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## Do European Top Earners React to Labour Taxation Through Migration ?

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# Do European Top Earners React to Labour Taxation Through Migration ?\*

Mathilde Muñoz<sup>†</sup>

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## Abstract

This paper studies the effects of top income tax rates on top earners' migration, using a novel individual dataset on mobility representative of the entire population of 21 European countries. I exploit the differential effects of changes in top tax rates on individuals at different earnings levels. Top earners' location choices are significantly affected by top income tax rates. The elasticity of the number of top earners with respect to the net-of-tax rate is between 0.1 and 0.3; it is above one for foreigners. Migration elasticities differ widely across member states, leading to different incentives to implement beggar-thy-neighbour tax policies within Europe.

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# 1 Introduction

The public discourse on tax progressivity often emphasizes mobility responses to higher tax rates rather than standard labour supply effects. Most top income tax reforms are usually followed by fierce debates on the expected emigration of top earners. Because it is more salient than other margins of responses to taxes, tax-driven mobility sheds light on the deadweight cost of tax reforms. Accordingly, the threat of high wage earners' emigration has been one of the main argument against more progressive tax schedules.

Is this public debate on top earners' migration responses to taxation justified by the empirical evidence? To what extent do top 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 on top earners, to answer these questions. This paper provides the first systematic evidence on *international* migration responses to personal income tax rates for a *representative* population of top taxpayers.

In spite of growing attention devoted to top earners' tax-driven mobility, there is still very little empirical evidence on the effect of taxation on the international mobility of individuals. Two empirical challenges can explain the paucity of empirical research in this area. First, there is a lack of international micro data with joint information on individuals' residential choices and taxes paid. Second, identifying the causal effect of taxes on location choices is challenging, because tax reforms and migration decisions may be correlated for many other reasons.

Three contributions in the literature managed to overcome some of these challenges, either by focusing on specific occupations with available residence and income individual-level data or by focusing on a reform targeted towards high skilled immigrants. [Kleven et al. \(2013\)](#) study the migration responses of football players to income tax differentials in 14 European countries for the period 1996-2008 exploiting variations created by the Bosman ruling and the implementation of specific tax schemes. [Akcigit et al. \(2016\)](#) use individual data on inventors for eight OECD countries for the period 1977-2000 and exploit the differential effects of top tax rates on inventors with different propensity to be treated by these changes. Finally, [Kleven et al. \(2014\)](#) use a specific tax scheme targeting high income in Denmark to estimate how foreigners responded to the reform.

These papers take a first step in providing credible estimates of international migration responses to taxation, and establish that superstars' location choices are indeed affected by personal income tax rates. However, these studies focus on very specific occupations and the validity of their estimates for the entire top earners populations can be challenged. As emphasized in the recent survey of the literature by [Kleven et al. \(2020\)](#), there is still a lack of evidence on tax-driven international migration for broader populations, a necessary parameter to better assess the tax policy implications of migration responses.

This paper aims to fill this gap. I propose an estimation of migration responses to top earnings tax rates for the entire top ten percent of earners in 21 European countries that addresses the two main empirical challenges described before.

I first overcome the *data challenge* by leveraging a newly constructed detailed individual-level dataset on mobility covering a representative sample of the overall European population, building on the largest European-wide survey (European Labour Force Survey: EU-LFS). The data allow me to track residence choices of taxpayers at different earnings levels in the European Union over the period 2009-2015. I combine this dataset with collected data on top personal income tax rates built from the OECD Taxing Wages.

In order to address the *identification challenge*, my main estimation strategy exploits the differential effects of changes in top income tax rates on location choices of top earners and individuals with lower earnings levels within a given country and year. This strategy allows me to filter-out unobserved country-specific shifts that are correlated with top tax rates changes and mobility patterns of individuals' affected or not affected by top tax rates reforms.

I start the analysis by describing new empirical facts on within-EU cross-national mobility. I build a novel mobility measure based on the EU-LFS that allows me to study individuals' mobility within Europe since 1987. I show that geographic mobility within the European free movement area has been rather stable from 1990 to 2005, and has increased twofold since then. This stylized fact is contrary to what has been observed in the US for the same period, where internal migration rates have been continuously decreasing since 2000 ([Molloy et al. \(2011\)](#)). I show that there are large heterogeneities driving geographic mobility within Europe, and that the composition and the evolution of mobile populations differ widely across Member States. I discuss how these differences may translate into differences in top earners' tax base sensitivity to top tax rates changes

across European countries.

I then turn to the analysis of the effects of top tax rates changes on top earners' mobility. I perform the analysis at two, successively more detailed levels. I start the empirical analysis by investigating the correlations between top tax rates and top earners' mobility at the aggregated level. I find that after accounting for time and country invariant characteristics, there is a positive correlation between the top retention rate and the share of top earners who locate in one country. Consistent with the prediction of a simple model of top earners' location choices, I show that the number of top earners who move from one European country to another is systematically significantly affected by changes in the top tax differentials between the two countries. By focusing on changes over time, within a given country pair, my aggregated model absorbs all time-invariant factors that can shift the demand and supply of top earners across countries. In accordance to my main estimation strategy, I show that bilateral migration flows of individuals with lower earnings levels are not affected by top tax rates differentials variations.

A large part of mobility patterns are likely to be driven by unobserved heterogeneities in individuals' characteristics and abilities. To control for micro-level determinants of mobility decisions, I exploit the individual dimension of my data and turn to the estimation of a full-fledged multinomial model. The multinomial logit model allows me to estimate the effect of an increase in the net-of-tax rate in a given country on the probability of an individual locating in this country.

My estimation strategy controls for both unobserved counterfactual wages and other unobserved migration determinants that could be correlated with individuals' location choices and changes in top tax rates. The EU-LFS provides me with a rare opportunity of measuring directly individuals' ability and characteristics through extensive information on demographics and individuals' past and current employment. I take advantage of the multinomial logit estimation features that allows me to interact these rich individual-level measures of ability with country fixed-effects, thus controlling for differences in wages premium across countries. The estimation also controls for country fixed effects, year fixed effects and country-specific linear trends that filter-out time-invariant factors, aggregate time shocks and country-specific longer-term evolutions in mobility and incomes. To control for the last source of potential endogeneity that lies in country-year shifts correlated with top tax rates and location choices, I exploit the differential effects of changes in the top tax rates on the location choices of top ten percent earners and individuals in lower earnings

deciles. As in a standard difference-in-differences setting, this allows me to use the coefficient estimate of the control group to differentiate-out the effects of unobserved country-year factors that affect similarly the top ten percent of earners and individuals with lower earnings.

I find that top earners' location choices are significantly affected by top tax rates. Across all specifications, the coefficient on log net-of-tax rate is positive, large and statistically significant for top earners, and declines monotonically with income capturing well differences in propensity to be treated by top tax rates across earnings levels. The estimates are robust to the inclusion of country-year fixed effects that control for all unobserved country-specific shocks. I use the coefficients from the micro-level analysis to estimate top earners' location elasticities with respect to the top net-of-tax rate. I provide the effects relative to several possible control groups for the top ten percent. At the lower end, using the 8th decile of earnings as a control group yields an elasticity of the number of top earners with respect to the net-of-tax rate of 0.15 that is statistically significant at the one percent level. Using the 6th-7th deciles, the median decile or the bottom fifty percent as control groups yields elasticities of respectively 0.27, 0.25 and 0.35, all significant at the one percent level.

Considering the 8th decile as the control group, the results imply that if the average European country decreases its top tax rate by 10 percentage points from a level of 60 percent, the number of top earners in this country would increase by roughly 2 percent. While European top earners' location choices are significantly affected by top marginal tax rates, the magnitude of the tax-driven migration effect on the total tax base is thus relatively small. I confirm this finding by laying out a simple theoretical framework that I use to calibrate the tax-revenue effects of top tax changes in Europe in the presence of top earners' migration responses to taxation. I find that while being statistically different from zero, the estimated elasticities are not large enough to compensate alone a decrease in current levels of top tax rates in Europe.

There are large heterogeneities in top earners' sensitivity to top taxes in location decisions that are likely to drive the overall estimated elasticity. Consistent with the findings of [Kleven et al. \(2013\)](#), [Kleven et al. \(2014\)](#) and [Akcigit et al. \(2016\)](#), I estimate that the elasticity with respect to the net-of-tax rate is very large for foreigners, and lies between 0.7 and 1.7. I find that top earners working in banking and insurance are also more likely to take advantage of top tax differentials when choosing where to locate compared to top earners working in more constrained occupation

like public administration or defence. These heterogeneities in individuals' sensitivity to taxes may lead countries with different tax bases composition to be affected differently by top earners' tax-driven migration. For instance, abstracting from any other margins of responses than migration, I find that the top earners' tax base in Germany is two times less elastic to changes in top marginal tax rates compared to the top earners' tax base in France or Luxembourg.

I then perform extensive robustness checks and extensions on these benchmark results. First, I investigate the role of firm-level characteristics on individuals' migration responses to taxation. Second, I use a French administrative dataset that merges individuals' tax data with the French part of the EU-LFS to show that my mobility measure is consistent and not biased by mismeasurement. Third, I show that my benchmark results are robust to the inclusion of preferential tax regimes targeted on foreigners satisfying specific eligibility rules. Finally, I show that there is no evidence of shifts from self-employment to self-employment that would be correlated with top tax rates changes and top earners' location choices.

**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. \(2020\)](#). On international migration responses to taxation, [Kleven et al. \(2013\)](#), [Akcigit et al. \(2016\)](#) and [Kleven et al. \(2014\)](#) 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 \(2018\)](#) in Switzerland, [Young and Varner \(2011\)](#); [Young et al. \(2016\)](#) in the US for millionaires, [Agrawal and Foremny \(2018\)](#) in Spain). [Moretti and Wilson \(2017\)](#) provide a central contribution by studying the effects of both 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 in the early 20th century, inventors' location choices within the US were also 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 are lower.

Estimating the elasticity of migration to the tax rate is also important for the theoretical literature of optimal taxation with migration, as it is an important parameter for the optimal tax formulas ([Mirrlees \(1982\)](#), [Wilson \(1992\)](#) and [Lehmann et al. \(2014\)](#)).<sup>1</sup>

The rest of the paper is structured as follow. Section 2 describes the construction of the novel European tax-mobility dataset used in the estimation and documents stylized facts on European mobility. Section 3 lays out a theoretical framework of top earners' location choices used for the rest of the analysis and discusses the identification strategy. Section 4 empirically investigates the effects of top tax rates on top earners' migration in Europe at the aggregated level. Section 5 presents the result of the discrete choice model and calibrates the policy implications of the estimates and Section 6 presents additional mechanisms and robustness checks on the baseline estimates.

## 2 Data and Stylized Facts

### 2.1 The Mobility Data

My analysis is based on a large individual dataset on top earners mobility built from the largest Europe-wide survey covering persons in private households: the European Labor Force Survey (EU-LFS). The EU-LFS is conducted every year in all European member states and EFTA countries, and participation in the EU-LFS for surveyed individuals is compulsory in fourteen coun-

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<sup>1</sup>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.

tries.<sup>2</sup> Labour force surveys (LFS) are implemented at the country level by national statistical institutes, and are then aggregated by Eurostat, which also corrects for non-response and applies weighting methods allowing to implement cross-country comparisons. The EU-LFS is regulated by law since 1973 and these legal grounds are a central element to ensure the quality of these data.<sup>3</sup> As LFS are used by European countries to compute central economic indicators, such as the unemployment rate, very high attention is devoted to the quality of the data. 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 of the data collected, especially regarding demographic variables such as gender, age, marital status or nationality of individuals. The EU-LFS dataset is described in more detail in the Data Appendix.

The EU-LFS is a repeated cross-section, 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, from 1987 to 2015. Individual information in the data include among others age, gender, country of residence, country of previous residence, occupation, previous occupation, employment status, employers' characteristics, marital status, country of birth, nationality, level and field of education. 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. Each individual surveyed in one member state will be defined as a resident of this member state if it satisfies the definition of long-term residence enforced by Eurostat. A person belongs to the resident population of a given country if he is physically staying, or intends to stay, on the economic territory of that country for a period of one year or more. As it is explicetely explained in the implementation guidelines of the survey: "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. Because an individual residing for more than 183 days in one country

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<sup>2</sup>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.

<sup>3</sup>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. The European regulation stipulates explicit rules and common methodology to ensure the comparability of the results across member states.

becomes a tax resident of this country, the EU-LFS measures the number of individuals who chose to be tax residents in each member state in each year covered by the survey. In addition, people also have to provide information on their country of previous residence. The EU-LFS therefore allows me 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.<sup>4</sup> The robustness of the residence concept used by the EU-LFS allows me to estimate real changes in residence and to rule out worries related to change in taxable residence only, in contrast with within-country studies of mobility that exploit tax returns data.<sup>5</sup>

**Selection of Top earners** Since 2009, information on employees' level of monthly labor earnings is collected during the interview.<sup>6</sup> 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 participating country, correcting for non response biases and survey sample weights, and attribute to each employee surveyed in the EU-LFS a decile of income. The information on the level of labour earnings is deleted by Eurostat from the micro files, and only the information on the decile of income is available for researchers. I use the information provided by the EU-LFS on decile of earnings for employees to select top earners' in my sample since 2009. I define as top earners individuals with labour income in the top decile of the earnings distribution of their residence country.

Table 1 provides descriptive statistics for the full population of employees surveyed in the EU-LFS for the estimation period 2009-2015, comparing top earners' characteristics with the average of the employees population. Individuals in the top ten percent of the labour earnings distribution are on average older and much more likely to be men and to be married, compared to the overall earnings distribution. Individuals in the top decile are highly educated, live in cities, have man-

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<sup>4</sup>The annual reports on intra-EU mobility published by the DG Employment discuss the reliability of available data on mobility flows in the EU. They especially emphasize that because of the residence definition used by LFS, yearly mobility measures built from the EU-LFS are the most reliable to study long-term mobility within the European Union. Using administrative French tax data merged with the EU-LFS, I show in Section 6 that the mobility measure of the EU-LFS performs very well, as almost all new residents are matched to an income tax statement after their change of residence.

<sup>5</sup>See [Agrawal and Foremny \(2018\)](#) for a discussion of this issue in within-Spain movements measured through income tax data.

<sup>6</sup>Monthly labour earnings relate to 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.

agerial responsibilities, work in bigger firms and have longer weekly work duration. The share of foreign born is lower among top earners' residents than in the average population, while the yearly geographical mobility rate has been higher for top earners than for individuals in lower earnings' deciles over the period 2009-2015. Top earners' population finally differ in their composition across European countries. Countries like Luxembourg or Belgium are characterized by a more international top earners' tax base compared to countries like Germany, Italy or Poland. Geographical origin and occupations of top earners also differ widely across Member States. These heterogeneities in top earners' tax base composition are likely to translate into differences in tax base sensitivity to top tax rates changes. I discuss this point later in the analysis.

**Complementary Data on European Top Earners** I complement my baseline mobility dataset build from the EU-LFS with additional individual-level European data on earnings levels from the European Survey on Living and Income Conditions (EU-SILC). The EU-SILC is a detailed individual-level annual European survey that gives precise information on various sources of income, such as monthly labor earnings, gross household income, and capital income and wealth taxes for the period 2005-2015. The main advantage of the EU-SILC dataset is that it shares a large set of common variables with the EU-LFS, and that these covariates are coded and defined in exactly the same way in the two surveys. In particular, the income variable used to build labour earnings decile in the EU-LFS is available in levels in the EU-SILC.<sup>7</sup> I take advantage of this feature to select individuals with labour income in the top decile of the earnings distribution of their residence country in the EU-SILC. This allows me to obtain a top ten percent sample defined in the same way than in the EU-LFS with detailed information on level of gross individual and household labour earnings for my estimation period.

## 2.2 Top Income Tax Rates

I collect data on top income tax rates across European countries. I construct yearly European top marginal income tax rates using data from the OECD Taxing Wages database. The final merged

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<sup>7</sup>The EU-SILC does not provide information on past country of residence and is thus not exploitable for the mobility analysis.

dataset on tax rates and mobility contains information for 21 European countries in the OECD.<sup>8</sup>

As outlined with more details in the theoretical framework exposed in the next SubSection 3.1, the relevant tax rate for migration decisions is the average tax rate on earnings. This is because location choices are driven by total tax liabilities paid in each potential location, that determine the total level of utility in each of these locations. Computing the effective tax rate of individuals included in the estimation sample would require detailed information on individuals' sources of income, wealth and household characteristics that are not available in my data, in addition to the exact level of earnings that is not observable. These limitations would be especially salient at the bottom of the distribution, where transfers largely affect 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.<sup>9</sup>

I follow Kleven et al. (2013) and Akcigit et al. (2016) and use top marginal tax rates on personal income as a proxy for effective tax rates. Although 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 at the top of the income distribution.<sup>10</sup> Therefore, my baseline measure of taxation is the top marginal tax rate on personal income. It combines the central government and local marginal personal income tax rate at the earnings threshold where the top statutory personal income tax rate first applied, as collected by the OECD Taxing Wages Database.<sup>11</sup>

The first important advantage of the top marginal tax rate measure is that conditional on being in the top bracket, it is 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. As emphasized by the recent work conducted

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<sup>8</sup>The list of countries included in the analysis is: Austria, Belgium, Denmark, Croatia, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Slovakia, Spain, Switzerland, United Kingdom. Norway, Greece, Sweden and Ireland did not provide sufficient information either on income decile level or past residence and therefore cannot be included in the estimation sample. More details on the dataset creation are provided in the Data appendix.

<sup>9</sup>The recent contribution of Agersnap et al. (2019) overcomes this challenge by studying migration responses to a change in welfare benefits in Denmark.

<sup>10</sup>Kleven et al. (2013) show that estimated elasticities using top marginal tax rates and average tax rates are very similar.

<sup>11</sup>Data are directly made available to researcher through the OECD Taxing Wages Database <https://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP>.

by [Stantcheva \(2020\)](#), 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. While individuals may be perfectly able to estimate their overall tax burden in their country of residence, they may be less apt to do so in alternative potential destination countries. By contrast, levels of marginal tax rates on personal income in the top tax bracket are very comparable across countries even when they are characterized by very heterogeneous fiscal and social regimes. The final advantage of using the top marginal tax rate on income is that it allows me to identify very clearly the threshold of top marginal tax rate treatment (top income tax bracket threshold) across member states. This is particularly useful to verify propensities to be treated by my top tax rate measure in my estimation sample.

In order to document propensities to be treated by top marginal tax rates across countries, I leverage detailed individual-level European data on income provided by the EU-SILC. I use the information on individual wage to select individuals in the top ten percent of the earnings distribution in the EU-SILC.<sup>12</sup> Figure 2 shows the distribution of gross wage and gross household income of individuals in the top ten percent of the wage distribution in a selected sample of countries. The information of earnings' distribution within the top decile is combined with information on top marginal tax rate threshold in the country. In most countries, the top decile is entirely treated by the top marginal tax rate. In some countries, such as Belgium or Luxembourg, lower income brackets are also affected by the top marginal tax rate. Figure 2 thus emphasizes that the intensity of top marginal tax rate treatment within the top decile and in lower income brackets may vary across countries, depending on the progressivity of the income tax schedule. The estimation strategy will thus exploit differences in propensity to be treated, rather than a pure treatment effect above the top decile. I discuss this point in more details later in the analysis.

To consider variations coming from the overall tax code, I build 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 that are also collected from the OECD Taxing Wages Database. I present the results using this broader measure of the top tax rate for my baseline estimation results. This approach however

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<sup>12</sup>As this information is defined similarly in EU-SILC and EU-LFS, and is the one used by Eurostat to compute individuals' earnings deciles in the EU-LFS, this allows me to obtain a sample of top earners comparable to my estimation sample, with additional information on earnings level.

implies treating 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.

There may be some complications coming from specific foreign tax rules and regimes across countries that I am not able to account for given my data. For instance, an individual coming to France may ask to benefit from a 30% income tax exemption if he satisfies the eligibility criteria of the “*impatriates regime*”. Depending on the unobserved individual’s eligibility criteria and legal arrangements with the tax administration, this might lead to different effective tax rates. Because of similar data limitations, I follow [Akcigit et al. \(2016\)](#) and assume that to a first order the individual pays the regular top tax rate in place in the country where he resides. I however investigate the robustness of the estimates to imputing foreigners tax schemes eligibility in Section 6.<sup>13</sup>

There are finally other taxes that may influence migration decisions, such as capital gains taxes or wealth taxes. However, my estimation sample is limited to employees for which the main part of the total income is the ordinary personal income. This allows me to a first order to abstract from other forms of taxation and to focus on the effects of personal income taxation.

## 2.3 Stylized Facts on European Mobility

I use the information on current and past residence to track individuals’ geographical mobility flows within Europe for the period 1987-2015. I also exploit data on residents’ country of birth and citizenship available since 1998 to provide additional evidence on individuals’ mobility within Europe over the period.

A first proxy of within-Europe mobility is captured by the evolution of foreign-born and non-citizen resident population in Europe, that measures the stock of individuals who moved across countries at some point in their life. The share of foreign-born residents in Europe is on average 12% over the estimation period and has been increasing since 2004 (Figure A.I). Interestingly the share of foreigners in the overall European population is not very different from what is ob-

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<sup>13</sup>As documented in Section 6 the aggregate numbers available on the number of taxpayers benefitting from these regimes and the specificity of the eligibility criteria required by these schemes indicate that the potentially eligible individuals represent a very small fraction of my overall estimation sample of European top earners.

served for specific occupations like football players for which roughly 10% of workforce is foreign born according to [Kleven et al. \(2013\)](#).<sup>14</sup> Mobility measured as share of non-citizens residents is lower (8% on average), and has also been increasing over the past 20 years.<sup>15</sup> Roughly half of foreign born and non-citizen residents are natives from outside the EU, suggesting that freedom of movement contributes to 50% of overall European mobility. Mobility is not a phenomenon focused at the top, as 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 [A.II](#). Some small countries like Luxembourg have especially large stocks of foreign residents (around 40%), by contrast to countries like Italy where this share is significantly lower.

I then exploit the information on individuals' past and current residence and focus on mobility flows in European countries. I define as movers individuals who were a resident of another country the year before the year of the survey. As the residence definition used by the EU-LFS requires for new residents an intention to stay of at least 12 months, this definition of cross-border mobility allows to robustly capture long term migrants. This provides me with a unique measure of individuals geographical mobility within Europe that is fully comparable across countries and over time. Figure [1](#) shows the share of individuals who change their residence country each year, comparing this migration share for all moves and within-Europe moves only, since 1987 to 2015. The Figure allows to isolate some historical events that affected European mobility, such as the end of the communist era that led to a pick of migration to Western Europe in 1990, the Great Recession that stopped temporarily migrations in 2008 or the recent refugees crisis that partially explains the increase in non-European moves since 2015. Overall, what emerges from the descriptive data analysis is that within-Europe mobility has been continuously increasing since 2000, in contrast to what has been observed for the same period in the US. One advantage of the EU-LFS based migration measure is that it is directly comparable to within-US inter-state migration rates, computed from the CPS data using information on individuals who changed their state of residence between march of one year and march of the previous year. The large decrease in inter-state mobility in the

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<sup>14</sup>See Table A.1 in the Appendix of [Kleven et al. \(2013\)](#) for country-level numbers.

<sup>15</sup>This figure is lower than the stock of foreign residents, because individuals who acquired the nationality of their residence country appear as nationals in the data.



US observed since 2000 has been interpreted by the literature as a sign of regional convergence.<sup>16</sup> In Figure 1, I show that Europe followed a very different path. Internal migration rates remain substantially different in levels (0.3% in Europe versus 1.5% in the US), a difference that can be explained by size differences between European countries and American states and by larger migration costs related to crossing country borders, compared to within-US mobility. However, in terms of trends, Figure 1 suggests that within-union mobility has been converging between the US and Europe over the past ten years.

### 3 Conceptual Framework and Identification Strategy

#### 3.1 A Simple Model of Top earners' Mobility

My empirical strategy builds on a very simple model of top earners mobility within Europe. I consider an integrated zone with  $N$  member states where  $n \in 1, \dots, N$ . There is a continuum  $K$  of taxpayers where  $k \in 1, \dots, K$ . In the simple case where the European labour market of top earners is perfectly competitive, the before-tax wage in each country is entirely determined by individual's marginal product in this country  $w_{nt}^k$ . In country  $n$ , an individual has to pay a tax rate  $\tau_{nt}$  on his total income at time  $t$ . In addition to the income earned, an individual receives an individual-country-specific utility benefit of locating as a tax resident in country  $n$  at time  $t$   $\Gamma_{nt}^k$ . This benefit is person-specific and could include among others a preference for the origin country  $m$  ( $\gamma_{mn}$ ), country-level characteristics such as the language or the quality of life ( $\gamma_n$ ), time-specific shocks that could affect migration decisions ( $\gamma_t$ ) and country-specific varying factors that affect residents' utility, such as economical changes or reforms ( $\gamma_{nt}$ ). In addition to systematic factors,  $\Gamma_{nt}^k$  also captures the fact that location decisions are affected by an individual taste shock for country  $n$   $e_{nt}^k$ . Total utility from choosing country  $n$  at time  $t$  is given by:

$$U_{nt}^k = u(w_{nt}^k(1 - \tau_{nt}^k) + \Gamma_{nt}^k) \quad (1)$$

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<sup>16</sup>See Molloy et al. (2011) for a careful documentation of this empirical fact and plausible explanations of decreasing interstate mobility within the US.

Individuals make their migration decisions conditional on their labour supply choices. It follows that the individual  $k$  chooses to live in country  $n$  at time  $t$  if and only if:

$$u(w_{nt}^k(1 - \tau_{nt}^k) + \Gamma_{nt}^k) \geq \max_{n'} u(w_{n't}^k(1 - \tau_{n't}^k) + \Gamma_{n't}^k) \quad (2)$$

Equation (2) shows that individuals can move because of the level of taxes ( $\tau_{nt}^k w_{nt}^k$ ), before-tax wages ( $w_{nt}^k$ ), factors like amenities or economical conditions loaded in  $\Gamma_{nt}^k$  and individual taste shocks ( $e_{nt}^k$ ). The migration condition also emphasizes that conceptually, location choices are driven by average tax rates, rather than marginal tax rates, which are equivalent in the simplistic case of a linear tax schedule. In the empirical analysis, I will proxy the average tax rate by the top marginal tax rate, making the assumption that the effective tax rate for top earners is well approximated by the marginal tax rate in the top bracket, as in [Kleven et al. \(2013\)](#) and [Akcigit et al. \(2016\)](#). I consider an increasing and concave log linear utility function with respect to wages and taxes, such that the utility of living in country  $n$  at time  $t$  for individual  $k$  can be rewritten:

$$U_{nt}^k = \alpha \log(1 - \tau_{nt}) + \alpha \log(w_{nt}^k) + \gamma_n + \gamma_t + \gamma_{mn} + \gamma_{nt} + e_{nt}^k \quad (3)$$

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  $\tau_{nt}$  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  $(1 - \tau_{nt})$  and this relationship should be increasing in the top retention rate.

## 3.2 Identification Strategy

The conceptual framework of top earners' mobility summarized by Equation (2) shows that top taxpayers can move because of the level of taxes ( $\tau_{nt}$ ), before-tax wages ( $w_{nt}^k$ ), various factors such as public goods, careers opportunities or economical conditions loaded in  $\Gamma_{nt}^k$  and individual taste shocks ( $e_{nt}^k$ ). The empirical question is how are top earners' location choices to one country affected by a change in the top income tax rate in this country. The simplest identification strategy exploits variations in top tax rates across countries and time (country-by-year variations) on top

earners' mobility patterns. To properly identify the effects of taxation on location choices, it is necessary to control (1) for all variations in  $w_{nt}^k$  that could be correlated with  $\tau_{nt}^k$  and (2) for all migration determinants included in  $\Gamma_{nt}^k$ , especially because variations in the level of top tax rates  $\tau_{nt}^k$  are most of the time not random and may be correlated with unobserved factors loaded in  $\Gamma_{nt}^k$ .

As shown by Equation (2), 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 lead migration that is purely driven by counterfactual earnings, in particular if counterfactual wages are correlated with top retention rates. The richness of the individual characteristics reported in the EU-LFS allows me to precisely measure individuals' skills and characteristics. As in [Kleven et al. \(2013\)](#) and [Akcigit et al. \(2016\)](#), I fully control for wages by including a vector  $a_t^k$  of nonparametric controls for individuals' ability, the effect of which I allow to vary by country (by interacting  $a_t^k$  with country fixed effect). By controlling for the interaction between each destination country fixed effect and rich individual ability measures, my estimation absorbs variations across countries over time of abilities' prices that could drive top earners' mobility patterns and be correlated with taxes.

Equation (2) also shows that location choices are affected by a set of migration determinants loaded in  $\Gamma_{nt}^k$  and that could be correlated with  $\tau_{nt}^k$ . I first address this challenge by using systematic controls for country-specific invariant characteristics through the inclusion of country fixed effects that fully account for the component  $\gamma_n$  of  $\Gamma_{nt}^k$ . 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  $\gamma_t$  that would be correlated with top earners' mobility patterns and top income tax rates changes. Regarding the preference for home or more generally migration costs, captured by the parameter  $\gamma_{mn}$  loaded in  $\Gamma_{nt}^k$ , the estimation will control for alternatively origin-destination dummies in the log-odd ratio analysis and a home dummy in the conditional logit specification.

This leaves me with a last source of endogeneity that lies in country-specific shocks  $\gamma_{nt}$  cor-

related with tax changes and mobility patterns. For instance, a recessionary shock in one country could be correlated with a top income tax reform implemented in response to this shock, but also to simultaneous changes in top earners' mobility trends from and to this country due to the recession, and not to the top income tax reform. 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. To do so, I allow the effects of top income tax rates on individuals' mobility to vary with individuals' earnings deciles. Individuals with high earnings levels are treated by top income tax rates, while individuals in lower income tax brackets are not affected by changes in top income tax rates. This approach is conceptually close to a difference-in-differences strategy where I compare location choices of individuals in the top tax bracket to individuals who do not face the top marginal tax rate, but are comparable in how their mobility patterns should be affected by unobserved simultaneous shocks. This allows me to exploit within-country variations in top marginal income tax rates by leveraging variations in the effects of taxes at the individual level. It enables to filter-out time-varying shocks  $\gamma_{nt}$  that affect similarly treated and control groups and that are correlated with location choices and top tax rates changes. For instance, this strategy will entirely control for the effects of a country-specific recessionary shock that affect mobility patterns' of the treated and the control group and is correlated with changes in tax rates in this country. The difference-in-differences strategy relies on the assumption that treated and control groups are affected similarly by unobserved country-specific shocks  $\gamma_{nt}$ . In the case where mobility patterns of top ten percent individuals are affected differently by unobserved country-specific time varying changes correlated with top income tax rates changes, this strategy does not allow to perfectly filter-out simultaneous cofounders.

## **4 Macro-Level Analysis of Top Earners' Migration Responses to Taxation**

Equation (2) establishes that the number of top earners who choose to locate in country  $n$  at time  $t$  is affected by the top retention rate in this country  $1 - \tau_{nt}$ . I start the empirical investigation of

this relationship at the macro-level and verify the prediction of the theoretical framework at two, successively more detailed levels.

## 4.1 Cross-Country Analysis

**Level-Level Correlations** I start by asking: do European countries with lower levels of top income tax rates have higher number of foreign-born and immigrants in their top earners' population? To answer this question, I study the correlation between the average level of top marginal tax rate and the number of foreign-born residents and new residents in the top decile over the period 2009-2015. Figure A.IV shows a negative (but not significant) correlation between the share of foreign-born among the population of top earners and the level of top tax rates (Panel A), and a zero correlation between the share of new-residents among the population of top earners and the level of top tax rates (Panel B). Contrary to the prediction of Equation (2), European countries with higher share of foreign born in their top decile tend to have higher levels of top marginal tax rates. For instance, Eastern Europe countries are characterized by low level of top tax rates but low level of both foreign born and new residents among their top taxpayers population. By contrast, some countries like France or Belgium have relatively high levels of top tax rates and much higher share of foreign born and new residents within their population of top earners. Of course, these differences are driven by countries specific characteristics included in  $\Gamma_{nt}^k$  and that are controlled for in the simple level-level correlation. This exercise illustrates that there are many other factors than taxes that may determine the number of top earners who were born (or are coming from) abroad in one country, and these factors may sometimes completely dominate tax differentials. To properly identify the effects of top income tax rates on top earners' mobility, it is important to control for any factors that could affect the variation in levels of top tax rates on the one hand, and the number of foreign born or new residents among top taxpayers on the another hand.

**Country-by-Year Variations in Top Marginal Rax Rates** I therefore complement the level-level correlations by studying the effects of 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 ( $\gamma_n$ ) and time-specific factors ( $\gamma_t$ ) that could affect top tax rates and top earners mobility flows. To partially capture country-time-varying potential confounders  $\gamma_{nt}$ , I also control for

GDP per capita and a linear time-trend. Here, the question asked is: conditional on countries permanent characteristics and year-specific shocks, are variations in top marginal tax rates correlated with variations in top earners' immigration flows? The results summarized in Table B.I show a positive correlation between the log share of new residents within the top decile and the log net-of-tax retention rate, while the correlation is flat when reproducing the same exercise for individuals in the bottom half of the earnings distribution, who are not affected by top tax rates variations (Figure A.V). The exercise shows that controlling for time-invariant factors and time-specific factors leads to a positive correlation between change in top retention rate and number of top earners' new residents, while the correlation is not verified for bottom earners not affected by changes in top marginal tax rates.

## 4.2 Log-Odds Ratio Analysis

I finally turn to the macro analysis of migration flows and taxation that is more directly related to the migration condition derived in the theoretical framework through Equation (2). I follow Moretti and Wilson (2017) and use the model of top earners' mobility to relate differentials in top tax rates with top earners' aggregated migration flows between two countries. Making an assumption on the distribution of one of the utility parameters, it is possible to use Equation (2) to directly derive an estimating equation that I am then able to take to my data. I denote  $V_{nt}^k$  the systematic component of the utility derived from location in country  $n$  such that  $U_{nt}^k = V_{nt}^k + e_{nt}^k$  with:

$$V_{nt}^k = \log(1 - \tau_{nt}) + \alpha \log w_{nt}^k + \gamma_n + \gamma_t + \gamma_{mn} + \gamma_{nt} \quad (4)$$

As explained before, a change in the level of top income tax rate affects the probability that a top earner moves from country  $m$  to country  $n$ . The magnitude of the effect of the tax change depends on the number of marginal top earners in this country, and therefore on the distribution of the term  $e$ . If the idiosyncratic components follow an i.i.d Extreme Value Type I distribution, from MacFadden (1978):

$$Prob(U_{nt}^k > U_{n't}^k, \forall n \neq n') = \frac{\exp(V_{nt}^k)}{\sum_{n' \in N} \exp(V_{n't}^k)} \quad (5)$$

Equation (5) determines the number of top earners who choose to locate in each country in each period, and can under some assumption be estimated directly through a conditional logit from the

individual-level data on location choices. I start by using Equation (5) to link the theoretical model of top earners' mobility with the aggregated data on European top earners' mobility flows as in [Moretti and Wilson \(2017\)](#). With this model, the utility derived by moving from  $m$  to  $n$  is given by  $U_{nt}^k - U_{mt}^k$ . Using Equation (5) and denoting  $P_{mnt}$  the number of top earners who move from country  $m$  to country  $n$  at time  $t$  and  $P_{mmt}$  the number of top earners who choose to stay in country  $m$ , it is possible to write the log odds ratio as linear in the difference in utility levels in origin and destination country:

$$\begin{aligned} & \log(P_{mnt}/P_{mmt}) \\ &= \alpha[\log(1 - \tau_{nt}) - \log(1 - \tau_{mt})] + \alpha\log(w_{nt}/w_{mt}) + [\gamma_n - \gamma_m] + [\gamma_{nt} - \gamma_{mt}] + \gamma_{mn} \end{aligned} \quad (6)$$

Focusing on the utility of movers compared to stayers conveniently allows to differentiate-out the denominator of Equation (5) for the macro-level analysis.<sup>17</sup> The estimated parameter  $\alpha$  captures the effects of top marginal tax rates differentials on top earners migration flows, and will therefore give a proxy of the elasticity of migration with respect to taxation in terms of *flows*.<sup>18</sup> I estimate Equation (6) (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 origin-destination fixed effects in the preferred specification. I also follow [Moretti and Wilson \(2017\)](#) by allowing a two-way clustering of the standard errors at the country-pair and origin  $\times$  year level. I present the estimated values of  $\alpha$  across specifications in Table 2 while Figure 3 shows the binscatter plots for the specification that adjusts for country-pair fixed effects, year fixed effects and origin-year fixed effects. If top tax rates affect

<sup>17</sup>In the next section, I estimate Equation (5) with a full alternative-specific logit model and a maximum likelihood estimator. This allows me to consider *all* location choices for the estimation, and not to restrict the analysis to country-pair with non-zero migration flows, in addition for controlling for individuals' unobserved heterogeneties and thus unobserved counterfactual wages. In the micro-level estimation of location choices, the origin country enters in the estimation through a dummy for the origin country and the clustering of standard errors by country of origin and year. I discuss this point later in the analysis.

<sup>18</sup>[Moretti and Wilson \(2017\)](#) shows that the elasticity in terms of flows is equal to the estimated  $\alpha$  scaled by  $1-P$  where  $P$  is the weighted average of the log-odds ratio. As in [Moretti and Wilson \(2017\)](#),  $P$  is very small in my sample and the elasticity is therefore well approximated by  $\alpha$ .

the migration decisions of top earners, the relationship between net-of-tax rates differentials and log odds ratio should be significant and positive. The plot and the associated estimates show that higher destination-origin net-of-tax retention rate differentials are systematically significantly associated with higher origin-to-destination migration, consistently with the prediction of the theoretical model. The coefficient on log personal top income tax is large and significant and ranges from 1.2(.60) to 2.1(1.0) across specifications. The estimation of the aggregated location choice model shows that top earners' migration flows within Europe are significantly affected by differentials in top personal income tax rates. 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. This is consistent with the prediction that within-country mobility in the US may be more sensitive to tax changes, because of lower migration costs. As my main estimation strategy exploits the differential effects of top tax rates on individuals with different propensities to be treated by these changes, I run a placebo check on the estimation using individuals in the bottom fifty percent that should never be treated by top tax rates. I show in [Figure 4](#) that bilateral migration flows of individuals with lower earnings levels are not affected by changes in top tax rates.

A first limitation of the aggregated location choice approach is to 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. A second limitation is that this estimation does not allow to control for unobserved individual heterogeneity. I overcome these two limitations in the next section by estimating a full-fledge multinomial model of workers' location choices in Europe.

## **5 Individual-Level Model of Mobility**

As a significant part of the location choices are likely to be driven by unobserved heterogeneities across individuals, I turn to the full estimation of the individual location choice model described in [Equation \(2\)](#). This micro-level estimation presents two main advantages compared to the macro-level analysis: it controls for individual-level determinants of migration and exploits differences in propensity to be treated by top income tax rates across individuals with different earnings levels.



## 5.1 Specification and Estimation

To model the location choice of top earners, I adopt a multinomial discrete-choice model. From the theoretical model developed in Section 3, an individual  $k$  locating in country  $n$  at time  $t$  receives the utility:

$$U_{nt}^k = u\left((1 - \tau_{nt})w_{nt}^k\right) + \Gamma_{nt}^k \quad (7)$$

For the empirical specification, I assume log utility of consumption, which allows me to rewrite utility as additively separable in pretax earnings and the tax rate. My benchmark estimation sample is a representative sample of all employees residing in 21 European countries for the period 2009-2015. I am able to observe the location choice and the earnings' decile of each individual for one period of time  $t$ . For each individual, I observe a large set of time-invariant characteristics (age, education level, field of education, family status, citizenship) and the residence country of the individual in  $t - 1$ . An important part of the empirical analysis is to control in a detailed and flexible way for the person-country-specific term  $\Gamma_{nt}^k$ , the counterfactual before-tax wage  $w_{nt}^k$  and to exploit differences in treatment by  $\tau_{nt}$  across individuals.

**Controlling for individual-country preference term ( $\Gamma_{nt}^k$ )** (a) The individual preference for living in any member state at time  $t$  is first assumed to depend on individual-level characteristics  $a_t^k$ . These include individuals' age, age squared, marital status and gender dummies, a dummy for being born outside the European Union, and an indicator variable for having a managerial position. The effect of these individuals characteristics is allowed to vary by country (they are all interacted with country fixed effects). (b) The person-country-specific term  $\Gamma_{nt}^k$  is also affected by country-level characteristics loaded in  $\gamma_n$  and  $\gamma_{nt}$ . In order to filter-out any time-invariant determinants of migration, the estimation includes country fixed effects that totally control for the effect of  $\gamma_n$  on migration decisions. To control for time-varying country-specific factors that could be loaded in  $\Gamma_{nt}^k$ , I include in the estimation a control for GDP per capita and a country-specific linear time trend. In an alternative specification, I replace the country-specific linear time trend and the GDP per capita by country  $\times$  year fixed effects. (c) Location decisions may also be affected by individual  $k$  taste for country  $n$ , for instance through a preference for home if the considered

country is individual's origin country. As the EU-LFS does not allow to observe individuals' exact country of birth, I use the information on previous residence to infer the preference of individual  $k$  for country  $n$ .<sup>19</sup> I include a dummy equal to one if the individual was previously a resident in country  $n$ . As emphasized by [Kleven et al. \(2013\)](#), controlling for past residence captures most of the home bias, compared to control for birth country or country where the first patent was filed as in [Akcigit et al. \(2016\)](#).<sup>20</sup>

**Controlling for counterfactual wages ( $w_{nt}^k$ )** An important determinant of location decisions lies in the unobserved counterfactual wage  $w_{nt}^k$ . Controlling for differentials in wages across countries is especially important when considering a very heterogeneous area such as the European Union. In the case where the labour market is fully flexible, individuals' ability completely determines their potential wages in each country. Part of the wage variation is thus well absorbed by the aforementioned controls that allow to control for aggregated trends at the country-year level and heterogeneities across individual-level characteristics prices across countries. In addition, I include a dummy for having a tertiary level of education, that controls for a robust and exogenous measure of individuals' ability. This quality proxy indicator is interacted with country fixed effects and therefore fully absorbs country-level wages differences at the top of the ability distribution. I also consider specifications where I interact the ability indicator with country fixed effects and year trends, to capture differential evolutions over time in the wage premium in different countries.

**Differences in propensities to be treated by the top marginal tax rate ( $\tau_{nt}$ )** The empirical analysis finally allows for differential effects of top personal income tax rates on individuals of different earnings levels. As explained in Section 2.2, I use the top marginal tax rate on income as

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<sup>19</sup>I use the information on past residence provided by the data in order to build an individual-specific taste for country  $n$   $\gamma_n^k$  that I use for modelling the location decision of individual  $k$  at time  $t$ . This inferred individual-country specific taste is viewed as time-invariant because the discrete location choice model is only used to model mobility decisions at time  $t$ , without modelling past residence choices in previous periods. As emphasized by [Akcigit et al. \(2016\)](#), this model implies that for any two countries, none of which is the home country of the individual, the utility from living in one of these countries does not depend on the other country. An alternative methodology would be to consider a dynamic location choice model with several periods as in [Schmidheiny and Slotwinski \(2018\)](#). However, this would require rich individual-specific information for the set of previous location choices, which are not sufficient in my data.

<sup>20</sup>Controlling for the home bias through a dummy for past residence has also been implemented by [Kleven et al. \(2013\)](#) as a robustness check for their main specification. The column (6) of Table 4 in [Kleven et al. \(2013\)](#) shows that controlling for past residence absorbs most of the home bias that is captured by a dummy equal to one for birth country in other specifications, and does not change the estimates.

my tax measure. My estimation strategy exploits differences in propensities to be treated by top marginal tax rates that come from differences in earnings deciles. The propensity to be affected by top marginal tax rate increases with the level of income, reaching its maximum at the top of the income distribution. I follow the approach of [Akcigit et al. \(2016\)](#) and I interact the log of the top retention rate interacted with indicator variables for the individuals' earnings decile at time  $t$ , denoted  $D(k)$ . Hence, the discrete choice model states that an individual  $k$  derives for each potential location choice  $n$  at time  $t$  the utility:

$$U_{nt}^k = \alpha_{D(k)} \log(1 - \tau_{nt}) + \alpha \log(w_{nt}^k) + \beta_n x_t^k + \gamma_n + \gamma_t + \gamma_n^k + \gamma_{nt} + e_{nt}^k \quad (8)$$

The utility coefficient  $\alpha_{D(k)}$  determines mobility responses of individuals in decile  $D(k)$  to the net-of-tax top retention rate. A positive  $\alpha_{D(k)}$  implies that an increase in the top net-of-tax retention rate in a given country has a positive effect on the probability of an individual with earnings levels  $D(k)$  locating in this country. I use the coefficient of the individuals not treated by changes in top marginal tax rates to account for the bias loaded in the estimated coefficients on log retention rate. As in every difference-in-differences settings, the assumption is that treated individuals and individuals in the control group  $g$  are affected similarly by confounders captured by  $\alpha_{D(k)}$ , but only the treated group is affected by the change in top marginal tax rates. The treated group refers to the top decile, where the expected propensity to be treated by top tax rates changes is the highest. The control group refers to a group with a lower propensity to be treated, but affected by similar country-year level policies. The coefficient on the log top retention rate  $\alpha_g$  for the control group should only load the effects of the unobserved factors in the error term and correlated with variations in  $\tau_{nt}$ . I follow [Akcigit et al. \(2016\)](#) and I compute the effect of the top marginal tax rate on the location choices of the top ten percent individuals as  $\Delta\alpha_g = \alpha_{topdecile} - \alpha_g$ . This allows to differentiate-out unobserved time-varying factors correlated with the changes in top marginal tax rates and location choices that affect the treated and control individuals in a similar way. As for a standard difference-in-differences approach, the choice of the control groups will affect the estimates. In my setting, the treatment by the top marginal tax rate is a continuous function of individuals' earnings, and individuals just below the top decile may be partially treated by the

top marginal tax rate. Therefore, the choice of the control group needs to balance between comparability with individuals in the top decile, and non-zero treatment probability. To reflect this treatment-comparability trade-off in the choice of the control group, I will present and discuss the results for several definition of the control group: individuals in the 9th-8th decile, individuals in the 6th-7th decile, individual in the bottom fifty percent, individuals in the 8th decile and individuals in the median decile.

**Estimation and Computation of Elasticities.** All the specifications of the random-utility model described in Equation (8) can be estimated as multinomial discrete choice model. As described in Section 3.2, if the error term  $e_{nt}^k$  is type I extreme value distributed, the multinomial model can be estimated by maximum likelihood. Denoting  $P_{nt}^k$  the probability that individual  $k$  locates in country  $n$  at time  $t$ , and with  $X_{nt}^k \gamma = \alpha \log(w_{nt}^k) + \beta_n x_t^k + \gamma_n + \gamma_t + \gamma_n^k + \gamma_{nt}$ , we can write:

$$P_{nt}^k = \frac{e^{\alpha_{D(k)}(1-\tau_{nt})} + X_{nt}^k \gamma}{\sum_{n'} e^{\alpha_{D(k)}(1-\tau_{n't})} + X_{n't}^k \gamma} \quad (9)$$

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 at time  $t$ . Following Kleven et al. (2013) and Akcigit et al. (2016), I use the estimates of  $\alpha_{D(k)}$  and the 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:

$$\varepsilon_{nt}^k = \frac{d \log P_{nt}^k}{d \log(1 - \tau_{nt})} = \alpha_{D(k)}(1 - P_{nt}^k) \quad (10)$$

Equation (10) allows to link the structural model based on the utility specification described in Equation (8) to the individual-level sufficient statistic  $\varepsilon_{nt}^k$ . This 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  $\alpha_{D(k)}$  that varies with individual's earnings decile, and of the predicted probability that the individual locates in country  $n$   $P_{nt}^k$ . Following Kleven et al. (2013), it is possible to compute country-level aggregated elasticities

$$\varepsilon_{nt} = \frac{\alpha_{D(k)} \sum_k P_{nt}^k (1 - P_{nt}^k)}{\sum_k P_{nt}^k} \quad (11)$$

which is equivalent to compute  $\alpha_{D(k)}(1 - \bar{P}_n)$  where  $\bar{P}_n$  is the average probability weighted by  $P_{nt}^k$  to locate in country  $n$  over the period of estimation.<sup>21</sup> Globally, as summary statistics, one can define  $\varepsilon$  as the weighted average elasticities across all countries. It would be possible to follow [Kleven et al. \(2013\)](#) and [Akcigit et al. \(2016\)](#) and to report separately the elasticity of foreigners  $\varepsilon_n^f$  from the elasticity of domestics  $\varepsilon_n^d$  in country  $n$ . Denoting  $I_n^d$  the set of all natives from country  $n$  and  $I_n^f$  the set of non-native from country  $n$  the authors show that:

$$\begin{cases} \varepsilon_n^d = \frac{d\log(\sum_{k \in I_n^d} P_{nt}^k)}{d\log(1 - \tau_{nt})} = \frac{\alpha_{C_{kt}} \sum_{k \in I_n^d} P_{n,t}^k (1 - P_{nt}^k)}{\sum_{k \in I_n^d} P_{nt}^k} \\ \varepsilon_n^f = \frac{d\log(\sum_{k \in I_n^f} P_{nt}^k)}{d\log(1 - \tau_{nt})} = \frac{\alpha_{C_{kt}} \sum_{k \in I_n^f} P_{n,t}^k (1 - P_{nt}^k)}{\sum_{k \in I_n^f} P_{nt}^k} \end{cases} \quad (12)$$

Structurally, the discrepancy between foreign and domestic elasticities comes from differences in tax bases. The main argument to document different elasticities of migration with respect to taxation in terms of natives and non-natives 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.<sup>22</sup> 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 of data limitations, the best available measure of foreign and domestics with respect to country  $n$  is based on past residence the year before, which may be less relevant in the case of policies targeted on foreigners. My preferred reported elasticity is computed using the baseline relationship exposed in Equation (11) without distinguishing between foreign and domestic top earners.<sup>23</sup> I call this parameter the uniform elasticity, using the denomination of [Kleven et al. \(2013\)](#). 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 \(2018\)](#). For compa-

<sup>21</sup>The proof has been derived in [Kleven et al. \(2013\)](#) and yields a formula close to the elasticity formula used in the aggregated location choice model of [Moretti and Wilson \(2017\)](#) discussed in Section 4. In the case where the labour market is characterized by rigidities, displacement and sorting effects can arise and may change the elasticity formula as discussed in the Appendix of [Kleven et al. \(2013\)](#).

<sup>22</sup>[Kleven et al. \(2020\)](#) provide an overview of some foreigners tax schemes implemented in OECD countries.

<sup>23</sup>The reported elasticity in this paper is directly comparable to the uniform elasticity in the flexible demand model estimated in [Kleven et al. \(2013\)](#).

rability purposes with previous studies, I use Equation (12) and compute the elasticity of foreign top earners defining  $I_n^f$  as the set of foreign residents with respect to country  $n$ . Similarly than the elasticity of non-natives with respect to the net-of-tax rate that has been estimated in the literature, this parameter will be high by definition, as it relates to a smaller tax base and to individuals who by definition have a lower idiosyncratic attachment for country  $n$ .<sup>24</sup>

## 5.2 Results

I start by estimating the multinomial discrete location choice with maximum likelihood on the entire sample of all European employees with earnings in the 1st, 5th, 8th and top decile over the period 2009-2015. The top panel of Table 3 shows the regression estimates of the multinomial discrete choice model for the estimation sample including all individuals in the 10th, 8th and 1st decile of earnings. The bottom panel of Table 3 presents the same results for the estimation sample including all individuals in the 10th, 5th and 1st decile of earnings. Because the conditional logit model duplicates each observation by the number of location alternatives, it is not possible to estimate the model on the entire population of employees surveyed ( $21 \times 5,700,000$ ). To show that the estimates are not changed by the choice of the benchmark estimation sample, I re-estimate the multinomial discrete location model on a randomly selected sample of the entire original sample including individuals in all earnings deciles described in Table 1 and show the results in Table 4.

I start by estimating the multinomial logit controlling for the home bias as described in Section 3.2 and including 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.<sup>25</sup> This corresponds to column (1) of Table 3 and Table 4. Below the estimates of the utility parameters  $\alpha_D(K)$ , I report the values and the standard errors of the uniform elasticity with respect to the net-of-tax rate following Equation (11). I also report the elasticity of foreigners computed following Equation (12) where  $I_{n,f}$  is defined as the number of top earners residing outside country  $n$ .

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<sup>24</sup>Equation (12) shows how the elasticity parameter is scaled by the average probability that individuals locate in country  $n$  at time  $t$ . If the home bias is strong, the predicted probability that non-natives or individuals previously located elsewhere, locate in country  $n$  at time  $t$  will be low, and the foreign elasticity will be high. This point has been made before by Kleven et al. (2013) and Akcigit et al. (2016).

<sup>25</sup>As the alternative-specific 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.

To control for the counterfactual earnings  $w_{nt}^k$ , I add to the baseline specification rich controls for individuals' ability described previously and that are interacted with country fixed effects. This specification corresponds to column (2) of Table 3 and 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 patterns 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 would for instance control for differential evolutions over time in the quality of public goods in different countries that could affect location choices and could be correlated with top retention rate changes. This specification corresponds to column (3) of Table 3 and of Table 4. To verify the robustness of the estimates to the top tax rate measure, I reproduce the preferred specification of column (3) using the alternative measure of top marginal tax rate that includes employees and employers social security contribution rates. This corresponds to column (4) of Table 3.

The estimated utility coefficient on the top retention rate is large and significant for top ten percent individuals and this for all specifications. It is also very stable and confirms the robustness of the estimate of  $\alpha_{top10}$  to the inclusion of additional controls and to changes in the benchmark estimation sample. The results show consistently that top earners' location choices are significantly affected by top marginal tax rates. The coefficient on log net-of-tax rate declines monotonically with income, capturing well differences in propensity to be treated across earnings levels. Across all specifications, the effects of the top retention rate on location choices is systematically large, positive and statistically significant for individuals in the top decile, and then decreases smoothly with the level of earnings deciles. Therefore, individuals in lower earnings decile exhibit low and non significant coefficient on the log retention rate as showed in Table 3 for the median and the bottom decile and in Table 4 for all individuals below the 7th decile. The utility coefficient on the log top retention rate for individuals just below the top decile (9th-8th decile) is positive and statistically significant in some specifications. This reflects that in my setting, treatment by the top marginal tax rate is a continuous function of income. As illustrated by Figure 2, the top marginal tax treatment threshold does not necessarily correspond to the top decile threshold. As a result,  $\alpha_{9th-8th}$  loads a partial treatment effect of top marginal tax rates. The magnitude of the coefficient should however be lower, as the mass of individuals in the 9th-8th decile are treated with lesser

intensity than individuals in the top decile. This is reinsuringly systematically confirmed by the coefficient estimates showed in Table 3 and Table 4. The 9th-8th deciles may thus give us a lower bound estimate for the computation of the elasticity.<sup>26</sup>

Using the preferred specification and the benchmark estimation sample of Table 3, the estimated migration elasticities of top earners range from 0.15 using the 8th decile as the control group to 0.25 using the 5th decile as the control group, and are both significant at the one percent confidence level. Because the elasticities are computed by differentiating out the effects of time-varying confounders loaded in the placebo coefficient  $\alpha_g$ , the estimates filter-out all country-year level changes that affect similarly the top decile and the control group  $g$ . In that respect, using individuals in the 8th decile as the control group is preferable because they will be more comparable to individuals in the top decile. At the same time and as discussed in Section 2.2, they could also be partially treated by top marginal tax rates changes, leading to underestimate the computed elasticity. By contrast, individuals in the median decile have a very low propensity to be treated by top marginal tax rates. In that case, the coefficient  $\alpha_g$  allows us to get rid of country-year changes that affect the top and the median decile of earnings' in a similar way, but may not perfectly control for the effects of time-varying country-specific affecting solely individuals at the top of the income distribution. For this reason, I find it useful to propose an interval, rather than a pure point estimate, and to report the results for various definitions of the control group as in [Akcigit et al. \(2016\)](#). The elasticities estimates using the full distribution of earnings presented in Table 4 are similar, with an estimated elasticity of 0.13 using the 9th-8th deciles as the control group, 0.27 using the 6th-7th deciles as the control group, and 0.35 using the bottom fifty percent as the control group.

The magnitude of the elasticities are rather small, and in line with the literature on international migration responses to taxation, while being lower than estimates for within-country mobility.<sup>27</sup> [Moretti and Wilson \(2017\)](#) find an elasticity of 0.4 for top inventors within the U.S while [Agrawal and Foremny \(2018\)](#) preferred estimate is 0.8 for top earners within Spain. This can be rationalized by the fact that within-country mobility is constrained by lower mobility costs compared to

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<sup>26</sup>Another explanation for the partial treatment effect detected in the coefficient of 8th-9th decile could be that individuals' location choices are affected by anticipation of future treatment. This mechanism is ruled-out by the assumptions of the discrete choice model, but could still arise in practice.

<sup>27</sup>For comparison, [Kleven et al. \(2013\)](#) estimate a uniform elasticity that is between 0.2 and 0.4 on average for football players. This corresponds to column (3) of Table A3 in [Kleven et al. \(2013\)](#) that relies on uniform migration elasticities and no sorting or displacement effects.



international mobility responses to taxation.

I find that the value of the elasticity with respect to the net-of-tax rate computed for foreign residents is larger, and lies between 0.7 and 1.7. This elasticity is structurally higher as it relates to a much smaller tax base. The finding of a much higher elasticity for foreign residents is consistent with the literature on international migration elasticity. [Kleven et al. \(2013\)](#) find that depending on the specification the non natives elasticity of football players with respect to the net-of-tax rate is between 0.6 and 1.3. [Akcigit et al. \(2016\)](#) estimate that the non natives elasticity of top inventors with respect to the net-of-tax rate lies between 0.6 and 1.0. [Kleven et al. \(2014\)](#) finally find that the migration elasticity of foreigners eligible to a specific tax scheme is between 1.5 and 2 in Denmark. Because it indicates how the probability that top earners located abroad decide to locate in one country when this country changes its top tax rate, the foreign elasticity can be compared to the macro estimates presented in Section 4. The estimated top earners' migration elasticity in the macro-analysis was around between 0.7 when focusing on the country-by-year variations in top marginal tax rates model and 1.5 using the logg-odd ratio model. The estimates obtained with the multinomial logit specification are thus exactly bounded by the estimates of the aggregated analysis.

To get a sense of the magnitude of the effects and to extrapolate from the benchmark estimates presented in Table 3, the results imply that if the average country decreases its top tax rate by 10 percentage points from a level of 60 percent, the number of top earners in this country would increase by roughly 2 percent. These effects are therefore small in magnitude, and indicate that while European top earners' location choices are significantly affected by top marginal tax rates as shown by the estimated utility parameters in Table 3 and Table 4, the overall magnitude of tax-driven migration responses is rather small. To investigate plausible country-level specificities in tax-driven migration responses of top earners, I use the benchmark estimates of Table 3 to compute country-level elasticities as described by Equation (11) and presented in Table 5. Interestingly, my model yields an upper bound for the foreign top earners' migration elasticity in Denmark of 1.7, that is very close to the reduced-form estimate of the quasi-experimental setting presented in [Kleven et al. \(2014\)](#) for the same country. The results in Table 5 show substantial heterogeneities in the estimated elasticities of the number of top earners' with respect to the net-of-tax rate across European countries. Some countries like Luxembourg, France and the United Kingdom are char-

acterized by high elasticities compared to the European average. Other countries like Austria, Italy or Poland have relatively lower elasticities. Abstracting from any other margins of responses than migration, my model indicated that top earners' tax base of Germany is two times less elastic to changes in top marginal tax rates compared to the top earners' tax base in France or Luxembourg. These differences in country-level migration elasticities reflect heterogeneities in top earners' tax base composition across European countries. To investigate this mechanism, I conduct an heterogeneity analysis on individuals' location choices and show how characteristics like top earners' occupations are correlated with tax-driven migration and may thus partially explain differences in top earners' tax base elasticity to net-of-tax rates.

These differences across countries are likely to translate into differences in incentives to implement beggar-thy-neighbor policies. To formalize these differences, I use the estimates presented in Table 5 to quantify the effect of tax-driven migration on European governments' tax revenue. For simplicity, I assume that the only margin of responses of individuals to taxes is through migration (e.g there is no labour supply effect of taxes). Keeping the assumption that the top marginal tax rate  $\tau_{nt}$  approximates the effective tax rates applied to top earners in country  $n$  at time  $t$ , I consider the effects of a change in the top tax rate on governments' tax revenue taking into account migration responses to taxation. For a given change in  $\tau_{nt}$ , I define the *behavioural burden* of the tax reform as the share of mechanical change in tax revenue due to a tax change that is lost to migration responses to the tax change. I show in the Appendix B that this behavioural burden is equal to:

$$\phi_n = \frac{\tau_n}{1 - \tau_n} \varepsilon_n \quad (13)$$

where  $\varepsilon_n$  is the average elasticity with respect to the net-of-tax rate as computed in Equation (11).<sup>28</sup> The parameter  $\phi$  proxies the side of the Laffer curve with  $\phi = 1$  indicating maximization of the tax revenue collected in the top tax bracket by the government. As soon as  $\phi < 1$ , the simplistic model indicates that any change in the current level of top marginal tax rate increases

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<sup>28</sup>The tax revenue collected from top earners' and the efficiency cost of tax reforms should conceptually be a function of the income weighted migration elasticity of top earners  $\bar{\varepsilon}_n$ . A discussion on optimal linear and non-linear tax rate in the presence of tax-driven migration and with more flexible social preferences is detailed in Muñoz (2019). As the data does not allow to observe the joint distribution of wages and migration elasticities, I use the unweighted migration elasticity  $\varepsilon_n$  to compute the efficiency cost of top tax reforms, which is equivalent to making the assumption that individuals' migration elasticities are evenly distributed across income levels within the top decile.

total tax revenue despite migration responses to taxes. I report in Table 6 the calibration of the formula in Equation (13) using the estimated cross-country elasticities presented in Table 5 and the average of top marginal tax rates over the period 2009-2015. The goal of the exercise is to quantify the revenue effect of an increase in the top tax rate given the estimated top earners' migration responses to taxes and abstracting from any other margin of responses. The left panel of Table 6 shows that given the current level of top tax rates in European countries and the estimated migration elasticities, a change in the top tax rate is always revenue-increasing. The estimated international migration elasticities of top earners with respect to the net-of-tax rate are not large enough to use tax-driven migration as an argument against higher top tax rates, a point that has also been made by Kleven et al. (2020). While top earners' tax-driven migration responses are not large enough to capture entirely the tax revenue effects of a top tax rate increase, they can however still have an effect on the achievable level of redistribution and thus on poorest individuals' welfare even when migration elasticities are small (Muñoz (2019)).

What are European countries' incentives to tax differently foreign residents? To investigate this question, I compute the efficiency cost of a reform of top tax rate that would be targeted on all top ten percent earners located outside country  $n$ . This would correspond to a foreign tax scheme targeted on rich immigrants, as in the Danish case studied by Kleven et al. (2014), but with much broader income eligibility requirements.<sup>29</sup> In that case, and assuming no sorting or displacement effects, the efficiency cost of the reform is only affected by the migration elasticity of foreigners. Assuming that top tax rates can only be targeted on foreigners, and using the estimated foreign elasticities presented in Table 5, the right panel of Table 6 shows that it would be revenue-increasing for many European member states to set top tax rates targeted on foreigners way below their actual level of top tax rates. This sheds light on the fact that countries have incentives to lower the top tax rates for top earners located abroad in order to increase unilaterally their tax base. If the decrease in the top tax rate is not targeted on foreigners, the migration effect cannot compensate the overall decrease in tax revenue caused by the decrease in top tax rate as shown in the left panel of Table 6.

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<sup>29</sup>Kleven et al. (2014) establish that the foreign tax scheme in Denmark targets the top 1% of earners.

**Controlling for country-year fixed effects** I investigate the robustness of my benchmark estimates to replacing country-specific linear time trend by country  $\times$  year fixed effects that filter out all country-specific time-varying factors in the estimation. In my setting, differentiating all country-year varying factors is challenging for two main reasons. The estimation first faces a “*curse of dimensionality*” because of the multiplication of country-level parameters included in the structural model, due to the important number of alternative location choices in the full-fledge multinomial model on the one hand, and to the very large number of individual observations on the other 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. It is not possible to solve the maximum likelihood when the specification with country-year fixed effects is estimated on the sample used in Table 3. The second challenge relates to the fact that the flow matrix is sparse, with sometimes few observations by cell considered (for instance at the origin  $\times$  year  $\times$  country  $\times$  income decile level). The convergence of the likelihood function becomes very sensitive with the addition of many indicator variables. Selecting a random sample of the data increases the sparsity of the flow matrix and issues caused by the non-linearity and the convergence of the likelihood estimator.

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. I select individuals with earnings in the 10th, 8th, 5th and 1st decile for 11 countries (half of my original sample) for which the number of missing cells at the country  $\times$  year  $\times$  origin  $\times$  income decile level is minimum.<sup>30</sup> 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 results showed in Table 3 and Table 4 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. I use this restricted estimation sample to show that the benchmark results showed in Table 3 are robust to the inclusion of country-year fixed effects instead of country-specific linear time trends. The first column of Table 7 repeats the preferred specification of Table 3 while column (2) replaces the interaction of country

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<sup>30</sup>This leads me to select the following countries: Austria, Belgium, Switzerland, Germany, France, Italy, Luxembourg, Poland, Slovenia, Slovakia and Great Britain.

fixed effect and year trend with a country-year fixed effect, therefore filtering-out simultaneous country-year level variations. The estimated values of the mobility parameter  $\alpha_{D(k)}$  is very close in magnitude to the estimates obtained in Table 3. The stability of the estimated  $\alpha_{D(k)}$  between column (1) and column (2) of Table 7 shows that the specification controlling for country  $\times$  year linear trend already filters-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. This suggests that the preferred specification of Table 3 controlling for country-specific linear time trend should be robust to the inclusion of country-year fixed effects.

**Effect of Top Earners' Characteristics on Migration Sensitivity to Top Tax Rates** To understand the underlying mechanisms driving top earners' tax-driven migration within Europe, I finally conduct an heterogeneity analysis by focusing on movers (Table B.II). 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 5. Individuals working in more constrained occupations, such as civil servant, are less likely to choose their location according to the retention rate, in contrast with individuals working in banking and insurance. This suggests that individuals working in some segments of the labour market can drive the overall top earners' migration elasticity. This is consistent with the findings of Kleven (2014) that show that top earners working in sports and entertainment react more to changes in top tax rates through migration. I also find that, consistent with the literature, single and young top earners' males are more likely to be sensitive to tax differentials in their location choices when they move. These heterogeneities in individuals' sensitivity to taxes may partially explain why countries with different tax bases composition are affected differently by top earners' tax-driven migration, as discussed previously.

The significance of the interaction between some occupations and top tax rates in migration decisions could also suggest that part of the estimated migration responses to taxes is driven by firms' responses to taxes differentials. I thus investigate in Section 6 how firm-level characteristics affect top earners' location choices.

## 6 Additional Mechanisms and Robustness of the Estimates

In this section, I present additional mechanisms and results on top earners' location choices responses to top tax rates. In particular, I investigate the role of firm-level characteristics on migration responses to taxes. I use administrative data merged with the French part of the EULFS to confirm mobility responses measurement used in the analysis. I finally investigate the robustness of my estimates to alternative specifications imputing foreign tax schemes eligibility and taking into account transitions from self-employment to employment.

**The Role of Employment-level Characteristics in Top Earners' Location Choices** While 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. I then investigate the role played by employers and more generally employment on top earners' reaction to taxation differentials through mobility. 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 estimated elasticity may be a mix of employee and employer responses.

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 company where individuals work and the transition between jobs in the labor market.

It is likely that the type of companies for which individuals are working, in terms of size, activity abroad or industry, affects 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 8 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 issues, I conduct the estimation on a randomly selected subsample of the full estimation sample used in the baseline results of the estimation. Results suggest 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.

I exploit the fact that the data allows me to observe if individuals change their employer before and after migration. 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 a job transition on tax-driven migration is ambiguous. On the 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 the other hand, firms could allocate their employees across borders internalizing 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) of Table 8 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 individual changed its employer compared to the previous period conditionally on being employed in the previous period. Column (3) repeats this specification replacing the indicator with a dummy equal to one if the individual has a new employer in year  $t$  while being either employed, self-employed or unemployed in the previous period. The coefficients on the interaction terms are non significant, suggesting that top earners who changed their employer between year  $t$  and  $t - 1$  were not more likely to take advantage of top tax rates differentials regarding their location decisions between year  $t$  and  $t - 1$ .

**Measurement Checks Using French Administrative Data** To provide evidence on the consistency of my EU-LFS-based measure of mobility and income, I use specific features of the French administrative data. The French Statistic Institute (INSEE) proceeds to a yearly matching between the French labor force survey (*F-LFS or enquête emploi*), the universe of tax declarations of French residents (*déclarations 2042*), and the universe of transfers received from social security organizations (family allowances, transfers), in a database known as the ERFS (*enquête sur les revenus fiscaux et sociaux*). The match between the F-LFS and the administrative tax files is only done for individuals who have been surveyed during the last quarter of the labour force survey (March).

INSEE matches the individual labor force survey files of the last quarter with the individual's French tax file.<sup>31</sup> Individuals who cannot be matched from the EU-LFS to the French administra-

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<sup>31</sup>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 (the sampling of the French Labor survey is based on housing taxation files, which implies that INSEE detains the exhaustive information on

tive tax base are dropped from the ERFs. A successful match means that an individual surveyed in the French part of the EU-LFS can be linked to a French tax statement. I show in Figure A.III that the share of new residents measured in the last quarter of the EU-LFS and the ERFs is very close, indicating that almost all new residents surveyed in the last quarter of the EU-LFS have been linked to a French tax record. This shows that the EU-LFS measure of the resident population allows me to observe individuals who become French tax resident after their migration. In the case where 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 number of new residents observed in the ERFs and the last quarter of the EU-LFS, as these individuals would not be matched to income tax files and would therefore be dropped from the ERFs.

**Accounting for Specific Foreign Tax Rules** A potential confounder of the analysis could be the existence of specific foreign tax rules and regimes that would not be captured by my baseline top tax measure. The eligibility rules for this type of regimes are very specific and depend on numerous unobserved variables that are not measurable in my data such as past residence history for a long period of time (up to ten years), total duration of stay, hiring conditions by firms, exact wages levels and jobs specificities. 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. The fact that some tax breaks for foreigners exist could still matter for the estimation. However, these schemes apply to either very specific people, or very high income, greatly limiting the risk of omission in the estimation based on the entire top ten percent sample.<sup>32</sup>

To check the sensitivity of the estimates to the existence of foreigners tax schemes, I re-estimate the specification of Table 7 taking into account the existence of preferential tax schemes available for foreigners. For countries where preferential tax schemes for foreigners exist during the estima-

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individuals' address), 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  $t$ .

<sup>32</sup>For instance, the numbers published by the French Tax Administration show that over the period 2009-2015 the number of new residents eligible to the preferential tax regime was on average 700 individuals per year. Similarly, the impatriates regime in Denmark studied in Kleven et al. (2014) applies to the top 1%, and not the entire top 10% as studied in my sample. The Italian inbound regime has also occupation, education, and previous residence in Italy requirements that limit greatly the amount of individuals that are likely affected by the regime in my sample.



tion period, I make the assumption that all individuals located elsewhere would face the preferential rate  $\tau_n^f$  in country  $n$ , regardless of the characteristics that determine their eligibility to the preferential rate.<sup>33</sup> I present the results in Table B.III. Estimates are stable to the inclusion of foreigners' tax schemes in the top tax measure. The results show that the coefficient on log retention rate is still large and significant for top earners and decreases monotonically with individuals' level of earnings. 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 income tax rate. This could be explained by the fact that in contrast with other reforms in top tax rates, the implementation of foreigners tax schemes is directly correlated with migration patterns, or economic shocks that may affect mobility patterns of the treated and control group. For instance, the implementation in Italy of the inbound scheme in 2010 aimed to target high skilled return migration flows after that the Great recession led a lot of Italians, especially young, to leave the country. Such recession is correlated with the implementation of the scheme but also with bottom earners migration patterns to and from Italy.

To conclude, the results are not changed by the assumption that all top earners located outside country  $n$  would be facing the preferential tax rate for foreigners when moving to this country. Regarding the available statistics on the total number of individuals claiming preferential tax schemes, and the very specific eligibility criteria for these regimes, this assumption seems however unrealistic.

**Shifting from Self-Employment to Employment** Migration responses to taxation may be simultaneous to changes in individuals' occupation. 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. In some cases, 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. I can only observe individuals who are employed at time  $t$  but I am able to observe if these individuals were unemployed, employed or self-employed

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<sup>33</sup> $\tau_n^f$  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  $n$ .

in the previous period. I build an indicator equals to one if the was self-employed in  $t - 1$ .<sup>34</sup> 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 was self-employed in the previous period. Results in Table B.IV show that the interaction term is not significant, indicating that there is no evidence that top earners who shift from self-employment to employment are more or less likely to significantly react to income taxation through migration.

## 7 Conclusion

In this paper, I study the effects of top personal income tax differentials on top earners' mobility in 21 European countries, a topic of 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 the differential effects of changes in top income tax rates on location choices of top earners and individuals with lower earnings levels within a given country and year.

I start by analyzing the effects of top tax rates differentials on top earners' migration flows at the aggregate level. I find that higher destination-origin net-of-tax rate differentials are associated with higher origin-to-destination migration of top earners, consistently with the prediction of an aggregated location choice model, which translates to an estimated top earners' migration flows elasticity of 1.5. Top tax rates differentials do not affect bilateral migration flows of individuals with lower earnings, in accordance to my main estimation strategy that exploits differences in the effects of top tax rates on the migration of individuals with different earnings levels.

I then estimate a full-fledge multinomial model of location choices that controls for individuals' heterogeneities and exploit differences in propensity to be treated by top tax changes along the income distribution. The 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 me to filter-out any unobserved country-year change that could be correlated

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<sup>34</sup>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.

with location choices of the treated and the control group and top tax reforms. I find that top earners' location choices are significantly affected by top marginal tax rates, while bottom earners are not, 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 at the one percent level and lies between 0.1 and 0.3, using respectively individuals in the 8th and the median decile as the control group. I find substantial heterogeneities in top earners' migration responses to taxes. The migration elasticity is especially high for foreigners with estimates that range between 0.7 and 1.7, both significant at the one percent level. 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. I show that when considering a broad definition of the top earners' population, high income earners' location choices are significantly affected by top marginal tax rates. The results of the literature on superstars' migration responses to taxes thus hold for a more general definition of the top earners' tax base. This finding is consistent with the fact that migration responses to taxation have been at the core of the public debate on top tax policy over the past years in Europe. While European top earners' location choices are significantly affected by top marginal tax rates, the magnitude of the effect on the total tax base is however relatively small. The results indicate that on average migration elasticities alone are not large enough to justify lower levels of top tax rates in Europe. This average result however masks large heterogeneities across countries. Member states differ widely in terms of the sensitivity of their top earners' tax base to changes in top income tax rates which may lead to very different incentives to implement beggar-thy-neighbour policies.

Because migration elasticities are significantly different from zero, they impose a constraint on governments' ability to redistribute compared to a world where location choices' of taxpayers are not affected by tax policy, even when they are small. An interesting avenue for research would be to quantify the potential welfare gains and losses caused by the estimated mobility elasticities in contrast to a situation where redistribution is free from tax-driven migration constraints. In a com-

panion and contemporaneous work (Muñoz (2019)), I use the estimates presented in this paper to quantify the distribution of welfare gains and costs that would be generated by the implementation of a European uniform federal income tax rate.

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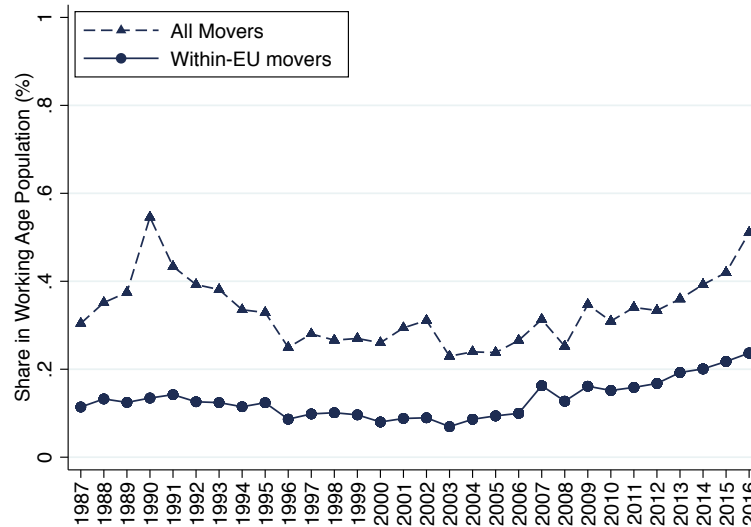
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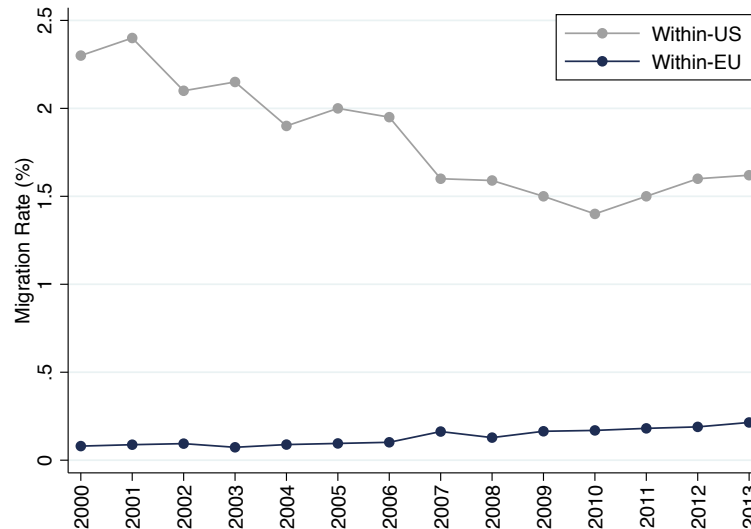
# Figures

Figure 1: Evolution of Mobility in the European Union

## Panel A. Within-EU Migration Rates

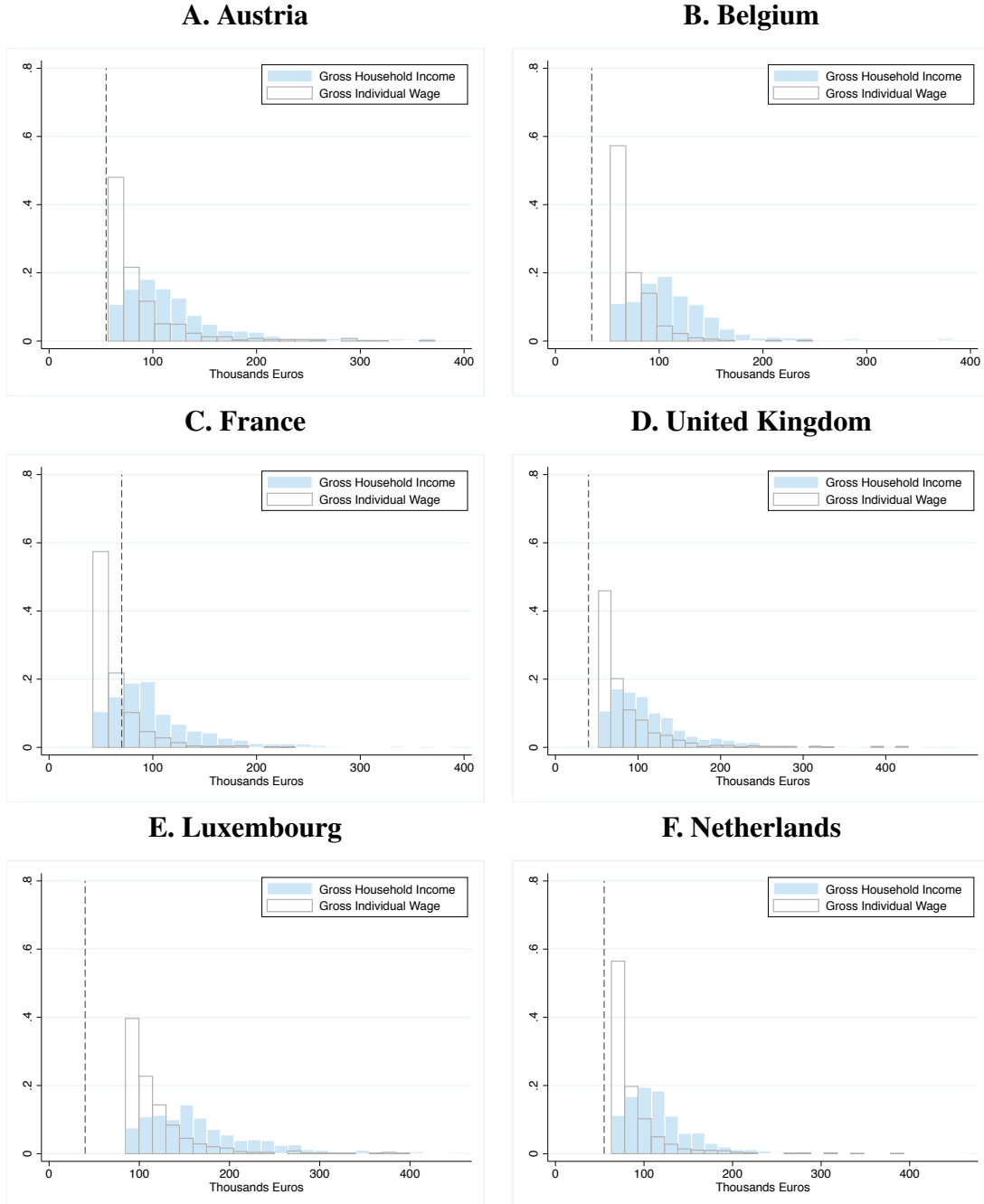


## Panel B. Within-EU Versus Within-US Migration Rates



Notes: The Figure shows the evolution of working-age individuals' geographical mobility in the European Union since 1987. The definition of the European Union is dynamic and takes into account successive geographical enlargements. Geographical mobility rates are computed using the information on current and previous country of permanent residence of the EU-LFS, as described with more details in the text. The Figure plots within-EU mobility rate (share of EU working-age residents of year  $t$  who were residing in another EU member state in year  $t-1$ ) and the overall mobility rate (share of EU working-age residents of year  $t$  who were residing in any other country in year  $t-1$ ). Panel B compares the obtained series for within-EU geographical mobility rates with within-US series for annual inter-state migration from Molloy et al. (2011).

Figure 2: Top Decile and Top Marginal Tax Rate Threshold in 2009

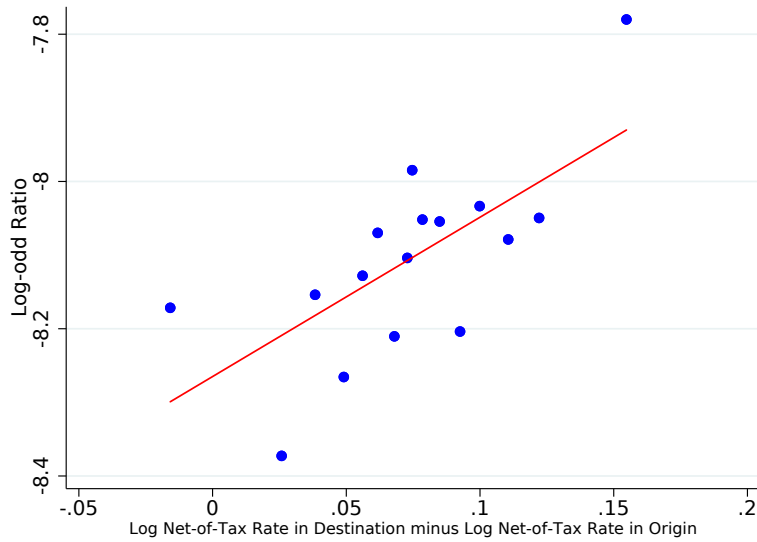


Notes: The Figure shows the distribution of individual-level main wage and household gross labour income in the top decile of the wage distribution in 2009. Data on individual wage and gross household income levels are from the EU-SILC. The top ten percent of the wage distribution in the EU-SILC is selected by ranking individuals on their main individual wage level, thus recreating the top ten percent of the income distribution used in the EU-LFS. Dashed lines represent the earnings threshold at which the top marginal tax rate on personal income applies (treatment threshold).

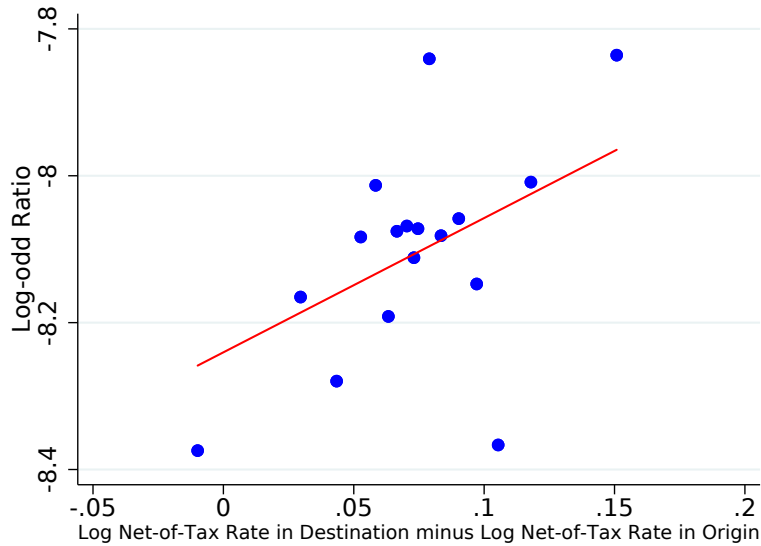


Figure 3: Effect of Top Tax Rates Differentials on Top Earners Bilateral Migration Flows

**Panel A. Baseline Specification**

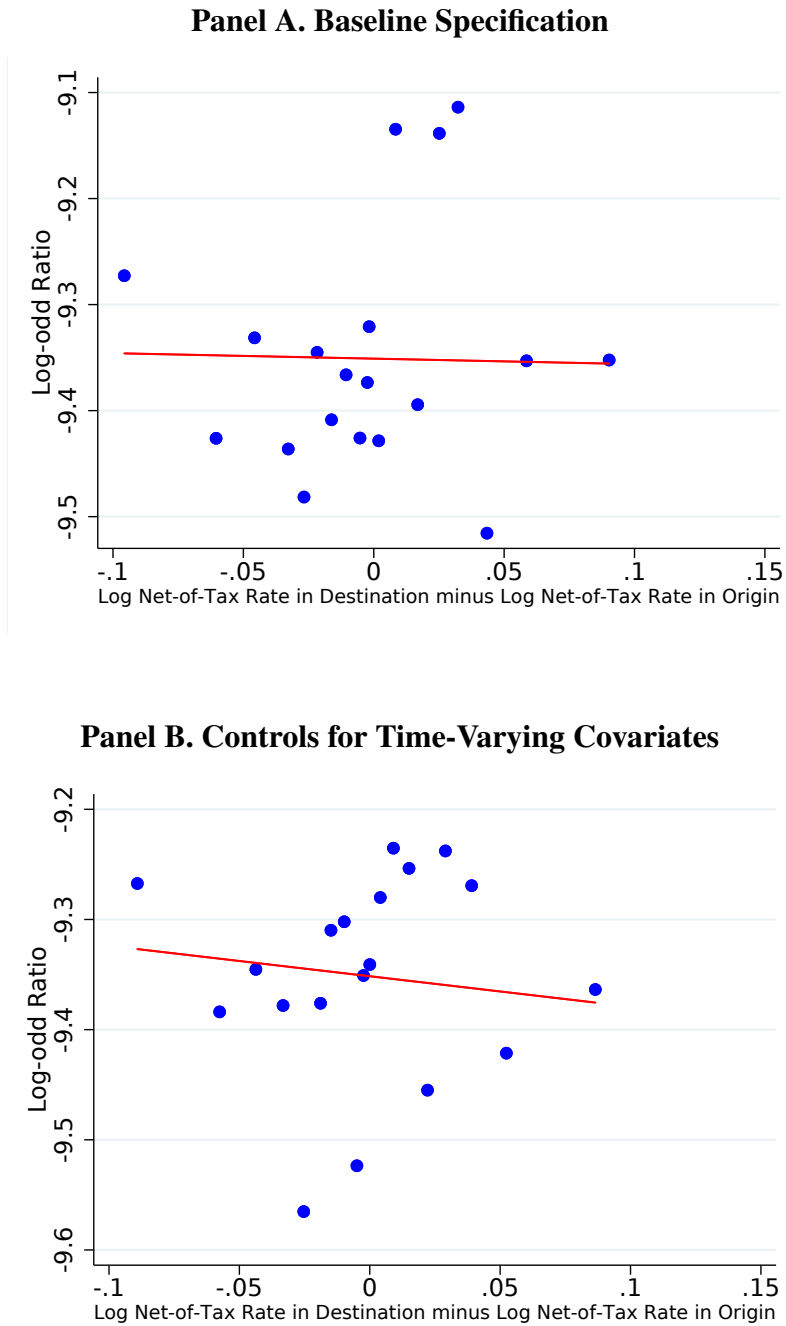


**Panel B. Controls for Time-Varying Covariates**



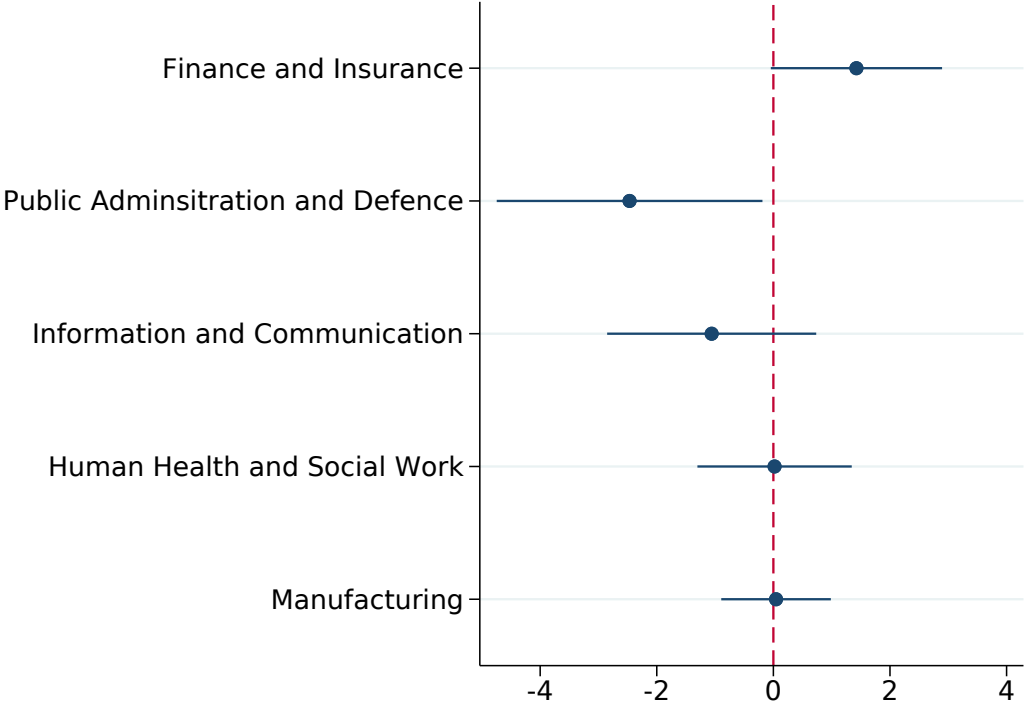
Notes: The Figure shows top earners' migration flows for a given origin-destination pair against the log top retention rate differential between destination and origin country over the period 2009-2015 for 21 European countries. The Figure plots within-bin averages using bins by 20 quintiles sorted on the measure of log retention rate used. Log-odds ratio are computed using  $\log(P_{mnt}/P_{mmt})$ , where  $P_{mnt}$  is the share of individuals moving from country  $m$  to country  $n$  at time  $t$ . Measures of log retention rate and log odds ratio are demeaned of their country-pair, origin-year and year means corresponding of the specification presented in column (3) of Table 2. Panel B adds controls for country-year time-varying covariates as in column (4) of Table 2.

Figure 4: **Placebo Effect of Top Tax Rates Differentials on Bottom Fifty Bilateral Migration Flows**



Notes: The Figure shows bottom earners' migration flows for a given origin-destination pair against the log retention rate differential between destination and origin country. Measures of log retention rate and log odds ratio are demeaned of their country-pair, origin-year and year means, repeating the specification of Figure 4.

Figure 5: **Heterogeneity of Migration Responses to Taxation by Occupation**



Notes: This Figure shows the heterogeneity in top earners' 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 administration, information and communication, health or manufacturing, from the estimation presented in Table B.II. 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 of Employees 2009-2015**

Variables	All Earnings Deciles	Top 10%
Number of observations	5,732,042	563,340
Age	40	44
Percentage of new residents	0.3%	.42%
Percentage of foreign born	12%	8.7%
Percentage of non-citizens	8%	4.7%
Percentage of non-citizens with an EU citizenship	3.7%	3.1%
Percentage with tertiary education level	48%	77%
Percentage of men	51%	74%
Percentage married	55%	70%
Percentage with managerial responsibilities	22%	57%
Percentage living in a densely populated area	44%	54%
Percentage working in a firm with more than 50 employees	45%	66%
Average number of hours worked per week	36	43

Notes: Descriptive statistics of the EU-LFS sample for the estimation period 2009-2015 for 21 European countries: Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, Netherlands, Poland, Portugal, Slovenia, Slovakia and Great Britain. The sample is restricted to individuals whose age is between 18 and 62 years old, individuals surveyed who are employees and for which information on labour earnings decile is available, and to individuals with no missing information for previous country of residence (97% of the sample). Each individual observation is weighted by a coefficient that ensures the representability of the sample at the European level. Earnings deciles are attributed by Eurostat before the sample selection on age and information on previous country of residence. Information on country of birth is not available for German residents (surveyed in Germany) and the share of foreign born thus excludes Germany from the computation. When individuals have more than one citizenship, only the citizenship of their country of residence appears in the survey.

Table 2: **Effect of Top Income Tax Rates Differentials on Top Earners Migration Flows**

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

Notes: Standard errors in parentheses are clustered at the origin-destination pair and origin  $\times$  year level. This Table shows the estimates of Equation (6) and plotted in Figure 3. Country-year level covariates include log population and log GDP per capita.

**Table 3: Effect of Top Retention Rate on Top Earners' Location Choices**

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

Notes: Multinomial logit regressions with robust clustered standard error at the country of origin  $\times$  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, 8th and 10th decile of labour earnings for the top panel and all individuals in the 1st, 5th and 10th decile of labour earnings for the bottom panel. The data includes individuals located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, Netherlands, 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 the number of foreigners 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 4: **Full Distribution of Earnings**

	(1)	(2)	(3)
log(1- $\tau$ ) $\times$ top 10%	1.91	3.37	3.14
s.e	(.60)	(.96)	(1.0)
log(1- $\tau$ ) $\times$ 8th-9th decile	1.64	2.47	2.27
s.e	(.30)	(.78)	(.91)
log(1- $\tau$ ) $\times$ 6th-7th decile	.87	1.59	1.28
s.e	(.32)	(.78)	(.92)
log(1- $\tau$ ) $\times$ 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: 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 the overall EU-LFS sample described in Table 2 for computation ease. The data includes top earners located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, Netherlands, 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. Elasticities are computed with several definition of the control groups as detailed in the text.

Table 5: **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 utility parameters estimated from the preferred specification (column (3) and (7) of Table 3) and the formula of Equation (11) averaged over the period 2009-2015.

Table 6: **Efficiency Costs of Top Marginal Tax Reforms**

	Scenario 1				Scenario 2			
	Efficiency cost of $\tau_{uniform}$ reform				Efficiency cost of $\tau_f$ reform			
	Lower bound		Upper bound		Lower bound		Upper bound	
	$dR/dT$		$dR/dT$		$dR/dT$		$dR/dT$	
Austria	.06	$\geq 0$	.09	$\geq 0$	.70	$\geq 0$	1.6	$\leq 0$
Belgium	.15	$\geq 0$	.22	$\geq 0$	.57	$\geq 0$	1.38	$\leq 0$
Denmark	.13	$\geq 0$	.17	$\geq 0$	.91	$\geq 0$	2.2	$\leq 0$
France	.37	$\geq 0$	.52	$\geq 0$	.70	$\geq 0$	1.7	$\leq 0$
Germany	.14	$\geq 0$	.22	$\geq 0$	.57	$\geq 0$	1.4	$\leq 0$
Italy	.05	$\geq 0$	.07	$\geq 0$	.66	$\geq 0$	1.7	$\leq 0$
Luxembourg	.21	$\geq 0$	.28	$\geq 0$	.57	$\geq 0$	1.4	$\leq 0$
Netherlands	.09	$\geq 0$	.15	$\geq 0$	.72	$\geq 0$	1.7	$\leq 0$
Poland	.05	$\geq 0$	.07	$\geq 0$	.27	$\geq 0$	.7	$\geq 0$
Portugal	.10	$\geq 0$	.15	$\geq 0$	.72	$\geq 0$	1.7	$\leq 0$
Spain	.19	$\geq 0$	.27	$\geq 0$	.56	$\geq 0$	1.4	$\leq 0$
Switzerland	.16	$\geq 0$	.293	$\geq 0$	.37	$\geq 0$	.9	$\geq 0$
United Kingdom	.40	$\geq 0$	.65	$\geq 0$	.52	$\geq 0$	1.3	$\leq 0$

Notes: Calibration of Equation (13) using estimates from Table 5. The efficiency cost refers to the behavioural cost created by the reform divided by the mechanical change in tax revenue after the reform given the current level of top tax rates.

**Table 7: Robustness to Country  $\times$  Year Fixed Effect**

	(1)	(2)	Alt. Tax (3)
$\log(1-\tau) \times$ top 10%	2.94	3.07	2.50
s.e	(.77)	(.76)	(.83)
$\log(1-\tau) \times$ 8th	2.22	2.31	2.03
s.e	(.56)	(.59)	(.60)
$\log(1-\tau) \times$ 5th decile	.680	.720	.815
s.e	(.61)	(.60)	(.61)
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
Observations	12,366,900	12,366,900	12,366,900

Notes: Multinomial logit regressions with robust clustered standard error at the country of origin  $\times$  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. 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. More details in the text for the computation of the selected sample.



**Table 8: Effect of Employment Characteristics on Individuals' Location Decisions**

	(1)	(2)	(3)
$\log(1-\tau) \times$ top 10%	5.33	3.87	4.31
s.e	(1.904)	(1.51)	(1.52)
$\log(1-\tau) \times$ 5th decile	2.27	1.27	1.70
s.e	(1.62)	(1.45)	(1.44)
$\log(1-\tau) \times$ 1st decile	.903	.264	1.03
s.e	(1.73)	(1.52)	(1.43)
$\log(1-\tau) \times$ top 10% $\times$ big firm	-1.907		
s.e	(1.65)		
$\log(1-\tau) \times$ 5th decile $\times$ big firm	-1.50		
s.e	(1.40)		
$\log(1-\tau) \times$ 1st decile $\times$ big firm	-1.55		
s.e	(1.50)		
$\log(1-\tau) \times$ top 10% $\times$ job transition		3.82	-.049
s.e		(2.86)	(1.93)
$\log(1-\tau) \times$ 5th decile $\times$ job transition		3.48	.414
s.e		(2.53)	(.867)
$\log(1-\tau) \times$ 1st decile $\times$ 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

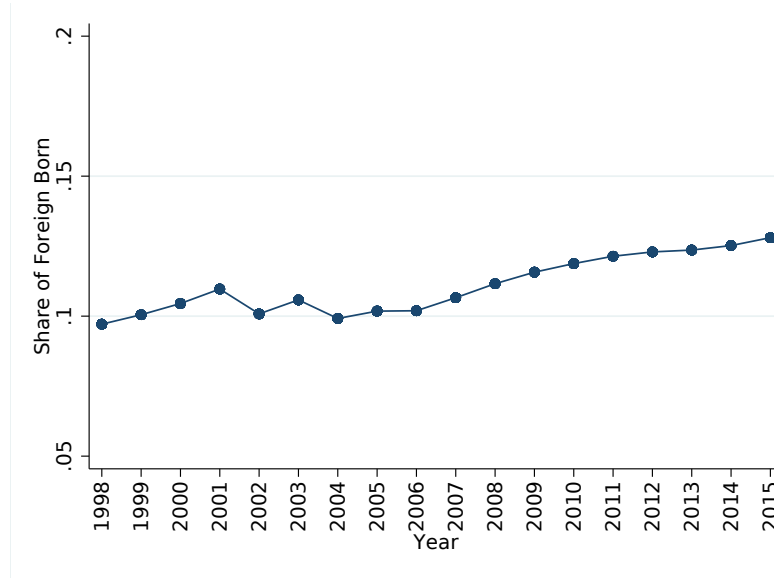
Notes: Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses on a randomly selected subsample of the original sample for computation ease. This table presents the result from the specification used in Table 3 adding interaction terms between earnings decile and employment 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.

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

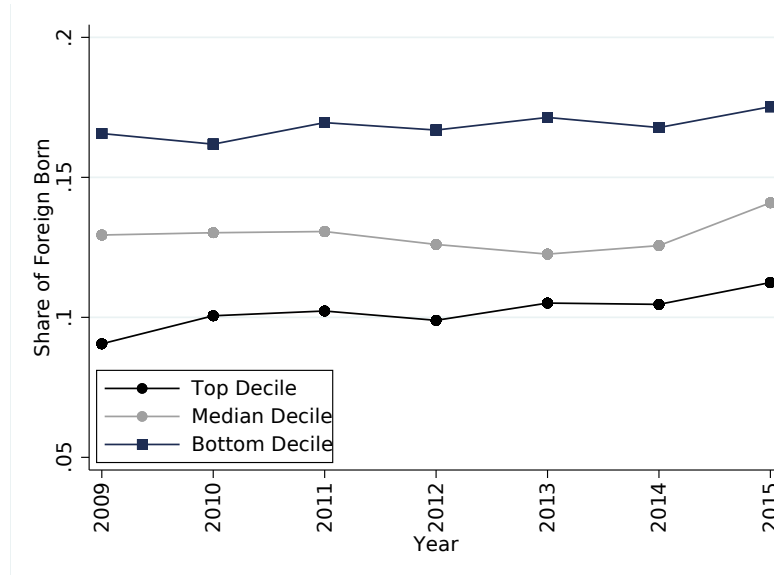
## **A Additional Tables and Figures**

Figure A.I: Foreign-Born Residents in Europe

**A. Share of Foreign Born Residents in the European Union**

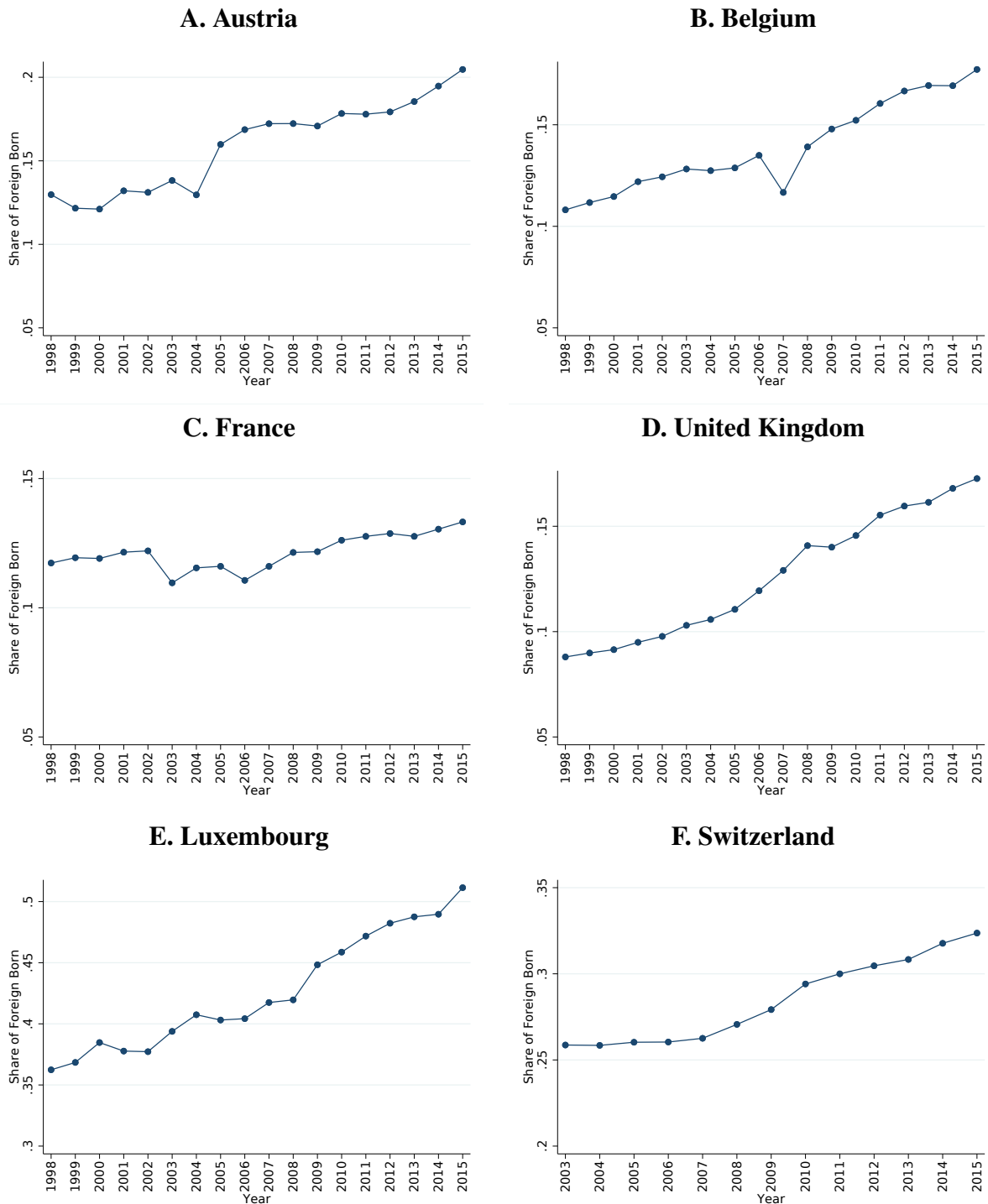


**B. Share of Foreign Born Residents by Income Decile**



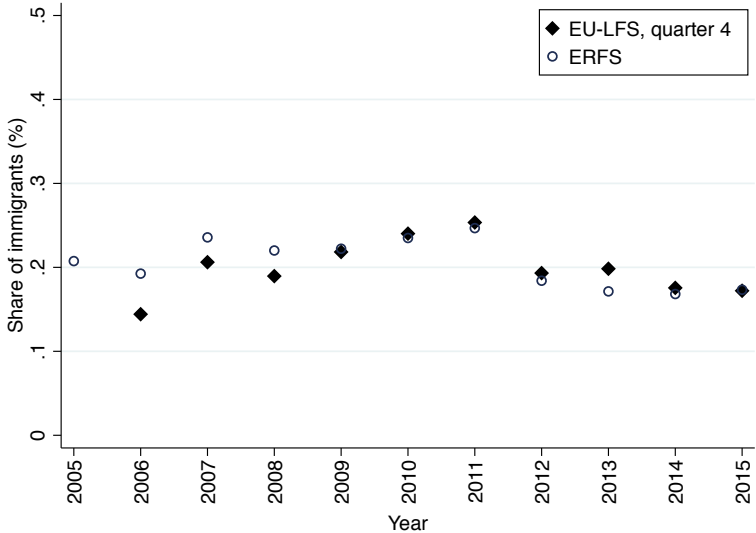
Notes: The Figure shows the evolution of the share of foreign-born residents in the working age population of the European Union. The definition of the European Union is dynamic and takes into account successive geographical enlargements. Panel A shows the evolution of the share of individuals whose age is between 18 and 62 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 A.II: Share 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. Series are built from the EU-LFS as described with more details in the text, and the data appendix.

Figure A.III: Consistency Between French Administrative Data and EU-LFS



Notes: This Figure compares the EU-LFS measure of new residents flows with the same measure in the ERFS. 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.

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

	Top 10%			5th decile			1st decile		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
log(1- $\tau$ )	.84	.75	0.84	-0.96	-0.28	-0.96	.30	-.06	.30
s.e	(.72)	(.78)	(0.31)	(0.60)	(1.72)	(1.89)	(.96)	(1.0)	(0.47)
Observations	120	120	120	101	101	101	114	114	114
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	No	Yes	No	No	Yes	No	No
Time trend (linear)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes

Notes: 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. 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-section level.

**Table B.II: Location Choices of Movers**

	(1)	(2)	(3)
log(1- $\tau$ ) $\times$ top 10%	1.88	2.57	2.99
s.e	(.62)	(.69)	(.96)
log(1- $\tau$ ) $\times$ 5th decile	.30	1.01	1.44
s.e	(.70)	(.71)	(1.02)
log(1- $\tau$ ) $\times$ 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: Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. 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 B.III: **Imputing Impatriates Schemes' Eligibility**

	(1)	(2)
$\log(1-\tau) \times$ top 10%	2.17	1.93
s.e	(.660)	(.682)
$\log(1-\tau) \times$ 8th	.552	.322
s.e	(.536)	(.593)
$\log(1-\tau) \times$ 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 of Table 7 imputing foreigners tax scheme eligibility in countries where such tax schemes have been implemented.

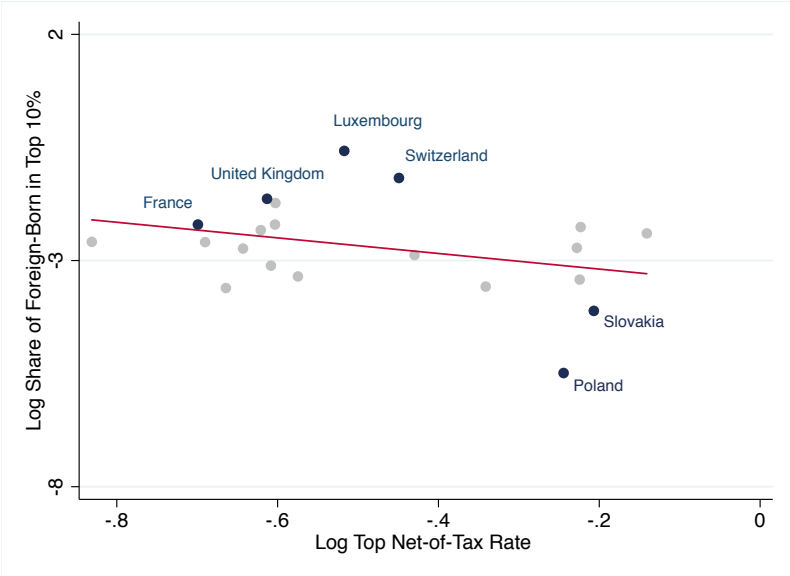
Table B.IV: **Effect of Occupation Transition on Location Choices Sensitivity to Taxes**

	(1)	(2)
$\log(1-\tau) \times$ top 10%	3.44	4.372
s.e	(.908)	(1.545)
$\log(1-\tau) \times$ 5th decile	.593	1.56
s.e	(.750)	(1.43)
$\log(1-\tau) \times$ 1st decile	-.525	.373
s.e	(.818)	(1.51)
$\log(1-\tau) \times$ top 10% $\times$ self-employment shif	-4.11	-7.14
s.e	(5.50)	(6.16)
$\log(1-\tau) \times$ 5th decile $\times$ self-employment shift	4.43	1.66
s.e	(4.82)	(5.51)
$\log(1-\tau) \times$ 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

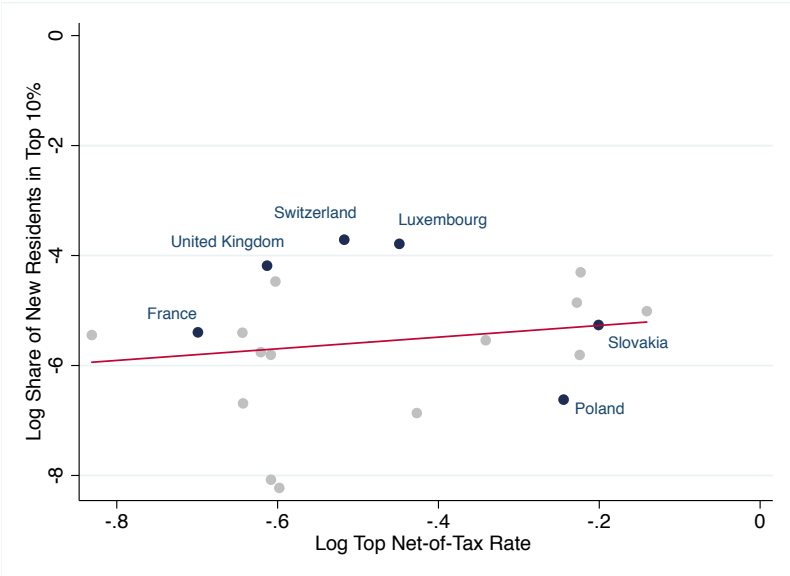
Notes: Notes: Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. This table presents the result from the specification used in Table 3 adding interaction terms between earnings decile and change of occupation between employment and self-employment. The subsample of estimation is randomly selected from the original estimation sample for computational issues.

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

**A. Share of Foreign-Born Within Top Decile**



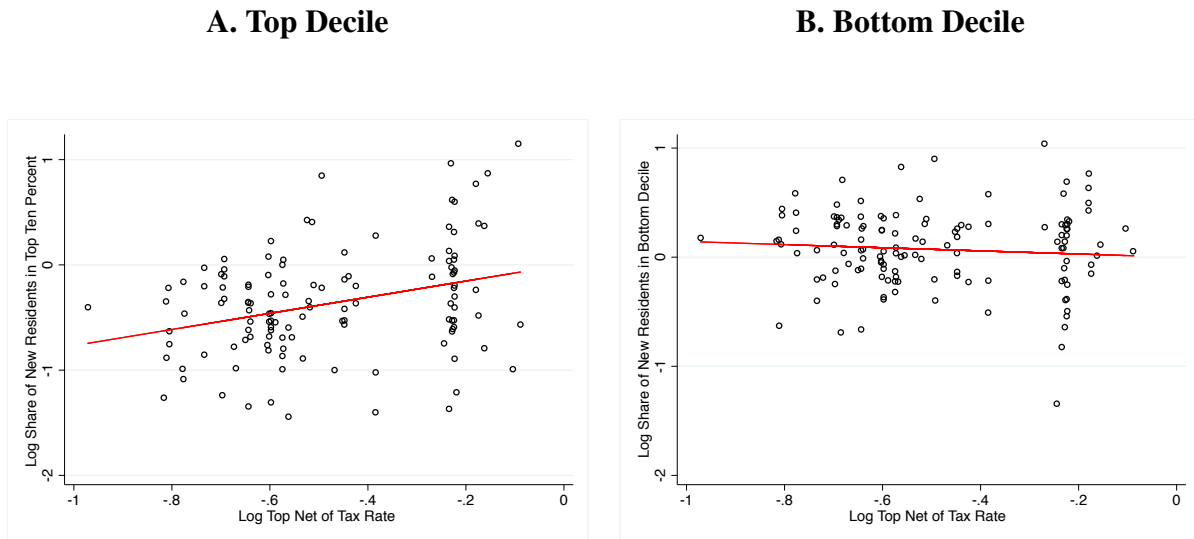
**B. Share of New Residents Within Top Decile**



Notes: The Figure shows the correlation between the level of top marginal tax rates on income and the level of mobile top earners' taxpayers. 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.V: Cross-Country Correlations Between Taxation and Migration, 2009-2015



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 subtract 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 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).

## 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 in each period a linear tax rate  $\tau$  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  $T_0$ .

I make the assumption that individuals can respond to taxation only 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 for each period  $R = \tau \sum_i N_i y_i$  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  $\tau$ . 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. Individuals have an extensive margin of response to the tax change through migration. Individuals react to  $d\tau$  through the migration effect  $-\varepsilon \frac{\tau}{1 - \tau} Y d\tau$ , 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  $dR = (1 - \varepsilon \frac{\tau}{1 - \tau}) Y d\tau$  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.<sup>35</sup>

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  $\tau_f$  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

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<sup>35</sup>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. In that case, the optimal tax rate is augmented by a transfer-weighted term.

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

$$dR = \left(1 - \varepsilon \frac{\tau}{1 - \tau}\right) dM.$$

## 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.<sup>36</sup>

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 therefore 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 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

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<sup>36</sup>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.

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 achieved, 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