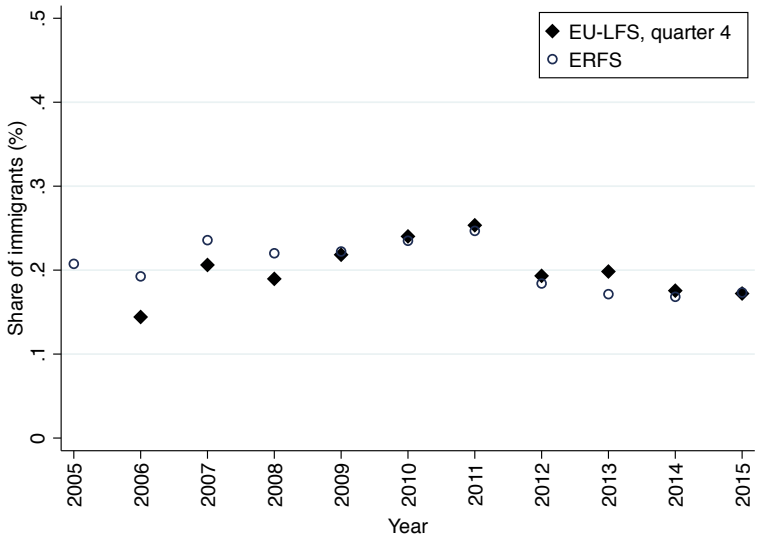
Notes: The Figure shows the evolution of within-EU migration rates since 1998. Migration rate of year N is computed as the number in year N of individuals aged 18-62 who were resident of another member state in N-1, divided by the overall number of individuals aged 18-62 in Europe in N. In the bottom figure, each line shows the coefficient of years indicators from regressing whether an individual works abroad on years indicators and individual-level controls. Individual-level controls include age, education, professional status and gender. By construction, coefficients for the year 1998 are omitted in the regressions and thus set to zero.

Figure 4: **Within-EU and Within-US Yearly Migration Rates**



Notes: The figure compares measures of intra-union mobility in the US and in Europe. Series for the United States are taken from Molloy et al. (2011) and are based on the Current Population Survey series on inter-state migration rates for population aged 16-64. Series for Europe are built from the EU-LFS measure of previous country of residence using the baseline sample selection of individuals aged 18-62, and select only migrants with previous country of residence within the EU. The inter-state US migration rate is the share of individuals surveyed in march of year N who were living in another American State in march N-1. The inter-country European migration rate is the share of individuals surveyed in year N who were resident of another European country in year N-1. The inter-NUTS2 migration rate is the share of European individuals who were living in a different NUTS2 region the year before the survey. Information on NUTS2 present and past residence is however not available for individuals surveyed in Austria, Germany, Netherlands, United-Kingdom, Ireland, Cyprus, Estonia, Island, Hungary, Lithuania, Latvia, Luxembourg and Romania.

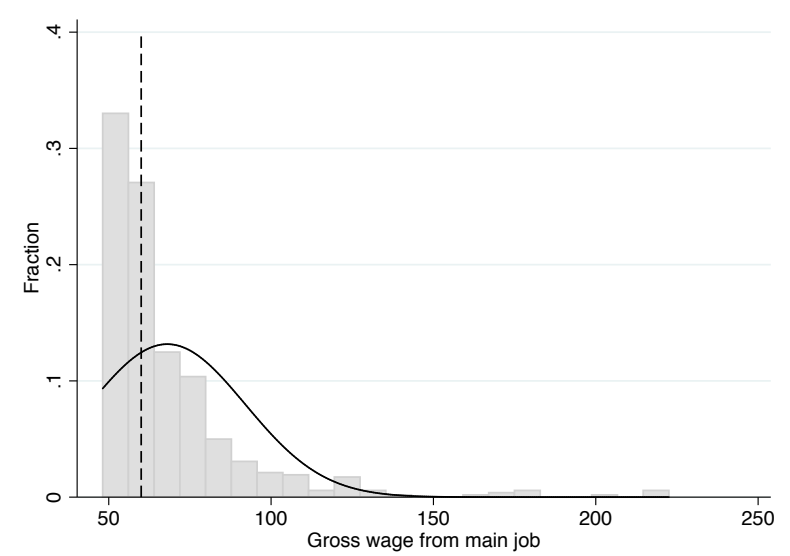
Figure 5: **Consistency Between French Administrative Data and EU-LFS**



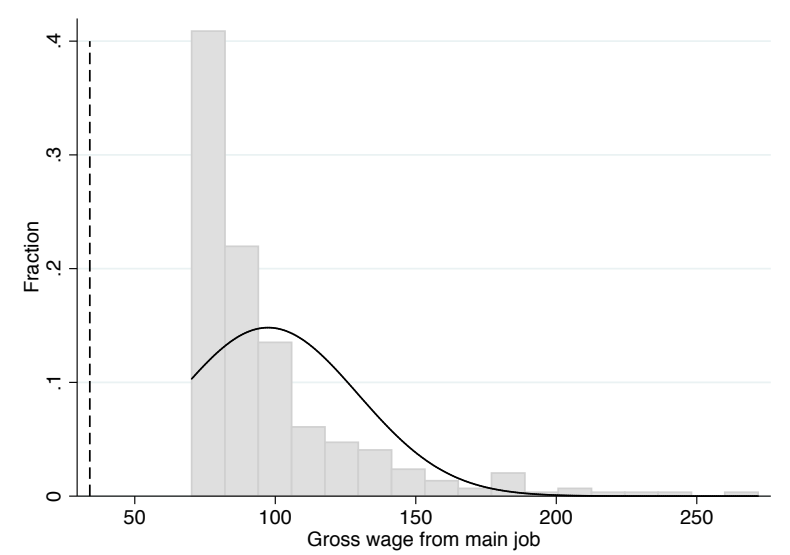
Notes: This figure compares the EU-LFS based measure of residents flows with alternative measures of yearly migration rate for the French case. ERFS is the merge between the last quarter of the French Labour Force Survey (the French part of the EU-LFS) and French administrative tax files. Only individuals surveyed in the labour force survey who actually filed an income tax return can be matched and found in the ERFS. Sample selection in both sources is individuals whose age is between 18 and 62 years old. Migration rate in the EU-LFS is computed as the number of individuals who were surveyed in France in year N and declared a different previous country of residence for N-1. Migration rate in the ERFS using the question in year N about previous residence in N-1 within and outside France (panswer "was living abroad" to the question "what was you residence last year"). Data plotted are raw and do not take into account representative survey weights. This is because the EU-LFS provides yearly-level data where weights are computed to assure the representativity of the sample at the yearly level. The ERFS provides quarterly weighting that ensures the representativity of the sample at the quarter level. Therefore, it is not possible to combine the yearly and the quarterly weights when using ERFS and EU-LFS datasets.

Figure 6: **Top Decile and Top Marginal Tax Rate Threshold**

Panel A. Austria



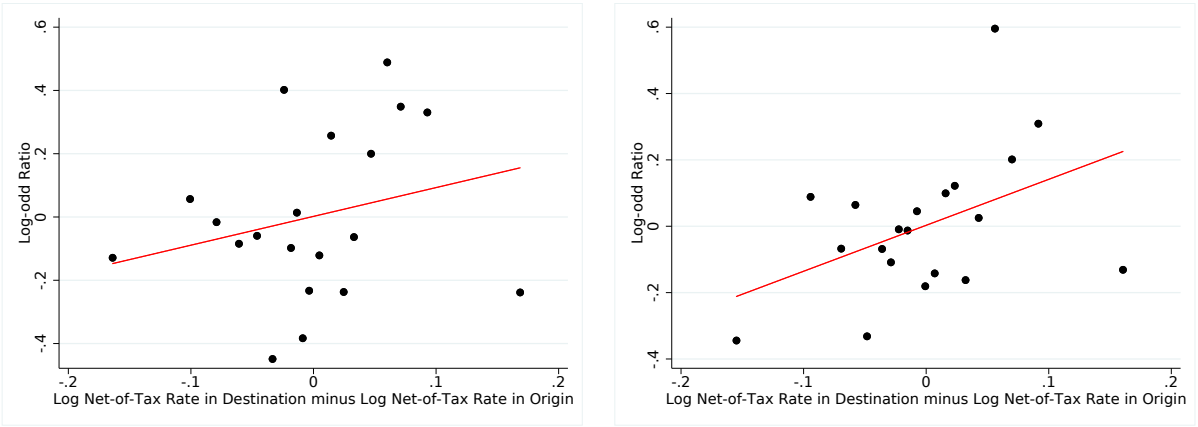
Panel B. Ireland



Notes: The Figure shows the distribution of labour earnings within the top decile using EU–SILC. As described with more details in the text, I use the common variable to EU-LFS and EU-SILC, I replicate the top decile measure of the EU-lFS in the EU-SILC where the level of labour earnings is available in the data. For this imputed top decile, I plot the distribution of the individual level of earnings. The dashed line denotes the income threshold for the top marginal tax rate. More explanations are detailed in the text.

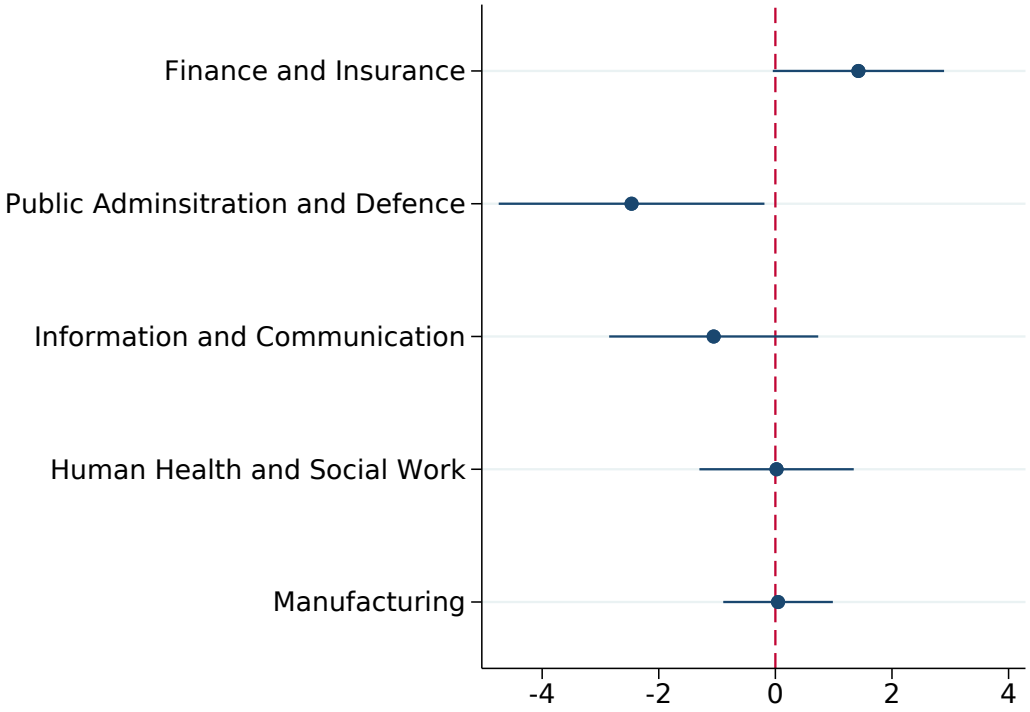
Figure 7: **Effect of Top Tax Rates Differentials on Top Earners Bilateral Migration Flows**

A. No Covariates **B. Covariates**



Notes: Log-odds emigration ratio are computed using $log(P_{odt}/P_{oot})$, where P_{odt} is the share of individuals emigrating from country o to country d. The figure shows outmigration for a given origin-destination pair against the log retention rate differential between destination and origin country. The figures plot within-bin averages across pair x year observations using bins by 40 quintiles sorted on the measure of log retention rate used. Measures of log retention rate and outmigration are demeaned of their country-pair and year means, and country-year covariates. β is the estimated reduced form elasitcity of the top earners migration flows with respect to net-of-tax rate, as described by Equation (4). The corresponding estimates are presented in Table 3.

Figure 8: **Heterogeneity of Tax-Driven Migration by Occupation**



Notes: This Figure shows the heterogeneity in location choices' sensitivity to taxes by occupation. The graph plots the estimated coefficient of the interaction term between the log top retention rate with a dummy for working in finance, public adminsitration, information and communication, health or manufacturing, from the estimation presented in Table 11. A positive and significant coefficient means that location choices of individuals working in this given sector are significantly more sensitive to taxes.

Table 1: **Descriptive Statistics For the Full Sample**

Variables	Average
Number of immigrants	62,017
Number of immigrants (per year)	8,800
Percentage with missing information on previous country of residence	3.1%
Percentage of employees with missing information for income decile	14.7%
Percentage of individuals carrying a job/occupation	72.1%
Percentage of employees in the overall population	61.8%
Percentage of employees in the occupied population	84.2%
Number of individuals surveyed in France (per year)	259,536
Number of individuals surveyed in Germany (per year)	355,116
Number of individuals surveyed in Switzerland (per year)	35,638
Number of individuals surveyed in Great Britain (per year)	269,082
Percentage of top ten percent who changed their country of residence	0.40%
Number of immigrants per year to France	1,255
Number of immigrants per year to Germany	1,898
Number of immigrants per year to Great Britain	2,785
Number of immigrants per year to Switzerland	469
Number of immigrants per year to Belgium	365

Notes: Descriptive statistics for the estimation period 2009-2015, where the sample is restricted to individuals whose age is between 18 and 62 years old. The number of observations at the European level is 15,510,934 for the entire period, accounting for survey yearly weighting factor. The countries in the sample are Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Luxembourg, Netherlands, Portugal, Slovenia, Slovakia, Spain, Switzerland, United Kingdom.

Table 2: **Descriptive Statistics For Top Earners**

Variables	Average
Number of immigrants	2,727
Number of immigrants (per year)	390
Percentage with missing information on previous country of residence	3.2%
Number of individuals surveyed in France (per year)	13,940
Number of individuals surveyed in Germany (per year)	22,904
Number of individuals surveyed in Switzerland (per year)	2,165
Number of individuals surveyed in Great Britain (per year)	6,508
Number of immigrants per year to France	63
Number of immigrants per year to Germany	96.2
Number of immigrants per year to Great Britain	73.6
Number of immigrants per year to Switzerland	39.9
Number of immigrants per year to Belgium	29.7
Age	45.1
Percentage of men	75.3 %
Percentage with managerial responsabilities	56.1%
Percentage living in a densely populated area	54.4%
Percentage working in a firm of more than 50 employees	66.4%
Average number of hours worked per week	42.2

Notes: Descriptive statistics for the estimation period 2009-2015, where the sample is restricted to individuals whose age is between 18 and 62 years old and whose income is in the last decile of the national distribution on labor earnings (top ten percent). The number of observations at the European level is 719,922 for the entire period, accounting for survey yearly weighting factor. The countries covered by the EU-LFS are: Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Luxembourg, Netherlands, Portugal, Slovenia, Slovakia, Spain, Switzerland, United Kingdom.

Table 3: **Effect of Top Income Tax Rates Differentials on Top Earners Migration Flows**

	(1)	(2)	(3)	(4)	(5)
$\log(1-\tau_{dt})/\log(1-\tau_{ot})$	1.21**	1.4**	1.1*	2.1**	1.8*
s.e	(.60)	(.59)	(.65)	(1.0)	(1.1)
Year FE	Yes	Yes	Yes	Yes	Yes
Origin FE	Yes	Yes	No	No	No
Destination FE	Yes	Yes	No	No	No
Covariates	Yes	Yes	Yes	No	Yes
Origin-Destination Controls	No	Yes	No	No	No
Origin-Destination FE	No	No	Yes	Yes	Yes
Origin FE $\times$ Year FE	No	No	No	Yes	Yes
Observations	435	435	435	435	435

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Standard errors in parentheses are clustered at the country-origin pair $\times$ year level. This Table shows the estimates of Equation (5) and plotted in Figure 7. Country-year level covariates include population and GDP.

Table 4: **Country-by-Year Variations and General Equilibrium Effects**

	Lower bounds Control group: 8th decile				Upper bounds Control group: 5th decile			
	(1)	(2)	(3)	Alt. Tax (4)	(5)	(6)	(7)	Alt.Tax (8)
log(1-τ)× top 10%	1.55**	2.48***	4.13***	3.1***	.97	1.95***	3.36***	2.96***
s.e	(.67)	(.70)	(1.1)	(.94)	(.68)	(.70)	(1.0)	(.91)
log(1-τ)× 8th decile	1.2*	1.26**	3.0***	2.71***				
s.e	(.61)	(.62)	(1.1)	(.91)				
log(1-τ)× 5th decile					-.26	.07	1.5	1.82*
s.e					(.68)	(.63)	(1.0)	(1.0)
log(1-τ)× 1st decile	-.44	-.03	1.6	1.2	-1.04	-.41	1.04	1.18
s.e	(.64)	(.64)	(.95)	(.95)	(.67)	(.64)	(1.1)	(.94)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covariates × Country FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Country FE × Year	No	No	Yes	Yes	No	No	Yes	Yes
Foreign elasticity	.14	.74	.67	.58	1.1	1.6	1.5	1.1
s.e	(.29)	(.25)	(.26)	(.31)	(.32)	(.36)	(.28)	(.27)
Uniform elasticity	.05	.16	.15	.11	.16	.25	.24	.17
s.e	(.04)	(.03)	(.04)	(.05)	(.04)	(.04)	(.04)	(.05)
Observations	35,075,335	35,075,335	35,075,335	35,075,335	35,440,093	35,440,093	35,440,093	35,440,093

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. Estimations are based on individual-level EU-LFS sample for the period 2009-2015. The sample estimation includes all individuals in the 1st, 5th and 10th decile of labour earnings for column (5)-(8) and all individuals in the 1st, 8th and 10th decile of labour earnings for column (1)-(4). Only employees whose age is between 18 and 62 years old are selected. The data includes individuals located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, Poland, Portugal, Slovenia, Slovakia and Great Britain. All specifications include country fixed-effects, and control for log GDP per capita. All specifications control for the individual-country variable which is a dummy equal to one if the country is the home country of the individual. Column (2)-(4) and (6)-(8) add the following individual-level covariates: age, age squared, gender dummy, marital status, a dummy for being born abroad, a dummy for having managerial responsibilities in the current job, and a dummy for having a tertiary level of education that controls for a structural measure of individuals' ability. All of these covariates are interacted with country fixed effects. Column (3)-(4) and (7)-(8) add a country-specific linear trend. The first row reports the coefficient on the log retention rate, interacted with a dummy for being in the top ten percent of labor earnings distribution. The second row reports the coefficient on the log retention rate interacted with a dummy for being in the 8th decile of labor earnings distribution. The third row reports the coefficient on the log retention rate interacted with a dummy for being in the median decile of labor earnings distribution. The fourth row reports the coefficient on the log retention rate interacted with a dummy for being in the bottom decile of the earnings distribution. Columns (4) and (8) include a measure of the top marginal tax rate on earnings combined with social security contributions rates. Foreign elasticity is the elasticity of top ten percent new resident (movers) with respect to the net-of-tax rate. The uniform elasticity is the elasticity of the total number of top ten percent individuals with respect to the net-of-tax rate. See text for more details on the computations and definitions of the sufficient statistics.

Table 5: **Full Distribution of Earnings**

	(1)	(2)	(3)
log(1-τ)$\times$ top 10%	1.91***	3.37***	3.14***
s.e	(.60)	(.96)	(1.0)
log(1-τ)$\times$ 8th-9th decile	1.64***	2.47***	2.27**
s.e	(.30)	(.78)	(.91)
log(1-τ)$\times$ 6th-7th decile	.87***	1.59*	1.28
s.e	(.32)	(.78)	(.926)
log(1-τ)$\times$ bottom 50	-.39	1.02	.76
s.e	(.45)	(.78)	(.923)
Country FE	Yes	Yes	Yes
Covariates + Country FE	No	Yes	Yes
Covariates + Country FE x Year	No	No	Yes
Control: 9th-8th decile			
Foreign elasticity	.23	.81	.78
s.e	(.55)	(.55)	(.55)
Uniform elasticity	.04	.14	.13
s.e	(.09)	(.09)	(.09)
Control: 6th-7th decile			
Foreign elasticity	.91	1.7	1.7
s.e	(.58)	(.60)	(.60)
Uniform elasticity	.16	.27	.27
s.e	(.09)	(.09)	(.09)
Control: bottom 50			
Foreign elasticity	2.0	2.1	2.1
s.e	(.66)	(1.1)	(1.2)
Uniform elasticity	.35	.35	0.35
s.e	(.11)	(.18)	(.17)
Observations	23,445,104	22,202,622	22,202,622

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. Estimations are based on random selection of 10% of the overall EU-LFS sample described in Table 2. Only employees whose age is between 18 and 62 years old and are selected on the EU-LFS based measure of income decile. The data includes top earners located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, Poland, Portugal, Slovenia, Slovakia and Great Britain. All columns include a country fixed-effect and control for log GDP per capita. Individual-country variable includes a dummy equal to one if the country is the home country of the individual. Column (2) to (3) add the following individual-level covariates: age, age squared, gender dummy, marital status, a dummy for being born abroad, a dummy for having managerial responsibilities in the current job, and a dummy for having a tertiary level of education that controls for a structural measure of individuals' ability. All of these covariates are interacted with country fixed effects. Column (3) adds a country-specific linear trend. The first row reports the coefficient on the log retention rate, computed as $log(1-\tau)$ with τ being the top marginal tax rate in country n collected from the OECD Taxing Wages database. Foreign elasticity is the elasticity of top ten percent new residents (movers) with respect to the net-of-tax rate. The uniform elasticity is the elasticity of the total number of top ten percent individuals with respect to the net-of-tax rate.

Table 6: **Estimated Country-Level Elasticities**

	Foreign elasticity		Uniform elasticity	
	Lower bound	Upper bound	Lower bound	Upper bound
Austria	.723	1.72	.06	.09
Belgium	.695	1.67	.19	.27
Denmark	.721	1.72	.11	.14
France	.615	1.49	.32	.45
Germany	.635	1.52	.16	.24
Italy	.702	1.68	.05	.06
Luxembourg	.734	1.74	.26	.37
Netherlands	.721	1.72	.09	.15
Poland	.675	1.61	.12	.18
Portugal	.720	1.72	.10	.15
Spain	.696	1.66	.24	.34
Switzerland	.663	1.60	.29	.41
United Kingdom	.635	1.46	.51	.81
European average	.673	1.61	.17	.24

Notes: Estimated elasticities at the country level using estimates from the preferred specification (column (3) and (7) of Table 4). The discrepancy between foreigners and uniform elasticities is mechanically driven by differences in tax bases, as emphasized in the text. See the text for detailed explanation on the estimation. Foreigners are defined using the residence-based definition (movers).

Table 7: **Effect of Top Retention Rate on Top Earners' Mobility**

	(1)	(2)	Alt. Tax (3)
log(1-τ)$\times$ top 10%	2.94***	3.07***	2.50***
s.e	(.778)	(.760)	(.834)
log(1-τ)$\times$ 8th	2.22***	2.31***	2.03***
s.e	(.564)	(.591)	(.608)
log(1-τ)$\times$ 5th decile	.680	.720	.815
s.e	(.606)	(.601)	(.617)
Country FE	Yes	Yes	Yes
Covariates $\times$ Country FE	Yes	Yes	Yes
Country FE $\times$ Year	Yes	No	No
Country FE $\times$ Year FE	No	Yes	Yes
Control: 8th decile			
Foreign elasticity	.61	.64	.41
s.e	(.50)	(.51)	(.62)
Control: 5th decile			
Foreign elasticity	1.9	2.0	1.5
s.e	(.84)	(.84)	(.86)
Observations	12,366,900	12,366,900	12,366,900

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. Estimations are based on individual-level EU-LFS sample for the period 2009-2015. The sample estimation includes all individuals in the 1st, 5th, 8th and 10th decile of labour earnings. Only employees whose age is between 18 and 62 years old are selected. The data includes individuals located in Austria, Belgium, Switzerland, Germany, France, Italy, Luxembourg, Poland, Slovenia, Slovakia and Great Britain. All specifications include country fixed-effects, an individual-country variable which is a dummy equal to one if the country is the home country of the individual, and the following individual-level covariates: age, age squared, gender dummy, marital status, a dummy for being born abroad, a dummy for having managerial responsibilities in the current job, and a dummy for having a tertiary level of education. All of these covariates are interacted with country fixed effects. Column (1) adds a country-specific linear trend, while Column (2) includes country-year level fixed effects.

Table 8: **Revenue-Maximizing Rates**

	τ_f^*		Uniform τ^*	
	Lower bound	Upper bound	Lower bound	Upper bound
Austria	.354	.548	.847	.883
Belgium	.361	557	.732	.821
Denmark	.355	.549	.809	.862
France	.386	.583	.645	.771
Germany	.381	.576	.747	.831
Italy	.359	.554	.854	.886
Luxembourg	.352	.545	.679	.810
Netherlands	.354	.549	.805	.859
Poland	.369	.563	.782	.852
Portugal	.354	.549	.798	.858
Spain	.362	.556	.695	.806
Switzerland	.370	.567	.662	.783
UK	.390	.567	.518	.705

Notes: This table shows the calibration of formulas presented in Proposition Proposition 1 for revenue-maximizing tax rates, for different governments' strategies in the tax game. The formulas are calibrated using estimated migration elasticities presented in Table 6 and a labor supply elasticity equal to 0.1. τ_f refers to the top marginal tax rate targeted on top earners coming from abroad.

Table 9: **Efficiency Costs of Tax Reforms**

	Scenario 1 Efficiency cost of $\tau_{uniform}$ reform				Scenario 2 Efficiency cost of τ_f reform			
	Lower bound	dR/dT	Upper bound	dR/dT	Lower bound	dR/dT	Upper bound	
Austria	.13	≥ 0	.17	≥ 0	.8	≥ 0	1.7	≤ 0
Belgium	.18	≥ 0	.30	≥ 0	.7	≥ 0	1.5	≤ 0
Denmark	.20	≥ 0	.30	≥ 0	1.1	≤ 0	2.3	≤ 0
France	.35	≥ 0	.64	≥ 0	.8	≥ 0	1.9	≤ 0
Germany	.18	≥ 0	.31	≥ 0	.7	≥ 0	1.5	≤ 0
Italy	.12	≥ 0	.16	≥ 0	.6	≥ 0	1.7	≤ 0
Luxembourg	.18	≥ 0	.36	≥ 0	.6	≥ 0	1.4	≤ 0
Netherlands	.16	≥ 0	.23	≥ 0	.8	≥ 0	1.7	≤ 0
Poland	.07	≥ 0	.11	≥ 0	.3	≥ 0	.7	≥ 0
Portugal	.17	≥ 0	.25	≥ 0	.8	≥ 0	1.8	≤ 0
Spain	.20	≥ 0	.36	≥ 0	.6	≥ 0	1.4	≤ 0
Switzerland	.16	≥ 0	.29	≥ 0	.4	≥ 0	.9	≥ 0
United Kingdom	.35	≥ 0	.758	≥ 0	.6	≥ 0	1.3	≤ 0

Notes: Calibration of Proposition 2 using estimates from Table 6 and a baseline value of 0.1 for the labor supply elasticity following the standard upper bound for this parameter in the literature. The efficiency cost refers to the sum of behavioural effects created by the reform divided by the mechanical change in tax revenue after the reform.

Table 10: **Effect of Employer on Migration Decisions, Randomly Selected Subsample**

	(1)	(2)	(3)
log(1-τ)× top 10%	5.33**	3.87**	4.31***
s.e	(1.904)	(1.51)	(1.52)
log(1-τ)× 5th decile	2.27	1.27	1.70
s.e	(1.62)	(1.45)	(1.44)
log(1-τ)× 1st decile	.903	.264	1.03
s.e	(1.73)	(1.52)	(1.43)
log(1-τ)× top 10%× big firm	-1.907		
s.e	(1.65)		
log(1-τ)× 5th decile× big firm	-1.50		
s.e	(1.40)		
log(1-τ)× 1st decile× big firm	-1.55		
s.e	(1.50)		
log(1-τ)× top 10%× job transition		3.82	-.049
s.e		(2.86)	(1.93)
log(1-τ)× 5th decile× job transition		3.48	.414
s.e		(2.53)	(.867)
log(1-τ)× 1st decile× job transition		2.23	-1.37*
s.e		(2.83)	(.725)
Covariates + Country FE	Yes	Yes	Yes
Covariates + Country FE x Year	Yes	Yes	Yes
Observations	10,635,981	10,635,981	10,635,981
Transitions from unemployment/self-employment inactivity	-	No	Yes

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. This table presents the result from the specification used in Table 4 adding interaction terms between earnings decile and labor market related indicators. Column (1) adds the interaction between a dummy variable equals to one if the individual is working in a firm with more than 50 employees and a dummy for being either in the 10th, 5th or 1st decile of earnings. Column (2) adds the interaction between a dummy equals to one if the individuals has a new employer the year of the survey conditional on having been employed the year before and a dummy for being either in the 10th, 5th or 1st decile. Column (3) adds the interaction between a dummy variable equals to one if the individual has a new employer unconditional on having been employed the year before. The subsample of estimation is randomly selected from the original estimation sample for computational issues.

Table 11: **Sample Restricited to Movers Only**

	(1)	(2)	(3)
log(1-τ)$\times$ top 10%	1.88***	2.57***	2.99***
s.e	(.62)	(.69)	(.96)
log(1-τ)$\times$ 5th decile	.30	1.01	1.44
s.e	(.70)	(.71)	(1.02)
log(1-τ)$\times$ 1st decile	-1.09	-.55	-.20
s.e	(.64)	(.66)	(.96)
Country FE	Yes	Yes	Yes
Covariates + Country FE	No	Yes	Yes
Covariates + Country FE x Year	No	No	Yes
Observations	86,204	83,935	83,935

Notes: This table shows the estimates of the location choice model when the sample is restricted to movers only. See notes below Table 4 for details regarding the estimation and specification.

Table 12: **Effect of Occupation Transition on Location Choices Sensitivity to Taxes**

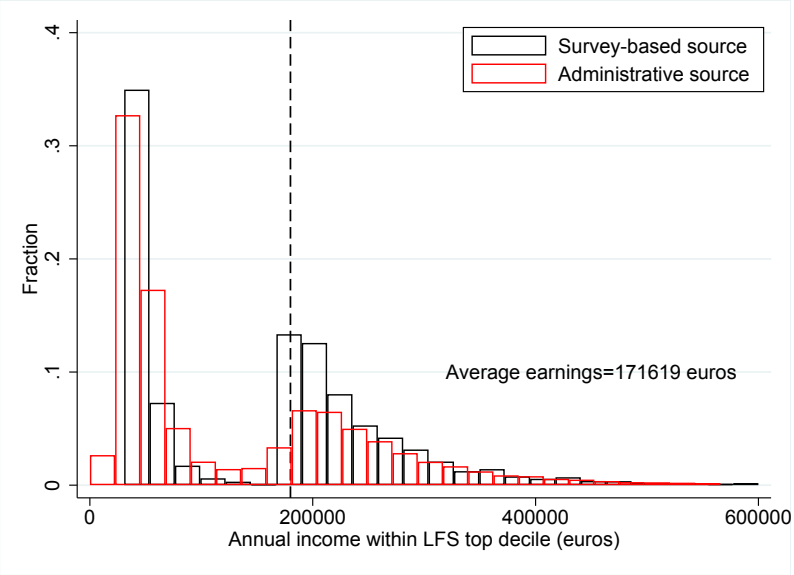
	(1)	(2)
log(1-τ)$\times$ top 10%	3.44***	4.372***
s.e	(.908)	(1.545)
log(1-τ)$\times$ 5th decile	.593	1.56
s.e	(.750)	(1.43)
log(1-τ)$\times$ 1st decile	-.525	.373
s.e	(.818)	(1.51)
log(1-τ)$\times$ top 10%$\times$ self-employment shif	-4.11	-7.14
s.e	(5.50)	(6.16)
log(1-τ)$\times$ 5th decile$\times$ self-employment shift	4.43	1.66
s.e	(4.82)	(5.51)
log(1-τ)$\times$ 1st decile$\times$ self-employment shift	3.18	.219
s.e	(5.33)	(6.01)
Country FE	Yes	Yes
Covariates + Country FE	Yes	Yes
Covariates + Country FE x Year	No	Yes
Observations	10,635,981	10,635,981

Notes: Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. This table presents the result from the specification used in Table 4 adding interaction terms between earnings decile and change of occupation between employment and self-employment. The subsample of estimation is randomly selected from the original estimation sample for computational issues.

Appendix for: Do European Top Earners React to Labour Taxation Through Migration ?

A Additional Tables and Figures

Figure A.I: **Distribution of Labour Earnings Within the French Top Decile**



Notes: This Figure shows the distribution of administrative and survey measures of labour earnings in France for 2009-2015. Series are computed from the ERFS, that merges the last quarter of the French labour force survey with individual-level administrative tax files. The survey based measure of labour earnings is monthly earnings from the main job net of income tax rate reported by individuals. Administrative measure of labour earnings is the taxable income reported in tax files. Individuals are ranked according to their survey based measure of income, which is the measure used in the EU-LFS to select top ten percent. The black dashed line gives the median of the survey based measure of earnings. The average labour earnings reported in the ERFS is around 170,000 euros, and 70% of the taxpayers have individual annual labour earnings that exceed 70,000 euros.

Table B.I: **Macro-Correlations Between Taxation and Migration**

	Top 10%			Top 5%			5th decile			1st decile		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
log(1-τ)	.84	.75	0.84**	3.36**	3.37**	3.36***	-0.96	-0.28	-0.96	.30	-.06	.30
s.e	(.72)	(.78)	(0.311)	(1.27)	(1.28)	(1.29)	(0.60)	(1.72)	(1.89)	(.96)	(1.0)	(0.47)
Observations	120	120	120	101	101	101	101	101	101	114	114	114
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Time trend (linear)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Each outcome variable at the country-year level is regressed in logs on the country's log GDP per capita, country fixed effects, year fixed effects, and the log retention rate, weighted by the population considered for each specification in each country and year. Top ten percent sample is defined using the EU-LFS definition of top wage decile. Top five percent sample is selected using an exact matching on characteristics between the EU-LFS and the EU-SILC described with more details in the text. Panel A uses the log share of foreigners in the given fractile population as the outcome variable. Panel B uses the log share of domestics in the given fractile population as the outcome variable. Column (1) of each specification gives the baseline specification, which includes country's log GDP per capita, country fixed effects, year fixed effects and clustered standard errors at the country-level. Column (2) adds a linear year trend to the baseline estimation. Column (3) relies on an alternative method for the clustering of the standard errors using the Discroll-Kray estimators that corrects for standard errors serial autocorrelation at the cross-sectionnal level.

Table B.II: **Imputing Impatriates Schemes' Eligibility**

	(1)	(2)
log(1-τ)$\times$ top 10%	2.17***	1.93***
s.e	(.660)	(.682)
log(1-τ)$\times$ 8th	.552	.322
s.e	(.536)	(.593)
log(1-τ)$\times$ 5th decile	-.923*	-1.11**
s.e	(.526)	(.563)
Country FE	Yes	Yes
Covariates $\times$ Country FE	Yes	Yes
Country FE $\times$ Year	Yes	No
Country FE $\times$ Year FE	No	Yes
Observations	12,366,900	12,366,900

Notes: This Figure reproduces the baseline estimation imputing foreigners tax scheme eligibility in countries where such tax schemes have been implemented.

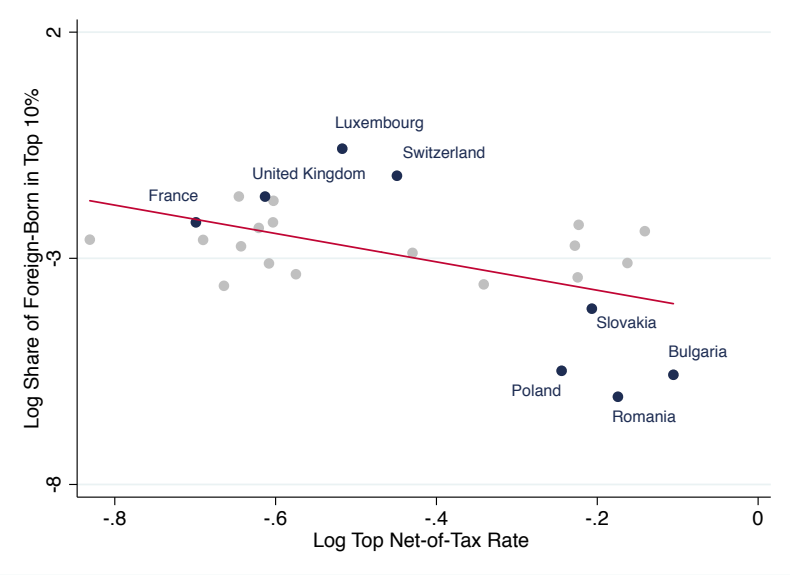
Table B.III: **Foreigner Tax Schemes**

Country	Eligible from	Number of beneficiaries in the top 10%	Share of top 10%
Denmark	1992	2,500	0.45%
France	2005	12,000	0.3%
Netherlands	1964	10,000	1%
Spain	2005	10,000	0.7%

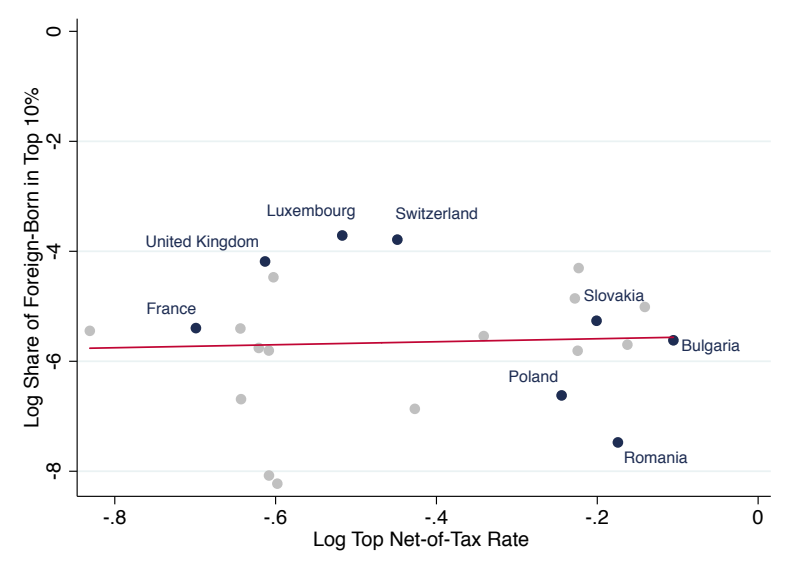
Notes: This Figure gathers basic descriptive statistics on foreigners tax schemes in Europe for a subsample of countries.

Figure A.II: **Macro-Level Correlations Between Top Tax Rates and Foreigners**

A. Share of Foreign-Born Within Top Decile



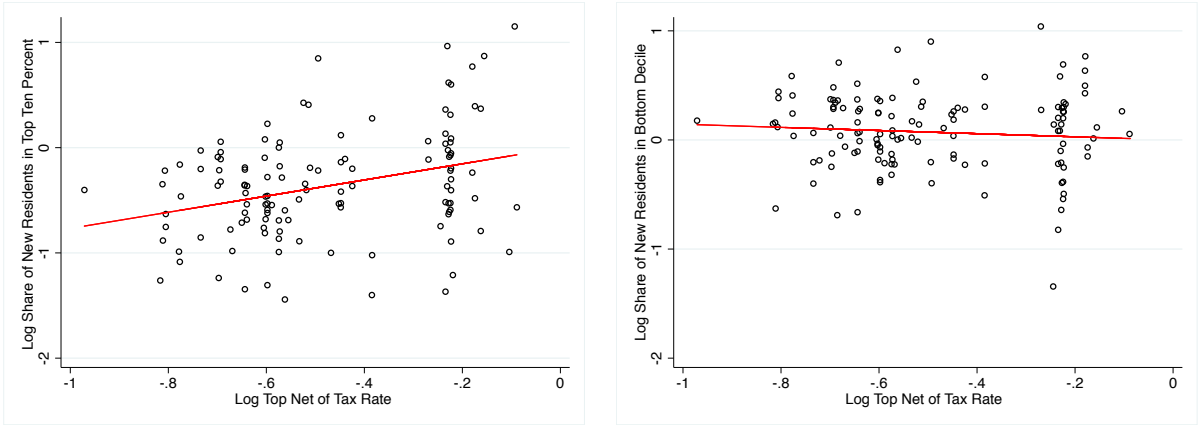
B. Share of New Residents Within Top Decile



Notes: The figure shows the correlation between the level of top marginal tax rates on income and the level of mobile top earners' taxpayers for the subsample of countries included in the estimation. Panel A depicts the log of the top retention rate against the log of foreign-born individuals within the top ten percent. Panel B depicts the log of the top retention rate against the log of new residents within the top ten percent.

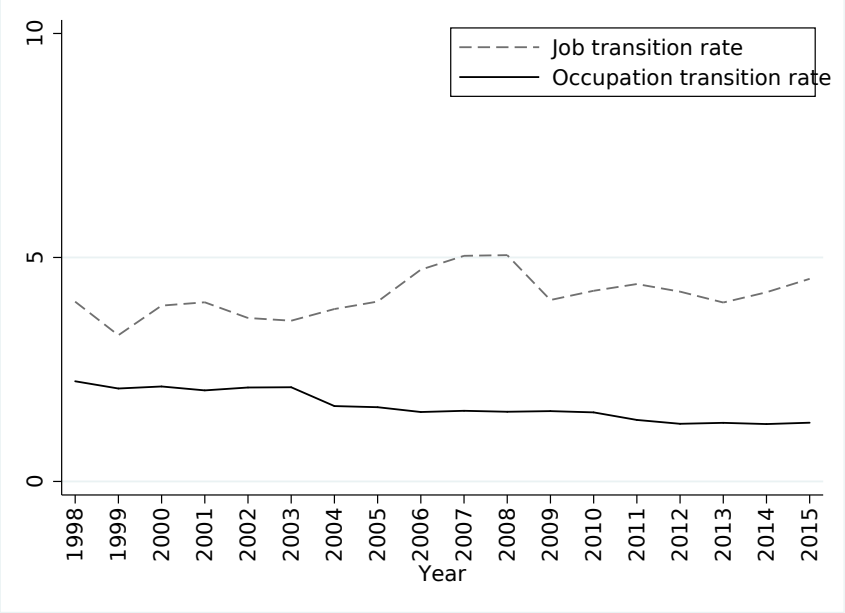
Figure A.III: **Cross-Country Correlations Between Taxation and Migration, 2009-2015**

A. Top Decile **B. Bottom Decile**



Notes: Each outcome variable at the country-year level is regressed in logs on the country's GDP per capita, country fixed effects, year fixed effects, and the log retention rate, weighted by the number of top earners in each country and year. Each scatter point represents the adjusted log outcome (the log outcome from which I substract all covariates except the taxation rate) times their estimated coefficients. Linear regression lines are depicted. For the upper figures, Panel A shows the share of new residents (foreigners) in the national top decile of the wage distribution (number of top 10 percent new residents divided by the overall number of top ten percent employees in that country). Panel B shows the share of new residents (foreigners) in the national top five percent of the wage distribution (number of top 5 percent immigrants divided by the overall number of top 5 percent workers in that country). Top five percent is built using an imputed measure of wage after an exact matching on characteristics using the EU-SILC. Panel C considers the share of foreign bottom earners (sum of foreigners in the first decile of the wage distribution divided by the total number of individuals in the first decile in that country).

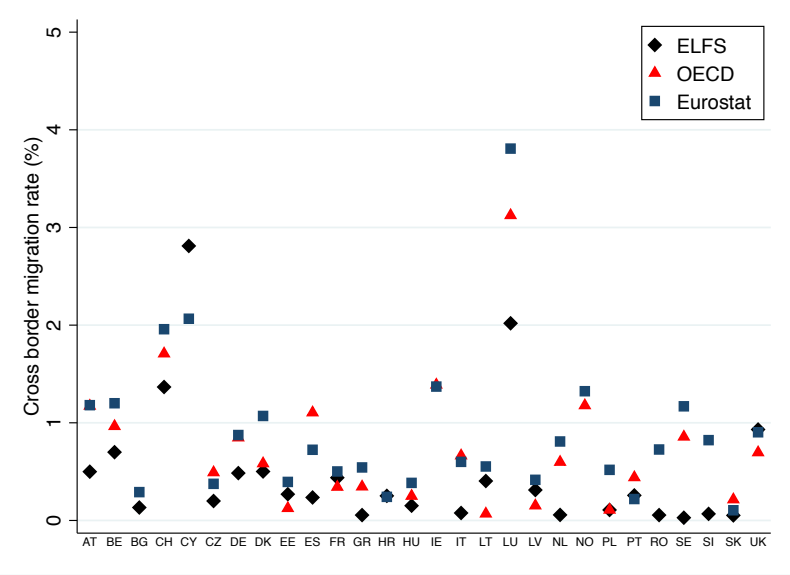
Figure A.IV: **Labor Market Transitions Trend, 1998-2015**



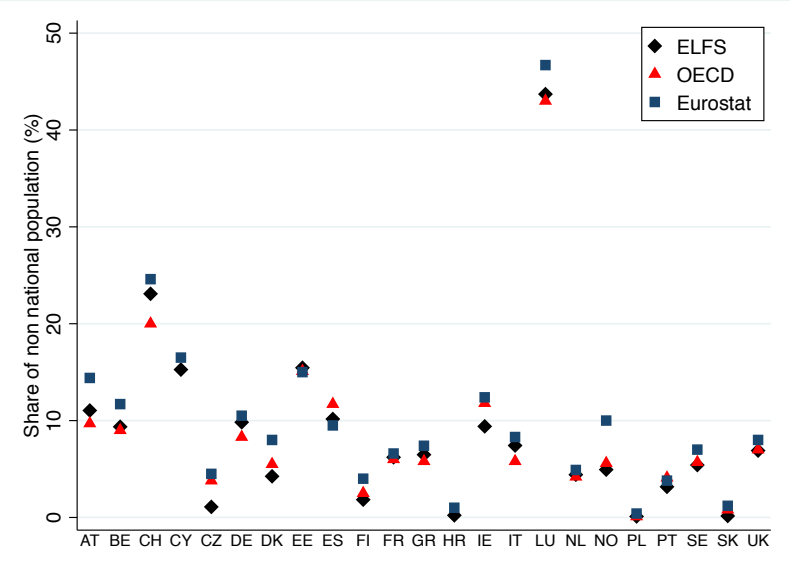
Notes: This figure depicts the evolution of transitions in the European labor market for the period 1998-2015. Job transition rate is computed as the overall number of individuals who started to work for their current employer in year N, conditional on the fact of having been an employee in year $N-1$, divided by the overall number of employed in N. Occupation transition rate is computed as the overall number of individuals who changed their occupation between $N-1$ and N, conditional on having been either employed or self-employed in $N-1$, divided by the overall number of employed and unemployed in year N. The sample is restricted to individuals whose age is between 18 and 62 years old.

Figure A.V: **Comparison of International Measures of Mobility**

Panel A. Annual Migration Flows

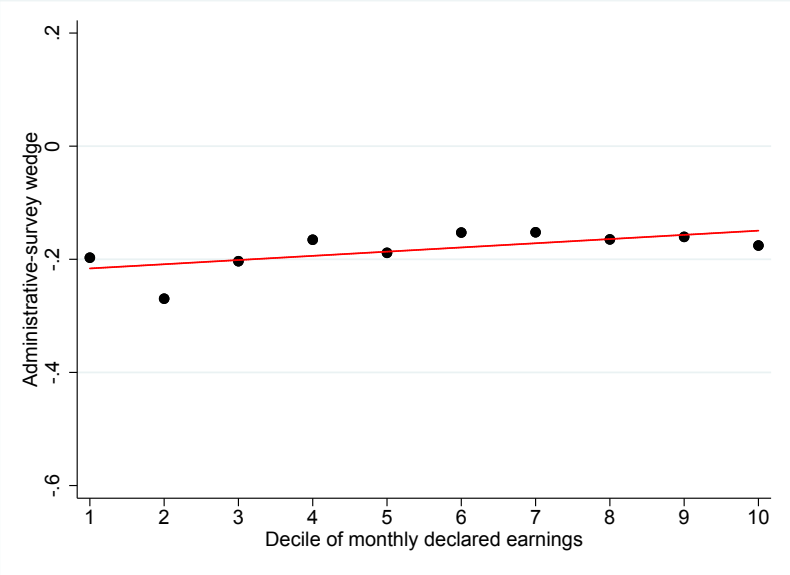


Panel B. Non-Nationals Stocks



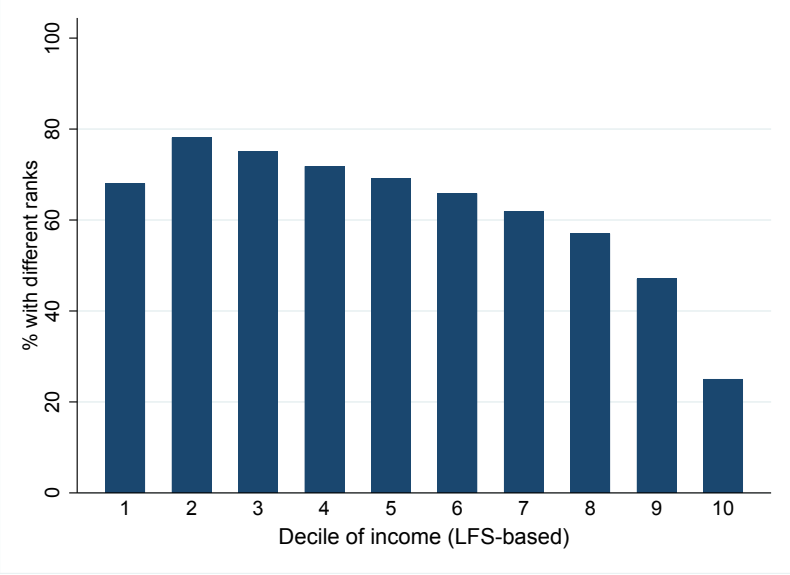
Notes: compares mobility measures from OECD, Eurostat and the EU-LFS. Migration rates and stocks from the EU-LFS are computed from the raw EU-LFS data, following the methodology described in \Autoref{sec:data}. I compute the yearly migration rates and stocks for the period 2009-2015 and the population aged from 18 to 62 years old. Migration rates and stocks from the Eurostat are built in the following way. I collect raw numbers on migration flows (yearly number of immigrants) and stocks (number of foreigners in the population) for each country from Eurostat UNIDEMO database. These raw numbers are computed by National Institutes based on national population registers. I then collect data on the total population from the same database. I finally compute the migration rate as the number of immigrants divided by the overall population multiplied by 100. I compute yearly migration rates for the period 2009-2015 and plot the average of the period. I proceed in the symmetric way to compute the OECD migration rate and stock, collecting data from the International Migration outlook.

Figure A.VI: **Misreporting Bias by Level of Income**



Notes: This figure plots the gap between self-reported earnings and administrative measure of wages by decile of survey-based earnings. The fitted line shows the correlation between misreporting bias in income and the ranking in labor earnings to check if mismeasurement is systematically correlated with being a top earner in our sample of estimation.

Figure A.VII: **Earnings Decile: Survey vs Administrative Measure**



Notes: This figure plots mistakes in income ranking by earnings decile. The histogram shows for each decile of earnings based on the EU-LFS measure of income the share of individuals that would end up in another decile if the ranking was based on the administrative-based measure of income. Among top earners defined according to the survey measure of income, 20\% would not be assigned to the top decile using the administrative measure of wages. The large majority of these individuals would be assigned to the 9th decile using the administrative measure of earnings.

B Derivation of Formulas for Calibrations

In this section, I simply derive the revenue maximizing linear-rate in the presence of tax competition. As it is standard in the literature, individuals are characterized by their skills w and their preferences over leisure and labour. They derive an utility $u^i(c, y)$ that is increasing in consumption c, and decreasing in earnings, as earnings require more effort, and individuals have a disutility for work. There is a mass N_i of type-i individuals in the economy. I consider for simplicity a government that sets a linear tax rate τ in order to raise an amount $R = \tau Y$, where Y denotes aggregated earnings $Y = \sum_i N_i y_i$. The tax revenue is redistributed to everyone as a lumpsum T_0.

Individuals choose their optimal amount of labour supply by taking into account their after-tax reward $c_i = (1-\tau)y_i + T_0$. It is therefore possible to define the gross earnings elasticity $e_i = (\partial y_i / \partial(1-\tau)) \times (1-\tau) \times y_i$, that denotes the change in individual i labour supply when the net-of-tax rate is increased by one percent. Assuming no income effects, there is no effect of the change in the universal demogrant on individuals' optimal labour supply. By definition, e_i is always positive. In addition to intensive margin responses to taxation, individuals can respond to taxation through migration. I define the migration elasticity as the change in the number of type-i individuals when the net-of-tax rate faced by these individuals is increased $\varepsilon_i = (\partial N_i / \partial(1-\tau)) \times (1-\tau) \times N_i$.

In the case where the government cannot impose a differential rate on foreigners, it simply maximizes $R = \tau \sum_i N_i y_i$ where both N_i and y_i are a function of the uniform net-of-tax rate. The optimal tax can be easily retrieved by studying a small deviation in the tax schedule τ. Consider an infra-marginal change in the uniform linear tax schedule $d\tau$. The small tax deviations induces a change in the government tax revenue equal to $d\tau Y$, due to a mechanical increase in tax revenue. As pre-tax earnings are endogeneously determined by a labour-leisure trade-off, the reform causes an aggregated change in earnings $-e\dfrac{\tau}{1-\tau} Y d\tau$. In the presence of tax competition, individuals have an extensive margin of response to the tax change through migration. Individuals react to $d\tau$ through an additional migration effect $-\varepsilon\dfrac{\tau}{1-\tau} Y d\tau$, that captures mobility response to the net effect of

the reform on their post-tax earnings. The total effect on tax revenue is therefore given by $dR = (1 - e\frac{\tau}{1-\tau} - \varepsilon\frac{\tau}{1-\tau})Y d\tau$ in the competing union. Summing behavioural and mechanical effects to zero yields the inverse tax rate formula for the Laffer rate that maximizes tax revenue.[25]

The proof is similar in the case where the government discriminates foreigners. In that case, the government maximizes the revenues collected on foreigners separately, meaning that it sets τ_f that maximizes the revenue raised on the set of foreigners $R_f = \tau_f \sum_{i \in F} N_i y_i$. The small tax deviation approach yields the same inverse formula with alternative elasticities that are now evaluated for each subgroup of taxpayers.

The derivation of the behavioural burden is straightforward. Denoting dM the mechanical change in tax revenue after a small tax reform, we can write in the case of the uniform tax rate $dR = (1 - e\frac{\tau}{1-\tau} - \varepsilon\frac{\tau}{1-\tau})dM$.

[25]The derivation of the optimal tax formulas specifying the entire maximization problem are detailed in Muñoz (2019). It also emphasizes how the revenue-maximizing rate is theoretically different from the Rawlsian rate in the case of migration.

C Data Appendix

C.1 Mobility Data

The EU-LFS is the largest European survey providing annual micro data on the labour participation of people aged 15 and more, in and outside the labour force. It is conducted every year in 33 participating countries: the 28 members of the Union, the three EFTA countries (Switzerland, Norway, and Iceland) and two candidate countries (former Republic of Macedonia and Turkey). It is designed as a continuous quarterly survey since 2004, with interviews spread uniformly over all weeks of a quarter. The participation in the EU-LFS for surveyed individuals is compulsory for fourteen of the participating countries. On average, the achieved sampling rate in the EU-LFS is approximately 0.3% of the total European population. Surveys are implemented by National Statistics Institutes, and aggregated by Eurostat, which also corrects for non-responses and applies yearly weighting methods. This allows to use the survey at the yearly level and to conduct cross-country comparisons. Population registers, latest population census and lists of addresses are the main sources for the sampling frame, and on average, the achieved sampling rate in the EU-LFS is approximately 0.3% of the total European population.[26]

The information on individuals' nationality and past residence is available since 1995, and allows us to select non-citizens and new residents, that I define alternatively as "foreign-born" and "foreigners". The main limitation of the data relates to the aggregation of the citizenship variable for foreigners. This implies that for foreign-born, and foreign citizens residents, it is not possible to observe their exact origin. It theorefore provides to infer for these individuals their counterfactual residence if they would live at "home". The data allows to identify a German residing in France as a foreigner, but does not enable to identify Germany as its origin country. Therefore, the residence-based definition foreigners is used in the estimation, as it is the only measure allowing to control for home bias for individuals who do not live in their home country. Each member state is also to publish compulsory yearly quality reports

[26] Sampling rates vary across countries and years. For instance, in 2013, the EU-LFS sampling rate was 4% of the overall population for Luxembourg, against 0.3% for France.

documenting sampling errors, non-response rates and general remarks about the quality of the data provided by the survey.

Regarding information on income and taxes paid, the EU-LFS provides the decile of labor earnings for surveyed earners since 2009. Information on the level of earners' monthly labor earnings is collected during the interview, but is not provided in the micro-data. The LFS instead directly provides the income decile of each earner. Importantly, this decile is based on labor income only, and does not take into account any other source of income, such as capital income. In addition to information on citizenship, current and past residence and income decile, the survey offers a large set of precisely measure individual-level covariates. These variables include age, gender, family status, number of children, size of the firm, sector of occupation, highest level of education acchieved, field of the education degree, presence or not of supervisory responsibilities in the job, number of weekly hours of work, information on past labour market status or unemployment, existence of other jobs, NUTS2 region of residence, and many other characteristics.

C.2 Top Marginal Tax Rates Data

I complete the mobility dataset with data on top marginal tax rate collected from the OECD Taxing Wages Database. The main measure I use is the combined central government and sub-central government marginal personal income tax rate at the earnings threshold where the top statutory personal income tax rate first applies. It is calculated as the additional central and sub-central government personal income tax resulting from a unit increase in gross wage earnings. The combined rate takes account of the effects of tax credits, the deductibility of sub-central taxes in central government taxes, etc. I build an alternative measure of the top marginal tax rate that takes into account social security contribution rates on employers and employees at the top of the income distribution. For this measure, I use the social security contributions rates paid by employers and employees at an income level that is 5 times higher than the average wage, and that are provided by the OECD Taxing Wages