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

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This paper studies the effects of top earnings tax rates on the mobility of top ten percent employees within Europe. I use a novel detailed micro-level dataset on mobility built from the largest European survey (EU-LFS), representative of the entire population of 28 European countries. My estimation strategy exploits the differential effects of changes in top income tax rates on individuals of different propensities to be treated by these changes. I find that top ten percent workers' location choices are significantly affected by top income tax rates. I estimate a rather low elasticity of the number of top earners with respect to net-of-tax rate that is between 0.1 and 0.3. By contrast, the mobility response to taxes is especially strong for foreigners, as I estimate an elasticity of the number of foreign top earners with respect to net-of-tax rate that is above one. Turning to tax policy implications, I uncover large heterogeneities in tax competition outcomes within Europe driven by countries' sizes and tax bases' compositions, that translate into large differences in incentives to implement beggar-thy-neighbour policies across member states. I formalise these country-level differences using a revenue-maximizing approach that I calibrate with my estimated parameters. These findings suggest that despite the overall moderate estimated mobility elasticity, tax competition entails substantial welfare costs.

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1 Introduction

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

Is this public debate obsession with top earners' mobility responses to taxation justified by the empirical evidence that top earners' significantly react to taxation through mobility? What are the implications in terms of tax policy of tax driven mobility? In this paper, I use the unique laboratory provided by the EU, a geographic zone with low internal barriers to mobility but substantially different taxation levels (Figure 1), to answer these questions. I estimate the effects of taxation differentials on top earners' location choices within Europe, I quantify the implications of top earners' tax driven mobility for European tax policy and I investigate plausible underlying mechanism of top earners' mobility responses to taxation.

Despite the growing attention devoted to top earners' tax-driven mobility in the public debate, there is still very little empirical evidence on the effect of taxation on the international mobility of individuals. The main explanation lies in the lack of micro data with information on mobility and important identification issues due to the endogeneity of tax reforms and migration decisions. As a result, we still have little knowledge on the magnitude and the evolution of overall within-

EU mobility flows, while these phenomena have been largely covered in the US. On the effect of income taxation differentials on international migration, two noticeable exceptions are the seminal contributions of Kleven et al. (2013) who study the migration response to income tax differentials of football players in 14 European countries for the period 1996-2008 and Akcigit et al. (2016) who use individual data on inventors for height OECD countries for the period 1977-2000. Kleven et al. (2014) also provide a central contribution by using a specific tax scheme targeted on rich immigrants in Denmark to estimate foreign top earners' mobility response to income taxation. These papers take a first step to fill the gap in the literature and establish that superstars location choices are significantly affected by labor earnings tax rates, for both domestic and foreigners. However, these studies focus on very specific occupations and the extension of their estimates to the entire top earners population can be challenged. As emphasized by the recent contribution of Kleven et al. (2019), there is still a lack of evidence on migration responses to taxation of broader population. This paper aims to fil this gap, and to propose an estimation of migration responses to taxation for a much broader definition of top earners, and for a larger set of countries that is more representative of the choice set faced by European citizens. In this paper, I show that the representativity of the population used to estimate extensive margin elasticities to taxation matters, and has large implications for the calibration exercises. I also demonstrate that studying migration responses to taxation within the entire set of European countries is important for tax policy discussions because it allows to capture mechanisms driven by large heterogeneities and that translate into large differences in incentives to engage into tax competition across member states.

The main contributions of this paper are threefold. I first provide new empirical facts on within-EU mobility, using novel measures that overcome the lack of data on international mobility. I then document the link between income taxation rates and top earners mobility flows at the macro-level in Europe, combining cross-country analysis and exploiting the timing of tax reforms to investigate dynamic effects of tax changes. I finally estimate a discrete choice model of migration location choices. I use my estimates to compute sufficient statistics relevant for tax policy: the elasticity of the number of domestic and foreign top earners with respect to top income taxation. I finally lay out a theoretical framework with a revenue-maximizing government in an open economy, using my estimates to calibrate the efficiency costs of top tax reforms in Europe.

My analysis is based on a novel detailed individual dataset on mobility covering a representative sample of the overall European population, based on the largest European individual survey (European Labor Force Survey). The EU-LFS is a repeated cross-section that covers roughly 0.3% of the overall European population per year since the 1980s. It contains extremely detailed individual-level characteristics on past and present location, employment status, demographics, and importantly income decile since 2009. The EU-LFS is the main European survey and is used by national statistics institutes to derive central economic indicators, such as the unemployment rate. Its reliability and representativity are thus extremely high, and allow to limit the expected biases and measurement errors usually related to survey data. I select as my baseline top earners sample employees whose labor earnings are in the top ten percent of the wage distribution of their residence country. I combine this dataset with collected data on top marginal taxes built from the OECD Taxing Wages, and national sources for non OECD countries.

In the first part of the paper, I propose a novel mobility measures to identify European residents who move to another member state (within-EU migrants). I document stylized facts regarding the evolution and the composition of within-EU mobility of individuals for the period 1998-2015. A key finding is that within-EU mobility has been continuously increasing since the 2000s, without being explained by structural changes in demographics nor labor market transitions. I show that this empirical fact is robust and opposed to what has been observed in the US for the same period (Figure 5). I show that the overall increase in residence mobility over the last decade masks large heterogeneities in mobility levels and trends across member states, that are likely to translate to heterogeneous effects of tax changes on mobility patterns within the EU. Exploiting additional administrative and survey data, I perform extensive consistency and comparison checks to show that my EU-LFS based measure of within-EU mobility is consistent and provide a useful tool to overcome the lack of international micro data on mobility.

In the second part of the paper, I turn to the analysis of the effect of top taxation changes on top earners' mobility. There are many challenges that arise when trying to identify the causal effect of income tax differentials on top earners' mobility behaviours. The first important issue is that migration decisions are driven by unobserved determinants, such as counterfactual income that an individual could receive in each potential location. This issue is especially salient when considering location choices among a large and heterogeneous set of countries, like the European

Union. I address this challenge by exploiting the richness of the EU-LFS, that provides extremely detailed information on individual's occupation and labor market outcomes. I use a large set of precisely measured individual-level characteristics that are directly linked to individuals' labor market performance to proxy top earners' ability in each potential location. Unobserved abilities and skills' prices heterogeneities across member states are thus well captured in my estimation.

Another issue lies in imperfect selection of top earners and bad top tax treatment assignment for the estimation. A first concern is that a fraction of top ten percent income earners could be not be affected by the top marginal tax rate, because their earnings are either below or just above the top tax bracket threshold. A second issue relates to sampling and underreporting biases that lead surveys to underestimate the top of the income distribution (Kolsrud et al. (2017)). Exploiting administrative tax data merged with the French part of the EU-LFS, I provide evidence that ranking based on self-reported income is consistent with ranking based on tax register income and I find no evidence of systematic underreporting of income, nor systematic correlation between measurement bias in income and decile of income. To reinforce my top taxation rate assignment, I use a second European dataset with information on income (EU-SILC). I proceed to an exact matching on characteristics and build an imputed measure of income for individuals in the EU-LFS. I use this imputed income to select top earners higher up in the top tax bracket and proceed to additional tests at the very top of the income distribution.

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

I start the empirical analysis with simple correlations between labor taxation and top earners' migration choices at the macroeconomic level. Starting with simple cross-country analysis, I show that there is no significant correlation between the stock of foreign top earners' and top taxation rates levels, as European countries may be characterized by very strong country-level factors that may affect top earners' stocks and levels of taxation. To exploit more variation in top marginal tax rates and top earners' mobility patterns, I turn to the estimation of an aggregated location choice model, explaining the differences in top earners' migration between two countries with differences in the net-of-tax rates between these countries, controlling for time-unvariant origin-destination factors. I find that higher differences between destination and origin retention rates lead to higher emigration from origin to destination country, consistently with aggregate location choice model, and leading to a reduced form estimate for the elasticity of top earners in terms of flows of about 1.5(0.5).

To take advantage of more variations in the estimation, I move to the analysis of specific tax changes. I first identify major changes in taxation differentials over the period and investigate how top earners migration trends have been affected around these changes, using a pure event study framework. This also allows me to investigate the timing in top earners' migration reaction to taxation. Cross-country migration costs being different from zero, migration responses to tax changes may not immediately arise after a tax change. I find that the effects of tax changes on top earners' migration tend to grow over time after the reform, but are difficult to identify because of the limited time-span of the data. I finally move to the more detailed strand of the macro analysis, that consists in analysing a country-specific tax reform. I exploit a quasi-natural variation provided by an important top marginal income tax reforms that took place in France. I rely on a standard differences-in-differences approach to visually investigate the differential effect of the reform on the aggregated flows of top and bottom earners in the country where the reform has been implemented. This approach exemplifies the identification strategy that will be used in the individual-level estimation for the entire set of European countries.

As the decision to migrate is made at the individual level, a large part of mobility patterns are likely to be driven by unobserved heterogeneity and individuals' characteristics. To control for micro-level determinants of mobility decisions, I exploit the individual dimension of the data and turn to a more structural approach. Specifying a discrete choice model with a random utility spec-

ification, I estimate a multinomial model of location choice to quantify the elasticity of migration with respect to taxation for top earners in Europe. My identification comes from differential impacts of top marginal tax rates variations on the mobility of individuals with different propensity to be treated by top taxation rates. Differences in propensity to be treated by top marginal tax rates relate to differences in individuals' earnings levels, and thus tax brackets. The main identifying assumption is that top earners and the pseudo control group are affected in a similar way by country-specific unobserved contemporaneous changes that are correlated with top marginal tax rates changes. My estimation strategy proceeds in two step. I first exploit country-by-year variations in top income tax rates, controlling for country fixed effects and country-specific linear trends, that differentiate-out country-level trends in migration and taxation. Importantly, this strategy allows me to investigate plausible general equilibrium effects of taxation on location choices' of all individuals across the earnings distribution. I then turn to a preferred specification including country-year fixed-effects, allowing to filter-out all country-year variations, and solely exploit the differential effect of top income tax rates on individuals of different propensity to be treated by these changes.

My results indicate that top earners' residence location choices are significantly affected by top income marginal tax rates changes. I find no evidence of equilibrium nor spillover effects of top tax payers tax-driven migration choices on lower earnings mobility decisions. This result suggests that considering the overall European labour market rather than specific occupations with more rigid demand, top earners' migration flows are not large enough to generate sorting and displacement effects. The coefficient on log retention rate monotonically decreases with earnings level, capturing well the differential effects of top income tax rate driven by differences in propensity to be treated by top tax rate, and thus the identification strategy. To take into account the comparability-treatment trade-off in the choice of the control group, I estimate sufficient statistics' intervals, rather than arbitrary point estimates. I compute lower bounds using control groups in higher earnings deciles, with high comparability properties, but partially treated by top marginal tax rates changes. Upper bounds are computed using control groups with low propensity to be treated but less similarities to top earners. I estimate that the elasticity of the number of top earners with respect to the net-of-tax rate is significant and lies between [0,1:0.3]. I find that the elasticity of migration with respect to the net-of-tax rate is significantly larger for foreigners (defined

as movers), and lies in the interval [0.7;1.7], which is consistent with elasticity in terms of flows estimated using the aggregated location choice model in the macro-analysis. With these results at hand, I discuss the importance of estimating top earners' migration responses to taxation within a large set of countries, representative of the current European Union, by contrast to previous studies. The larger the number of countries in the structural estimation of mobility responses, the higher the number of foreigners potentially attractable, compared to domestics. This mechanically leads the migration elasticities to be scaled up by the number of countries in the estimation set, and underlines the challenges related to a large mobility union with tax heterogeneities.

I use the sufficient statistics estimates from the structural analysis to discuss the tax policies implications of my results. I uncover large heterogeneities in top earners' tax driven mobility across European member states, driven by countries' size and top earners' tax base composition, that could translate into very different outcomes of tax competition. To investigate the overall tax revenue effects of my estimates, I lay out a simple theoretical model of labor supply that takes into account extensive migration responses to taxation. I use the revenue maximizing-approach to derive and calibrate formulas on the behavioural deadweight burden created by the implementation of a top tax reform in a free movement area as a function of my estimated sufficient statistics. I estimate that a cut in the top marginal tax rate generates a mechanical decrease in tax revenue that is not compensated by top earners' behavioural responses to the reform, as uniform elasticities are far below unity. However, I show that when governments are able to target foreigners with a specific top income tax rate, they can unilaterally increase their tax revenue by cutting the top taxation rate on top earners located abroad.

I finally turn to the analysis of drivers and mechanisms related to top earners' tax driven mobility within the European Union. In particular, I investigate wether labor market channels affect top earners' tax driven mobility. I complement my baseline residence location choice estimation with employers level controls and interaction effects; and find no effects of labour market channels on top earners' location sensitivity to top marginal tax rates.

This paper is more generally related to the broad literature on labor supply and taxable income responses to income taxation, extensively reviewed by Saez et al. (2012), that suggests that individuals react to income taxation along the intensive and extensive margin. The workhorse Mirrlees (1971) model extended to an open economy shows that the way individuals react to taxation

through migration affects the standard optimal tax formula. This theoretical result underlines the need for empirical estimates of the elasticity of migration with respect to taxation[1], as recently emphasized by the seminal contribution of Lehmann et al. (2014). My paper contributes to this literature by providing estimates that proxy for this central structural parameter.

On the empirical side, my work is also related to a small but growing literature on within-country migration. Liebig et al. (2007) and Schmidheiny and Slotwinski (2018) use discontinuities in Swiss cantons' income tax rates to estimate the effect of income tax differentials on high skilled and top earners mobility, showing that individuals significantly react to tax differentials through mobility across regions. Similarly in the United States, Young and Varner (2011); Young et al. (2016) investigate the effect of federal income tax differentials on millionaires migration, and find very limited effects. A recent study by Agrawal and Foremny (2018) also finds significant effects of income tax differentials on top tax payers' location decisions within Spain. Moretti and Wilson (2017) provide an important contribution by studying the effect of federal taxes differentials on top income inventors mobility, using exhaustive administrative data. As top earners might not react solely to taxation on labour, 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. There also exist few papers that have investigated the effect of income tax rates on multinational location choices, such as Egger et al. (2013) who find that firms tend to locate their headquarters where top income tax rates and tax progressivity are lower, suggesting that top earners migration may also embed firms' side response to variations in labor taxation rates.

The paper is structured as follows. In Section 2, I detail a basic theoretical framework to analyse mobility responses to taxation. I describe the mobility dataset that I use for the empirical analysis and document stylized facts regarding within-EU lmobility. I perform some consistency checks on the EU-LFS-based measures of top earners' mobility, documenting potential misreporting and measurement biases. I finally discuss the identification strategy that I use in the rest of the paper. In Section 3, I present reduced-form evidence on the elasticity of migration with respect to taxation at the macro level. In Section 4, I present the results from multinomial micro-level regressions

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

controlling for unobserved counterfactual income and differences in propensity to be affected by top tax changes. I use the coefficients estimated from these regressions to compute migration elasticity of top earners. I lay out a theoretical framework that accounts for mobility responses to taxation, and I compute the behavioural effects of tax reforms on governments' revenue using my estimated parameters. I finally run robustness checks on my baseline estimation, and investigate further labour market mechanisms in top earners' migration decisions.

2 Framework, Data and Strategy

2.1 Basic model of top earners mobility

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

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

I assume that there is no time dependency in the migration decision, that is to say no expectations about future tax rates or no adjustment costs of mobility. Therefore, each location choice that takes place in t is a function of the top tax rate faced by individuals k at time t. In the baseline model, individuals' origin country enters in the utility only through the idiosyncratic utility term. Therefore, $\theta^k_{n,t}$ is allowed to be a function on individual k origin country m, where m is equal to n for individuals who decide to stay in their country of origin at time t. 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 $\tau_{n,t}$ will affect country n top earners' population through top earners' flows between country n and every other country n'. Therefore, the number of individuals locating in country n is a function of (1-$\tau_{n,t}$) and this relationship should be increasing in the top retention rate.

2.2 Data

To study the effect of top marginal tax rates on top earners mobility, I collect extensive data on European top earners. I build a micro-level dataset which relies on two sources. The first source is the European Labour Force Survey Database. This is the largest European survey providing annual data on the labour participation of people aged 15 and more, over and outside the labour force. The second source is mainly based on OECD Taxing Wages database.

2.2.1 The Mobility Data

In this paper, I use a large individual dataset on top earners mobility built from the largest European survey: the European Labor Force Survey (EU-LFS). The EU-LFS is conducted every year, in 33 participating countries for the most recent years: the 28 members of the Union, the three EFTA countries (Switzerland, Norway and Iceland) and two candidate countries (former Republic of Macedonia and Turkey). The EU-LFS is designed as a continuous quarterly survey since 2004 with interviews spread uniformly over all weeks of a quarter. The EU-LFS covers persons in private households, and the participation in the EU-LFS for surveyed individuals is compulsory for fourteen participating countries: Belgium, Germany, Greece, Spain, France, Italy, Cyprus, Malta, Austria, Portugal, Slovakia, Norway, Switzerland and Turkey. Population registers, latest population census and lists of addresses are the main sources for the sampling frame. On average, the achieved sampling rate in the EU-LFS is approximately 0.3% of the total European population.[2] Surveys are implemented by National Statistics Institutes, and aggregated by Eurostat, which also corrects for non-response and applies yearly weighting methods in order to obtain consistent sur-

[2]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.

vey weights allowing to use the survey at the yearly level with cross-country comparisons. The EU-LFS is enforced by an European regulation since 1973[3]: these legal grounds are a central element to ensure the quality of the survey data. In particular, the legal guidelines stipulate rules and a common methodology to ensure the comparability of the results by specifying the design of the survey. It also implies the compulsory publication of yearly quality reports reporting sampling errors, non-response rates and general remarks about the quality of the data provided by the survey. As National Labor Force Surveys are used to compute central economic indicators, such as the unemployment rate, a very high attention is devoted to the quality of the data reported. As a consequence, EU-LFS reliability and representativity is remarkably high for a survey. In addition, some countries use register data to complete and check the consistency of the data collected, especially regarding demographic variables such as the gender, the age, the marital status or the nationality of individuals.

The EU-LFS is a repeated cross section database, where the sample of individuals surveyed each year is randomly drawn. It provides detailed information on demographic and social characteristics at the individual level. Individual information in the data include age, country of residence, occupation, marital status, country of birth, nationality, country of work, level of education from 1998 to 2015. Since 2009, the EU-LFS provides the decile of labor earnings for employees. The EU-LFS uses a very robust definition of residence, which makes it suitable for the analysis of mobility. The survey is intended to cover the whole of the resident population, that are all persons whose usual place of residence is in the territory of the Member States of the European Union. This comprises all persons living in the households surveyed during the reference week, and those persons absent from the household for short periods due to studies, holidays, illness, business trips, etc. A person belongs to the resident population of a given country if he is staying, or intend to stay, on the economic territory of that country for a period of one year or more. This question ("How long do you intend to stay in this country") has to be explicitly asked to surveyed individuals who are new in the country where they are surveyed. If the intended length of stay is lower than one year, the individual is removed from the resident population and is not included in the survey. All individuals who belong to the same household are resident where the household has a centre of

[3]Regulation (EC) No 577/98. Note that 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.

economic interest : the principal residence. A member of a resident household continues to be a resident even if that individual makes frequent journeys outside the economic territory, because its centre of economics interest remains in the economy in which the household is resident. The EU-LFS therefore allows to capture permanent change in residence based on the 12-months rule, and to define movers as individuals who change their residence country between the year of the survey and the year before.

Top earners I define as top earners individuals with labor income in the top decile of the labor income distribution of their country of residence. Since 2009, information on the level of monthly labor earnings is collected during the interview, and this information is thus only available for employees. Individuals are asked to show payslips to confirm the information they provide during the interview. The measure of income decile through the survey is particularly convenient, as it avoid to impute level of earnings based on individuals' characteristics. The national statistics institutes then compute the earnings distribution in each country according to the collected answers, correcting for non response biases and survey sample weights, and attribute decile of income to each individual in the EU-LFS with an information on income. Importantly, the decile computed by the LFS does not include any other source of income than labor income, such as capital income or rents.[4]It has been well documented that survey data may under-sample individuals at the very top of the income distribution. Hence, the measure of top earners derived from the EU-LFS and used in the analysis can be wiewed as the top decile excluding individuals located at the very top of the income distribution.

Table 1 provides descriptive statistics for the full population covered by the EU-LFS for the estimation period 2009-2015. Table 2 gives additional summary statistics for the sample of top earners during the same period.

[4]More precisely, the decile of income is computed relative the monthly (take-home) pay that is the pay from the main job after deduction of income tax and National Insurance Contributions. It includes regular overtime, extra compensation for shift work, seniority bonuses, regular travel allowances and per diem allowances, tips and commission, compensation for meals.

2.2.2 Top Income Tax Rates

I merge the EU-LFS with collected data on national income tax rates at the top of the income distribution. I build a dataset of European top marginal income tax rates (MITR) for the period 2000-2015 using data from the OECD Taxing Wages database and national sources for European countries outside the OECD.

As outlined by the theoretical framework described in 2.1, the relevant tax rate for migration decisions is the average tax rate on earnings. However, the EU-LFS does not provide information on exact level of earnings, that would allow to compute effective tax rates for each income level. I hence use top marginal tax rates as a proxy for the effective tax rates. If top marginal tax rates are in general not equal to average tax rates because of the nonlinearity of the tax system, they should be, in theory, strongly correlated, and this correlation should be increasing with the intensity of treatment by the top marginal tax rate. The elasticity of migration with respect to top marginal tax rate can therefore be interpreted as a reduced-form parameter of the structural elasticity of migration with respect to the effective top taxation rate. I discuss the implications of using the top marginal tax rate as a proxy of the effective tax rate in the top decile in 2.5.2.

My baseline measure of taxation is the marginal top tax rate on income, that is the combined central government and sub-central government marginal personal income tax rate at the earnings threshold where the top statutory personal income tax rate first applies. Top marginal tax rates on income present the advantage to be salient, which make them a good measure for migration-based decisions. They are also very comparable across countries, making the cross-country data collection and comparision easily implementable for a large set of countries. Finally, the main advantage of using the top marginal tax rate on earnings is that it allows to identify very clearly the bracket that is effectively treated by changes in this tax measure. As the main estimation strategy exploits differences in propensity to be treated by tax changes across individuals, identifying country-level income thresholds of treatment by changes in our top marginal tax rates measure is central for the analysis.

To provide additional evidence and take into account other components of labour taxation, I use an alternative measure of top income taxes that combines the top MITR with social security contributions rates paid by employees on gross earnings, collected from the OECD Taxing Wages

Database. I present the results using this broader measure of τ for the estimation results of the individual-level analysis.

2.3 Sample Selection, Descriptive Statistics and Stylized Facts

Identification of Mobility I use the information on current and past residence to track individuals' mobility flows within Europe for the period 1998-2015. I define as foreigners individuals who have been resident of another country the year before the year of the survey, and are therefore new residents in the country where they live. These individuals changed their country of residence between year t and $t-1$. As the residence definition used by the EU-LFS requires an intention to stay larger than 12 months, this definition of cross-border mobility allows to robustly capture long term migrants. For these individuals, I am able to identify their exact current and previous country of residence, even if located outside Europe. I use the terms migrants, new residents and foreigners as interchangeably. I discuss in section §4 the implications of a residence-based definition of foreigners.

Figure 4 depicts trends in within-EU cross-border mobility for the period 1998-2015. The figure shows the increase in within-EU migration rate since 1998, where I define the migration rate as the share of individuals in the overall European working age population who changed their residence country between year t and year t-1, from a member state to another.[5] Within-EU migration rate has been multiplied by two between 1998 and 2015. This continuous increase in within-Europe mobility contrasts with what has been observed in the US. One advantage of the EU-LFS based migration measure is that it is directly comparable with within-US inter-state migration rate, computed from the CPS data using information on individuals who changed their State of residence between march of year t and march of year t-1. The large decrease in inter-state mobility in the US observed since 2000 has been interpreted by the literature as a sign of regional convergence (Molloy et al. (2011)). Figure 5 indicates that such phenomena is not yet a play in Europe, since the migration rate has been continuously increasing over the last 15 years. Internal migration rates remain substantially different in levels, because of average size differences between European

[5]Here, the term member state refers to European countries included in the free movement area and therefore includes countries like Norway or Switzerland, that are not part of the EU but have free movement agreements with European countries.

countries and American States, and because of larger migration costs in Europe implied by different languages and only partial political integration. However, Figure 5 suggests the beginning of within-Union convergence between the European Union and the United States.

The observed smooth increase in within-EU mobility masks considerable differences in evolutions and in levels of mobility phenomenas across member states. Figure figure **??** plots national migration rates for different members states and underlines the heterogeneity in openness between European countries. The same conclusion can be drawn from that relies on various mobility measures and shows that there exist large discrepancies between European countries regarding mobility. Small economies such as Switzerland and Luxembourg have large immigration rates and share of foreign-born in their national population compared to other European economies. Interestingly, the average stock of foreigners in European countries population is rather high, on average 8%, and not very different for what is observed for specific occupations like football players for which roughly 10% of countries' workforce is foreign born according to Kleven et al. (2013).

One natural explanation for the increase in within-EU migration rate could be structural changes in demographic trends in Europe, such as changes in age structure or education level. To asses the importance of demographics changes in observed mobility patterns, I estimate an individual-level regression that includes year fixed effects. I plot in the Panel B of Figure 4 the estimated coefficients on year fixed effects, that give average mobility in each period, after accounting for individual-level covariates. The graph shows that controlling for changes in demographics does not affect the upward trend in within-EU migration rates. I interpret the results of these regressions as the evidence that compositional changes in European demographics account for very little of the observed increase in within-EU migration rates. Another logical explanation for increase in within-EU mobility could be an upward trend in labor market transitions, such as changes of employers or changes of occupations. In Figure A.I, I show the evolution of job and occupation transition rates within the EU for the overall period 1998-2015. I see no evidence of an increase in labor market transitions since the 2000s that could explain the increase in migration and labor mobility rates for the same period.

I combine information on income and education level with EULFS-based mobility measures to document more specifically mobility patterns of top ability individuals in the EU. Across all income levels, top earners have the highest cross-border migration rate (Figure A.III). This could

be partially explained by the fact that top earners face lower relative costs to migration, are likely to be more integrated in the international labor market and therefore have better transferability of skills across national labor markets.

2.4 Adressing Measurement Bias and Consistency

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

2.4.1 International Data on Migration

I start by comparing my mobility measures to other available international statistics on migration in Europe. Very few harmonized measures of migration flows are made available by governments and statistics institutes. I use the OECD measure of foreign immigrants flows, which is based on population registers, and the Eurostat measure of yearly immigration flows, based on the Eurostat demographic database. I plot in Panel A of Figure **??** yearly migration rates given by Eurostat, the OECD, and built from the Labor Force Survey. On average, the EU-LFS migration rate measure is lower than the value obtained using OECD and Eurostat raw values of immigrations flows. Discrepancies do not only arise when comparing the EULFS-based measure to the other available measures, but also between the OECD and Eurostat measures. I see one main explanation for this, which is that migration flows are difficult to measure, because they occur by definition at one point in time. I argue that the discrepancies in migration rates measures are not driven by EU-LFS specific biases, but by the nature of the phenomenon studied. Two facts confirm this intuition. First, I reproduce the comparison exercise for the measure of non-nationals stocks in member states population. Panel B of Figure **??** shows that when considering measures of stocks, rather than flows, of mobility, the EU-LFS based measure is fully consistent with others available sources. Second, I go back to the comparison of within-EU and within-US migration rates. Molloy et al. (2011) study of within-US migration rates show that there exists similar discrepancies in yearly inter-state within-US migration measures across sources. This gives a reason to believe that the differences between EU-LFS, OECD and Eurostat mobility measures are not due to specific

survey measurement bias that could arise in the EU-LFS, but more to structural characteristics of migration flows. In the next subsection, I exploit administrative data in order to confirm EU-LFS based mobility measure accuracy, using administrative French data.

2.4.2 French Administrative Data

Survey data may suffer from measurement errors, especially when considering individuals at the top of the distribution. I use the special features of the French data to document the consistency of my EU-LFS-based measure of mobility and income. The French Statistic Institute (INSEE) proceeds to a yearly matching between the French labor force survey (enquete emploi) and the register tax files (declarations 2042), in a database known as the ERFS (enquete sur les revenus fiscaux et sociaux). It is thus possible to obtain precise information on income from the French tax administration merged with the french subsample of the EULFS (F-LFS).

The ERFS matches the administrative tax files only for individuals surveyed during the last quarter of the year since 2004. Therefore, I am able to obtain individual tax files for about 25% of the individuals surveyed in France in my European-level estimation sample. This represents roughly 80,000 individuals each year, and around 150 immigrants per year. 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[6], their full names, and their family structure. The French tax system is not a pay as you go system: individuals surveyed during the last quarter of year t are matched with the tax file they file at year t+1, that determines the amount of taxes they have to pay on income earned during year t. The INSEE matches the labor force survey with the individual's tax file using individual's address, name, and family structure for individuals who file a joint declaration. The information used being very precise, they are able to match a large majority of the individuals surveyed in the enquete emploi, and the number of observations given by Eurostat and by the ERFS is very close. As a result, the share of new residents in the French population captured by the EULFS (last quarter) and the ERFS is similar (Figure 6). Note that if my mobility measure would capture non-permanent migration flows, the discrepancy between the ERFS and the EU-LFS data would be much higher, as these

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

individuals would not be matched to income tax files.

I use the special features of the ERFS to evaluate misreporting and measurement bias of income in the LFS. I call administrative-based measure of income the aggregation by INSEE of all declared wages components in the individual tax declaration (declaration 2042). I compute individual's misreporting bias, which I define as the absolute difference between the administrative and the survey-based measure of income, divided by the income declared in tax files.[7] Misreporting would threat the validity of the estimation only in the case where it would bias my selection of top earners. This would happen if outliers in terms of administrative-survey wedge are over represented at the top of the income distribution, or if misreporting is systematically correlated with the rank in the income distribution. I conduct two exercises to evaluate this possibility. First, I rank individuals in the ERFS according to their survey and administrative based measure of income, conditional on the fact to observe both measures of income for these individuals. I then evaluate the probability to define an individual as a top earner using the administrative-based ranking, while the administrative-based measure of income would yield a different decile. Figure A.VI shows the share of ranking mistakes by decile of survey-based income. The top decile is characterized by the lowest gap between register-based and survey-based ranking. Among the 25% of individuals allocated to the top ten percent of the survey-based income distribution but not to the top ten percent of the administrative-based income distribution, 70% would be allocated to the ninth income decile using the administrative-based ranking. Hence, if any, ranking mistakes at the top of the income distribution using survey information are limited in magnitude. I confirm this finding by showing that there is no endogeneity between misreporting bias and the level of earnings. I plot in Figure A.V the average misreporting bias by decile of survey based income and show that there is no strong correlation between the level of earnings and the extent to which individuals misreport these earnings in the survey compared to their tax files.

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

2.5 Identification Strategy and Threats to Validity

In this paper, I aim to isolate the causal effect of changes in tax differentials on top earners' mobility location choices within the European Union. As it does not rely on quasi-natural exogeneous changes in top taxes levels, my identification strategy may be subject to issues. I identify three main counfounders that are likely to affect the causal inference of the estimation: the omitted determinants of migration, the endogeneity of tax changes and the partial treatment bias. I discuss these issues and address them in various ways.

2.5.1 Omitted Determinants of Mobility

Mobility is a decision that occurs at the individual-level; we thus expect this choice to be largely driven by unobserved heterogeneity between individuals and by specific characteristics that we may not be able to measure. I identify the main omitted variables in migration decisions as unobserved counterfactual earnings and heterogeneities in wealth level.

Migration not only depends on top retention rates individuals face in the country where they choose to locate, but also on the set of counterfactual earnings that they could receive in each country included in their choice set. These counterfactual earnings are never observable, and neither are the counterfactual average tax rates. Hence, estimated responses to taxation through mobility could partially load a part of migration that is purely driven by counterfactual earnings, in particular if counterfactual wages are correlated with top retention rates. The richness of the labor force survey allows to control precisely for individuals' ability in the labor market, and thus to control for unobserved heterogeneities in abilities. I use a large set of individual characteristics such as the age and age squared, the highest level of education attained, the marital status, the gender, the fact of being born outside the European Union and the existence of supervisory responsibilities in the current job as a proxy for individual's ability at work. In my individual-level estimation, I allow the effects of these covariates to vary along each potential destination. Micro estimates capture the fact that ability might be rewarded differently across member states. As the individual characteristics I use to proxy individuals' ability are detailed, interacted with country fixed effects and directly related to individuals' professional status, the structural estimation of location choices will capture well differences in abilities' prices across European labor markets.

Top earners' residence choices might also be partly, or totally, determined by taxation of non-labor income. Top earners are likely to earn capital income and to own large amounts of wealth. Hence, taxes on capital gains and net wealth may significantly affect their choices of tax residence. Therefore, the estimated effect of top marginal earnings tax rates could load the effects of other taxation rates paid by top earners on their mobility, especially if the variations in differentials of top earnings tax rates are strongly correlated with the variations in differentials of capital and wealth tax rates. If capital income taxes and labor income taxes vary in the similar direction and are both correlated with top earners mobility, the estimated elasticity will capture the overall effect of the top tax burden variation on top earners mobility, which is an interesting and relevant parameter *per se*. In the case where capital tax rates and top income tax rates vary in opposite directions, my estimation of top earners' reaction to taxation could be misleading. If one member state increases its labor income tax rate, decreases its capital tax rate at the same time, and top earners' mobility is correlated with both tax changes, I will underestimate the elasticity of taxation with respect to migration. Fortunately, it is likely that contemporaneous variations in capital and income tax rates happen in the same direction, which is almost always verified during our estimation period[8]. Finally, as my sample of estimation includes top earners who are employees only, the bias coming from omitted changes in capital tax rates are expected to be limited, because individuals' main source of income is likely to be labour in this case.

2.5.2 Validity of Top Tax Rates Assignment

My mobility measure based on the EU-LFS allows to select the top 10% of the income distribution. One potential worry is that the selected top earners sample could be only partially treated by the top marginal tax rate. In that case, I would infer a treatment effect of top marginal tax rates changes to individuals who are not effectively treated by this change. Another issue with individuals being too low in the top tax bracket relates to the approximation of average tax rates by top marginal tax rates. The theoretical framework of top earners migration described in 2.1 shows that mobility decisions are determined by the effective tax rate, that corresponds to the overall amount of taxes paid by individuals. The majority of tax systems being non linear, the average tax rates faced by top

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

earners may be different from their marginal tax rates. As I do not observe exact level of earnings, it is not possible to compute the effective tax rate, and I use the top marginal earnings tax rate as a proxy of the average tax rates of top earners. The idea is that top marginal tax rate on income should be strongly correlated with the average tax rate, but is exogeneous to the level of earnings, unlike the average tax rate. If changes in average and marginal top tax rates are strongly and significantly correlated, my estimated elasticity can then be interpreted as a reduced form estimate of the migration elasticity with respect to the effective tax rate. If the assumption that changes in top marginal tax rates and in average tax rates are strongly correlated seems very realistic at the very top of the income of the distribution, as demonstrated by Akcigit et al. (2016) and Kleven et al. (2013), this correlation might be weaker at the bottom of the top income bracket. This is because individuals just above the top tax bracket threshold have a small part of their income effectively treated by the top marginal income tax rate, and because for these individuals, earnings might be no longer exogeneous to the top marginal tax rate, as we know from the literature that the decision of being in the top tax bracket can be manipulated through taxable income and labor supply decisions. I document these two potential threats of validity in two steps. First I use a second European-level dataset to (i) document the propensity to be treated by top tax rates in the top decile across member states and (ii) select top earners higher in the top tax bracket. Second, I provide additional evidence on propensity to be treated by top marginal tax rates in the top decile using French administrative data with register-based information on income. The European Survey on Income and Living Conditions (EU-SILC) is a detailed annual European survey that gives precise information on various sources of income, such as monthly labor earnings, gross household income, capital income and wealth taxes, for the period 2005-2015. It therefore allows to select the top of the income distribution in each European country, with information on exact level of income. The main advantage of the EU-SILC dataset is that it shares a large set of common variables with the EU-LFS, such as individuals' gender, age, country of residence, marital status, ISCED education level, number of hours worked by week, size of the firm of work, country of birth, type of work contract etc. Covariates are coded and defined in the exact same way in the two surveys, which allows to identify similar individuals among the two datasets. To improve the EU-LFS selection of top earners using the EU-SILC, I proceed in two steps. First, I use the EU-SILC to evaluate the propensity of top earners' defined in the EU-LFS to be treated by the top marginal tax

rate. This exercise allows to get a sense of how wrong we could be assessing that the individuals in the top ten percent of the earnings distribution that we select for the estimation are treated by the top marginal tax rate. The EU-LFS computes decile of income according to information on individuals' monthly earnings, which is also collected by the EU-SILC, the difference being that the exact level of monthly earnings is not made available in the EU-LFS, but is available in the EU-SILC. I use this special feature to select in the EU-SILC the top ten percent in each national earnings distribution, plot the income distribution of the selected decile and use national top income tax brackets thresholds to evaluate the probability of treatment of the top decile by the top marginal tax rate. Figure 8 shows the distribution of monthly wage earnings and gross household income in the top decile together with national top tax bracket thresholds for the two cases of Belgium and Luxembourg. This exercise emphasizes that depending on the member state considered, the EU-LFS based top ten percent measure of top earners can either be very accurate (Belgium case) or partially include individuals not treated by the top marginal tax rate (Luxembourg post 2013 reform). Note that this is also a drawback of studying a large set of heterogeneous countries, as European countries are characterized by large differences in the progressivity of their tax systems. Some countries will only see the top five percent being treated by the top tax bracket, such as France, while in other countries, individuals may be treated by the top earnings tax rates while being located much lower in the income distribution.[9] To take into account these differences in treatment threshold across countries, my identification strategy will make use of propensity to be treated by top tax rates, rather than pure treatment or control criteria.

I finally use the EU-SILC to build an imputed measure of income within the top ten percent bracket, in order to select individuals higher in the top tax bracket. I exploit the common set of individuals' covariates to implement an exact statistical matching on characteristics between the two European surveys. This matching procedure enables me to impute earnings for the top earners selected in the EU-LFS. I rank the individuals in the original top ten percent sample by level of imputed income, and select the top five percent of the imputed income distribution in order to conduct additional tests on top earners more deeply treated by top marginal tax rates changes.

Because the EU-SILC is a survey, we may still be worried that declared income does not allow

[9]The extreme example in that case are flat income tax rates, that apply to all individuals, regardless of their income levels.

to properly evaluate top decile propensity to be treated. I thus exploit French administrative data to investigate top marginal tax rate treatment in the top ten percent of the income distribution in France. I use the EU-LFS-based income measure to rank individuals within the ERFS. I plot the distribution of administrative and survey income of the selected top ten percent of earnings distribution in Figure 7. Average reported earnings of selected top earners sample in France is around 170,000 euros, and roughly 30% of the selected top ten percent have an annual individual[10] wage below 70,000 euros, which is the top tax threshold between 2009 and 2012, and 50% have a wage below 150,000 euros which is the top tax threshold after 2012, leading roughly the top five percent to be effectively treated by top marginal tax rates in France.

2.5.3 Endogeneity of Top Marginal Tax Rates

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

[10]Note that the French tax system is not an individual-based system, and couples can choose to pay taxes on their joint household income.

simultaneous changes in top earners' migration to and from this member state.

To adress 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. I start by using the differential effect of country-by-year variations in top MITR on individuals of different earnings levels. Formally, I allow the effect of top marginal tax rates on mobility to vary conditional on the individual's earnings level. The underlying idea is that both top earners and lower earnings level are affected by country-year level changes in policies or economic conditions, but only top earners should be effectively treated by top marginal income tax rate changes. As this estimation strategy includes a country-specific year trend, it only partially controls for unobserved country-specific shocks, and exploits a part of country-by-year variations in top MITR. Without the inclusion of country-year fixed effects, the coefficients of top earnings tax rate on location choices of control groups load general equilibrium and spillover effects of top earnings tax rates changes on lower income mobility. For instance, changes in top marginal tax rates could be correlated with changes in housing prices through top earners' mobility response, that could also affect low earners migration choices. Therefore, the effects of top marginal tax rates on lower earnings level individuals mobility decisions will be informative on labor market structure, and broader effects of top income taxation. I discuss these points more in details in 4. I then turn to a more restrictive specification, that focus exclusively on *within-country* variations of top marginal income tax rates, replacing country-year trend by country-year fixed effects in the estimation. This allows to completely filter-out simultaneous changes that were previously loaded in control group mobility responses to taxation, and to directly exploit the treatment intensity in different income groups.

For both specifications, I use the placebo estimates of top earnings tax rates on the control group location choices to retrieve the true effect of top marginal tax rate on treated individuals. Differences in propensity to be treated by top marginal tax rates come from differences in earnings levels, and thus in tax brackets. This approach is conceptually close to a differences-in-differences strategy where I compare treated individuals in the top tax bracket to individuals who do not face the top marginal tax rate, but are comparable. Its accuracy thus depends on how close the pseudo-control group (lower earnings level) is to the treatment group (top tax bracket). The main identifying assumption if that shocks correlated with changes in top marginal tax rates changes cannot affect top earners' and lower earnings levels in a different way. Importantly, in the first

specification, the control group estimates load the effects of unobserved time-varying factors and spillovers in addition to partial treatment, while in the second specification the placebo coefficients can only load the intensity of treatment by top MITR changes.

A last potential confounder is the existence, as discussed in the introduction, of specific tax schemes targeted of foreigners. As the eligibility rules for this type of preferential tax schemes are very specific and depend on variables such as previous residence for a long period of time (up to ten yers), wages or occupation, it is not possible to infer from the available data the eligibility to such tax breaks. Fortunately, no tax schemes targeted on foreigners have been implemented during the estimation period with the exception for Italy, limiting the risk of country-year level shock correlated with top marginal tax rates and top earners' migration patterns. I gather in Table **??** some descriptive statistics for the existing tax breaks in Europe during the estimation period and show that potentially eligible individuals to such schemes represent a very small fraction of the top ten percent population. Nevertheless, to take the existence of these policies into account, I present in 5 additional results that take into account preferential tax schemes for foreigners and that complement my baseline results.

3 Macro-Level Analysis of Migration and Taxation

The macro-level analysis of European migration patterns allows to establish simple country-level correlations and facts between top labor income taxes and top earners' mobility patterns. I proceed in three steps, succesively more detailed. I start by investigating cross-country correlations over time between top earners' mobility and income taxation. I then build bilateral migration flows to distinguish the effect of country of origin top tax rates on top earners' emigration choices. I finally use tax reforms to estimate the effect of tax changes on top earners' migration behaviour.

3.1 Overview on Top Tax Rates and Top Earners Migration

I start by presenting some basic stylized macroeconomic facts on the correlations between top marginal earnings tax rates and mobility at the country-year level. I exploit country-by-year variations in top marginal earnings tax rates and aggregated country-level mobility flows in Europe for top and bottom earners. Figure 9 shows cross-country correlations between tax rates and mobility

for various income levels in Europe for the period 2009-2015, where each observation represents a European member state in a given year. The outcome plotted is adjusted for each country's log of GDP per capita, country fixed effects and year fixed effects, in order to eliminate time invariant cross-country variation, with clustered standard errors at the country level. Results of the reduced-form estimation are summarized in Table B.I.

Results show that the share of immigrants in the national top ten and top five percent population is positively correlated with the top marginal retention rate.

I investigate the robustness of the correlations with respect to alternative specification, sample selection and causal inference. I introduce a linear time trend in addition to year fixed effects that allows to control for long-run trend in mobility. Estimated coefficients are stable to the inclusion of the year trend term. I also check whether the cross-country correlations are affected by the sample of countries included in the regression. I reproduce the analysis for the set of EU-15 countries only, and find similar estimates and standard errors. I finally turn to the causal inference discussion regarding the estimation of standard errors. The estimation considers outcomes (migration rates) and dependent variables (top retention rates) that are likely to be correlated across country-year observations. Hence, error terms might be correlated over time for a same country, but could also be correlated across countries and across periods. I address the first issue by clustering the standard errors at the country level, allowing correlation of residuals over time within each member state. Nevertheless, because of the time dimension of the data, one potential worry lies in cross-sectional dependence of residuals, and in particular of spatial autocorrelation of error terms. For instance, unobserved determinants of migration of two neighbouring countries are likely to be correlated. I therefore reproduce the estimates using the alternative estimator proposed by Driscoll and Kraay (1998) that allows cross-sectional correlation not only within the same time period but also across time periods up to an assumed maximum autocorrelation lag. Results using this alternative computation of standard errors are presented in column (3) of Table B.I.

An important take-away of this first macro analysis exercise is that cross-country correlations between taxation and migration are modest, and not always significant for the top ten percent, as showed by Table B.I. Mainly, as emphasized in Kleven et al. (2019), there exists very strong country-level specificities and trends in terms of taxation and mobility, especially within the heterogeneous set of European countries, where low tax rate countries have fewer top earners stocks

and flows compared to more developped member states with higher taxation rates. Furthermore, the variations in top marginal tax rates over the period are rather limited. Therefore, the simplest version of the cross-country analysis does not provide compelling evidence on top marginal tax rates and mobility of top earners. I therefore complement the macro analysis with additional tests at the aggregate level.

3.2 Aggregate Location Choice Model

I now turn to the cross-country analysis of migration and taxation, going back to the migration condition described in Equation (8). I follow Moretti and Wilson (2017) and base the macro-level empirical analysis on location choice model at the aggregate level. The utility of a top earner in a given state depends on the after-tax earnings in that state, cost of living, amenities, and individuals' idiosyncratic preferences for this state. Mobility may be costly, and for each country of past residence (o) and of destination (o), the utility of an individual k who to country d at time t and was living in country o in previous year is:

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

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

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

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

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

Where P_{odt}/P_{oot} is the top earners share that moves from one state to another relative to the population share that does not move. This strategy differs conceptually from the standard random utility one, where individuals decide at period t where to locate, irrespective or their origin location.[11] The estimated parameter β will estimate the effects of top marginal tax rates on top earners migration flows, and will therefore gives an estimate of the elasticity of migration with respect to taxation in terms of *flows*. I estimate Equation (4) (1) controlling for all origin-level and destination level time-invarying characteristics through origin-country fixed effects and destination-country fixed effects, (2) filtering all time-varying factors through year fixed effects, (3) partially controlling for country time-varying variables (GDP per capita and overall population) and (4) controlling for migration costs at the origin-destination level through a dummy for contiguity and commong language, that is further replaced by origin-destination fixed effects in an alternative specification. I follow Moretti and Wilson (2017) by clustering the standard errors at the origin-country $\times$ year level.

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

In Figure 10, I plot the results of the estimation of Equation (5). The plot shows that higher destination-origin net-of-tax rate differentials are associated with higher origin-to-destination migration, consistently with the prediction of the theoretical model. The estimated parameter is rather large and significant, and translate to a migration elasticity of top earners migration flows of 1.5 (0.5).

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

3.3 Tax Reforms

The cross-country and bilateral flows analysis show correlations between top marginal tax rates and top earners flows, both at the origin and destination country level. However, these correlations stay limited in magnitude and significance, and are likely to be counfounded by many simultaneous trends and characteristics. To introduce more variations in the macro analysis, I finally turn to the exploitation of quasi-natural changes in top marginal tax rates on income. I first implement an event study, focusing on large tax changes implemented in the EU over the period of estimation. I then specifically investigate the effect of a country-level reform in top marginal tax rates on top earners' migration flows, to exemplify the differences-in-differences strategy that I will use in the individual-level analysis to macro data on migration flows.

Event Study I start by the analysis of important tax changes that have occured during the estimation strategy in the entire set of European countries. I also investigate potential long-run effects of tax changes on within-EU migration patterns. Because migration costs are different from zero, mobility decisions may not follow immediately a tax change. Individuals may also anticipate a tax change event, and leave their country of current residence before the actual implementation of the tax change. In Figure A.VII, I use the origin-destination specification to present evidence that tax changes have dynamic effects on migration flows over time. I use a simple event study approach that exploits changes in origin-destination differentials in top taxation rates. I consider both negative and positive changes in tax differentials within EU for the period 2009-2015, making the assumption that the mobility response to a tax differential increase is the same, but of opposite sign, that the mobility response to a tax decrease. To avoid to carry too much noise in the estimation, I focus for each origin-destination country-pair on the highest absolute change in top marginal tax rates differential between destination and origin state. I estimate the effect of the tax change on the outmigration log odds-relation around the tax change (before and after), relative to its value in the year prior to the tax tax change. I denote as year 0 the year just before the change in differentials, and the window of observation is therefore [-6;7]. Formally, I estimate the following equation, where t denotes the calendar year of the observation, 0 is the index for outcomes observed at the tax year of the change, and J_{odt} is the time in years relative to the tax change event:

$$log(P_{odt}/P_{oot}) - log(P^0_{od}/P^0_{oo}) = \alpha_{od} + \sum_{j=-6}^{7} \beta_j 1D^0_{od}[J_{odt} = j] + year + u_{odt}D_{od} \quad (6)$$

D^0_{od} takes the value 1 if the destination-origin log retention rate increases at the tax change, -1 if it decreases, and 0 if it does not change. I cluster the standard errors at the year $\times$ country of origin $\times$ country of destination level. The coefficient is set to 0 at the time of the tax change event by construction. The estimated coefficients from Equation (6) measure how emigration from origin to destination increases where the tax differentials changes relative to state pairs where it does not change. It is thus close to a difference in difference specification. Three main results emerge from the estimation of Equation 6, showed in FigureA.VII. First, the figure doesn't show any pre-trend in outmigration patterns before the tax change. It doesn't look like tax changes are implemented as a response to clear mobility trends. Second, emigration increases in the years after the tax change, indicating that top earners are more likely to move from one country to another when the top marginal tax rate in the destination country decreases compared to the rate in the origin country. This effect is consistent with the positive elasticity of foreigners we find in the simple cross-country analysis, and to the prediction of the theoretical framework described in Section 2. Third, the effects of the tax change on outmigration do not arise immediately after the tax change, but tend to grow over time. These results are similar in spirit to the one outlined by Moretti and Wilson (2017) who conduct a similar analysis for within-US inventors migration. The dashed horizontal line shows the average estimated coefficient in the pre-treatment period, which is negative. Computing the difference between the estimated coefficients after the tax change and the pre-treatment effect would in fact give an higher average effect of the tax change on mobility. However, clear long-term effects of tax changes on migration flows are difficult to capture because of the limited time span of the data. Note that as the estimations solely exploits the realisation of the tax change as the event, the information on the size of the change in tax differentials is not loaded in this nonparametric analysis.

Country-Case Tax Reforms The study of country-level tax reforms allows to isolate the causal effect of taxation on migration, relying on the quasi-exogeneous change in the level of top taxation.

Using a differences-in-differences approach, it allows to visually check the effect of a change in the top marginal tax rates on mobility flows of individuals affected or not by the reform. Mainly, such country-level analysis exemplifies the type of variations that are used in a more systematic way in the micro-level analysis that exploits differences in propensity to be treated by top tax changes across individuals. It will provide evidence that the EU-LFS measure of mobility is able to capture the effects of large top MITR variations on aggregated flows of top earners, compared to lower earners that have not been treated by these reforms.

The reform consists in an increase of 5 percentage point in the French top MITR through the creation of a new top tax bracket in 2013 on income earned in 2012.[12] I show in the Panel A of Figure 11 the immigration flows for top earners that have been affected by the reform against the flows of bottom earners that were not affected by the increase in the top marginal tax rate on income. The Figure shows a decrease in top earners' inflows after the implementation of the reform compared to the flows of bottom earners who were not affected by the reform. While the migration flows were roughly following parallel trends before the change was implemented, they started to diverge in 2012. I complete the picture by showing in Panel B the same Figure with an alternative control group following the synthetic control method described in Abadie et al. (2010). The trends of the two series are parallel before the reform by construction. This approach has the advantage to use a similar population, that is to say top ten percent individuals in neighbouring European countries who were not affected by a change in the top marginal tax rate in 2012.

4 Individual-Level Model of Mobility

The macro-level analysis is insightful as it allows to emphasize simple correlations between top marginal tax rates and top earners' mobility within Europe. However, as outlined by the basic mobility model, a large part of mobility may be explained by idyosyncratic tastes, and by

[12] As the French tax system is not a pay-as-you go system, there is sometimes a lag between the year where the reform is announced and implemented. In that case, the creation of the new tax bracket at a marginal tax rate of 45% has been anounced by the newly elected government Hollande in September 2012, and implemented in 2013 on income earned in 2012. It is important to precise that at the end of December 2011, an exceptional surtax of 4% on both capital and labour income for individuals with more than 250,000 euros has been voted. This reform that applied to earnings of 2011 declared in 2012, may have affected top earners' arrivals in 2012. Therefore, the response of top earners' flows observed in 2012 may be a combination of the new bracket implementation and the announcement of the top earners' surtax.

individual-level characteristics. As a significant part of the location choices are likely to be driven by unobserved heterogeneities across individuals, I turn to the estimation of an individual-level location choice model, that builds on the theoretical model described in section 2.1. This micro-level analysis presents many advantages compared to the macro-level analysis: it allows to control for individual-level determinants of migration and to exploit differences in propensity to be treated by top income taxes across individuals in a systematic way.

4.1 Estimation

My estimation is based on the assumption that the individual has an additive random-utility, which is increasing, concave, and additively separable in wage and taxes, such as an individual k coming from country m and living in country n at time t has the utility:

$$\begin{aligned} U_{nt}^{k} &= u((1-\tau_{n,t}^{k})w_{nt}^{k}) + \theta_{n,t}^{k} \\ &= \alpha_k log(1-\tau_{n,t}) + \beta_n x_t^k + \eta_n + \gamma_t + home_{n,m,t}^{k} + \phi x_{n,t} + v_{n,t}^{k} \end{aligned} \tag{7}$$

The utility derived by individual k from living in country n at time t depends on the net-of-tax wage he receives and country-specific and year-specific characteristics. With the error term being error I extreme value distributed, the multinomial logit model can be estimated with a maximum likelihood. Equation 7 captures the idiosyncratic preference for home through a dummy equal to one if the individual was a resident of country n in $t-1$, and allows to filter out the home bias in location choices. The specification allows the effects of individual characteristics x_t^k to vary by member states through country-specific coefficients β_n. This captures differences in relative prices of skills and ability across member states and therefore proxy for counterfactual wage earnings. α_k captures the effect of top marginal taxes on individual's k location choice, and this effect varies with individual level of earnings. Unobserved characteristics of locations μ_n and time specific factors γ_t are controlled for using varying fixed effects and trends. The maximum likelihood estimation allows to predict $P_{n,t}^k$ the probability that individual k locates in country n at time t, and this for all the countries $n \in N$ available in individuals' choice set.[13]

[13] More precisely, for each individual k located in a given country in N, the multinomial model allows to compute the set of $P_{n,t}^k$ for all the countries included in N.

I use the estimates of $\alpha_{C_{kt}}$ and the individual level predicted probabilities $P^k_{n,t}$ to compute individual-level elasticities sch that:[14]:

$$\varepsilon^k_{n,t} = \frac{dlogP^k_{n,t}}{dlog(1-\tau_{n,t})} = \alpha_k(1-P^k_{n,t}) \tag{8}$$

Equation (8) is central, as it allows to link the structural model based on the random utility assumption to the individual-level sufficient statistic $\varepsilon^k_{n,t}$. The individual-level parameter captures how the probability that any individual k included in the sample of estimation locates in any country n changes when the net-of-tax rate in this country is changed. The individual elasticity is a function of the estimated mobility-parameter α that is allowed to vary with individual's income decile, and of the predicted probability that the individual locate in country n $P^k_{n,t}$. Following Kleven et al. (2013), it is possible to aggregate individual-level elasticity at the country level such that:

$$\varepsilon_n = \frac{\alpha_k \sum_k P^k_{n,t}(1-P^k_{n,t})}{\sum_k P^k_{n,t}} \tag{9}$$

Where Equation (9) captures the uniform elasticity in a flexible demand model for country n as $\varepsilon_n = dlogP_n/dlog(1-\tau_n)$. This is equivalent to compute $\alpha_k(1-\bar{P_n})$ where $\bar{P_n}$ is the average probability weighted by $P^k_{n,t}$ to locate in country n.[15]

It would be possible to follow Kleven et al. (2013) and Akcigit et al. (2016) and distinguish the elasticity of foreigners ε^f_n from the elasticity of domestics ε^d_n in country n. Denoting I^d_n the set of domestic top earners in country n and I^f_n the set of non-domestics of country n:

$$\begin{cases} \varepsilon^d_n = \dfrac{dlog(\sum_{k\in I^d_n} P^k_{n,t})}{dlog(1-\tau_{n,t})} = \dfrac{\alpha_{C_{kt}} \sum_{k\in I^d_n} P^k_{n,t}(1-P^k_{n,t})}{\sum_{k\in I^d_n} P^k_{n,t}} \\ \varepsilon^f_n = \dfrac{dlog(\sum_{k\in I^f_n} P^k_{n,t})}{dlog(1-\tau_{n,t})} = \dfrac{\alpha_{C_{kt}} \sum_{k\in I^f_n} P^k_{n,t}(1-P^k_{n,t})}{\sum_{k\in I^f_n} P^k_{n,t}} \end{cases} \tag{10}$$

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

[14] Formally, $P^k_{n,t} = exp^{\alpha_{C_{kt}} log(1-\tau_{n,t}) + \beta_n x^k_t + \eta_n + \gamma_t + home^k_{n,t} + \phi x_{n,t}} / \sum_{n' \neq n} exp^{\alpha_{C_{kt}} log(1-\tau_{n',t}) + \beta'_n x^k_t + \eta'_n + \gamma_t + home^k_{n',t} + \phi x_{n',t}}$.

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

respect to taxation in terms of foreigners and domestics groups has been explained by the fact that governments can discriminate between these two categories using different taxation rates on these two subgroups of top earners. However, as I consider a broad definition of top earners, that is usually not concerned by foreigners' tax schemes that are usually focus on specific occupations or very high income earners, distinguishing these two parameters is not relevant in my case. In addition, the best definition of foreigners available in the data relates to past-residence, and the foreign elasticity would therefore be closer to the flow elasticity, rather than the stock elasticity wich is the relevant policy parameter, as emphasized by Agrawal and Foremny (2018). This is because the EU-LFS only allows to observe if individuals are nationals or not of the country where they are resident, without providing the exact nationality of individuals who are not nationals in their residence country. To be clearer, the data allows to know if a French resident is a foreigner, but does not allow to know what is the exact nationality of this foreigner, and therefore prevent us to control for its home country in the location choice model. Say that this individual is German, I could control for the fact that he is a foreigner when studying his location choice to France, but coud not control for the fact that he is German when looking at the alternative location choice of Germany. Because of this data limitation, the national-based definition of home cannot be used in the location choice model. I use a much more restrictive approach and control for home bias by controlling for the country where the individual was previously resident. This approach can however be viewed as conservative, as it controls for the highest degree of migration cost. Therefore, in my paper, foreigners are defined as movers, rather than foreigners living abroad. It follows that the elasticity of foreigners relates to the elasticity of movers, and thus to the flows elasticity, rather than the stock elasticity. It would however be possible to estimate the elasticity of foreigners using the nationality-based definition of foreigners for the aggregation presented in Equation (10).[16] I present these alternative results in the Appendix.

My preferred reported parameter is therefore the *uniform* migration elasticity. I will also report the foreigners elasticity for comparability purposes with previous studies, but this parameter will structurally be high, as it relates to a smaller tax base and to individuals who are by definition more mobile.[17]

[16]The data limitation regarding nationality prevent the identification of domestics living abroad for the elasticity aggregation, but allows to observe all foreigners (those living at home and abroad).

[17]In my data, individuals with a foreign nationality represent on average 8% of the population, which is comparable

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

My first identification strategy exploits country-by-year variations in top marginal tax rates on individuals with different propensity to be treated by top tax rates. Differences in propensity to be treated come from differences in individuals' labor income levels, that is to say in tax brackets. Naturally, we expect the propensity to be affected by top marginal tax rates to increase with the level of income, being maximal at the top of the income distribution, and minimal at the bottom. To allow for heterogenous effects of the top marginal tax rates on individuals with different earnings levels, I interact the log of the top retention rate with a dummy for being in each decile of the income distribution. Location choices of individuals' with different earnings levels are thus allowed to be affected differently by the top log retention rate, and these effects are capured by decile-specific coefficients α_k. As the first step of the estimation does not include country $\times$ year fixed effects, α_k loads general equilibrium and spillover effects of top income tax rates on location choices. In the absence of country-year fixed effects, the coefficients on log retention rates captures the differential effect of the top MITR on individuals of different income level, rather than pure treatment effect of top tax rates. Importantly, without country-year dummies, the effects of simultaneous changes correlated with top MITR and location choices may be loaded in the estimates. The decile-specific coefficients therefore capture a mix of partial treatment, spillovers and the effects of time-varying factors correlated with changes in top taxes.

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

to the numbers for football players or inventors. New residents represent on average 0.3% of the population.

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

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

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

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

Table 4 shows estimation of upper bounds elasticities using the median decile as the control group, and lower bounds using the 8th decile as the control group.[18] The estimated utility coefficient on the top retention rate is large and significant for top ten percent individuals, for all

[18]Because of computational issues, it is not possible to include the full sample of individuals surveyed to obtain decile-specific $\alpha_{C_{kt}}$ with the full range of income decile in the sample. However, I present the results of the estimation for the full range of deciles on a randomly selected subsample in Table 5.

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

Regarding lower bounds estimates presented in column (1)-(4), the coefficient of the log retention rate on the 8th decile as the control group location choices is significant at the five percent level, suggesting a mix of spillover and partial treatment effects loaded in α, due to lower distance between the treatment and the control group. As outlined in section 2.5.2, in a significant number of European countries included in the estimation set, the 8th decile is treated by the top marginal tax rate on earnings, explaining the significant coefficient, but lower as individuals in the 8th decile are treated with less intensity than individuals in the top decile.

In the most detailed specification, uniform elasticity ranges from 0.1 to 0.3, and are significant at the one percent level. The magnitude of the elasticities are rather small, and in line with the literature, while lower than the stock elasticities that have been estimated for within-country mobility.

By contrast, the mobility elasticity of foreigners is rather large, and lies between 0.7 and 1.6. The elasticity of the number of foreigners with respect to the net-of-tax rate is structurally higher as it relates to mt much smaller base of movers. The magnitude of the micro estimate for the foreigners elasticity is reinsuringly very close to its macro counterpart that relates to the elasticity of top earners migration *flows*.

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

4.3 Exploiting Within-Country Variations in Top Income Tax Rates

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

In this identification, the estimated values of the utility parameters α_k directly capture the differential impacts of top marginal tax rates on individuals with different propensity to be treated, ruling out correlated factors that were potentially previously loaded in the same coefficients. In this case, interacting the effect of top marginal tax rates with earnings level not only allow to exploit

pure differences in treatment, but also the intensity of this treatment along earnings distribution. Compared to the previous estimation, the estimated coefficient allow to directly get a sense of the treatment intensity in each income bracket.

The only potential confounder left with this identification strategy is the case where top earners and lower earnings level are affected differentially by contemporaneous country-specific and top marginal tax rates variations. For instance, if a country-year level policy has very different implications for the top ten percent and the control group, $\alpha_{true} = \alpha_{treated} - \alpha_{control}$ may not allow to fully filter-out the effect of this unobserved shock. Going back again to the case of the country-specific recessionary shock, this would be the case if the national recession is correlated with changes in top marginal tax rates and, or even cause, a change in top earners income shares that could affect top earners and lower deciles migration differentially.

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

The second challenge relates to the nature of the data, and the population studied. Because the analysis is based on yearly migration flows, rather than national stocks, and a much broader definition of top earners, the data is by nature highly non-linear, with sometimes few observations by cell considered (for instance at the foreigner $\times$ year $\times$ country $\times$ income decile level). The introduction of country-by-year fixed effects requires enough within-country variation in location choices of individuals of different earnings levels and different migration status to estimate the mobility parameter α at each earnings level. Of particular sensitivity is the convergence of the likelihood function, that needs to be acchieved to present consistent and reliable estimates of the utility mobility parameter.

To get around the issues related to the computational burden and the convergence of the estimator, I first limit the number of alternative countries considered in the estimation. To ease the convergence and the estimation of the model, I further normalize the effect of the log retention rate on location choices of individuals in the first earnings decile to zero. As the first estimation

exploiting country-by-year variations systematically and consistently indicated a weak and non-significant coefficient on log retention rate for individuals in the bottom decile, this normalization is not restrictive. Conceptually, the estimation strategy is now close to a double differences-in-differences approach, where the treatment effect of top tax rates on the top and lower deciles used as a control group are estimated relative to a pure control group, for which the treatment effect is assumed to be zero by construction.

The first column of Table 7 repeats the preferred specification of Table 4 using the restricted sample of estimation and the double differences-in-differences approach. Column (2) replaces the interaction of country fixed effect and year trend with a country-year fixed effect, therefore filtering-out simultaneous country-year level variations. The estimated value of the mobility parameter is stable, and very close to the estimates relying on country-by-year variations identification presented in Table 4. The similarity of the estimates presented in column (1)-(2) suggests that the specification controlling for country $\times$year linear trend already significantly filtered-out time-varying factors, and that the addition of country-year fixed effects does not significantly modify the results compared to the country-by-year specification. Similarly than before, but perhaps more directly as the coefficient now load treatment intensities, the estimated coefficient indicates that individuals in the 8th decile are partially treated by top tax rates, while individuals in the median decile are not. As a result, using the 8th decile as a control group is not entirely satisfying since the placebo coefficient will embed the effect of top marginal tax rates changes caused by partial treatment. The estimated elasticities for foreigners range from 0.7 to 2.0 in the preferred specification, and are fairly similar to the estimated elasticies relying on the entire set of countries estimated before and showed in Table 4. As the within-country specification shows stable estimates compared to the preferred specification showed in column (3) and (7) of Table 4, I will use these results as my baseline estimates for the rest of the paper. This is in order to keep the feature of a large set of alternative countries in the location set allowed by my mobility dataset in the tax policy discussion conducted in the next section.

4.4 Tax Revenue Effects of Tax Reform

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

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

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

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

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

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

$$\tau_J^{f*} = \frac{1}{1+e+\varepsilon^f} \tag{12}$$

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

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

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

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

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

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

$$\Phi^f = \frac{\tau_J^f}{1-\tau_J^f}(e+\varepsilon^f) \tag{14}$$

From the government's revenue maximization problem described in detail in Appendix B, denoting dM the mechanical change in tax revenue raised on top earners after the reform, dB1 the intensive behavioural effect and dB2 the extensive migration effect, it is possible to rewrite $dR/dy = dM \times (1 - dB1 - dB2)$. Hence, a fraction of the mechanical change in tax revenue is lost due to behavioural responses to taxation coming from labor supply responses to the reform, but also to migration reactions to taxation. This fraction is an increasing function of the elasticities of labor supply and migration with respect to taxation, as emphasized by Proposition 2. If top tax payers do not react to taxation through mobility or labor supply choices, the behavioural loss is exactly equal to zero. In the case where the tax system is non-distortionary with a zero marginal tax rate, the behavioural loss is also zero. The effects of the behavioral responses to taxation are weighted by the tax wedge at the top of the current tax system, $\tau/(1-\tau)$, that captures the size of the tax wedge from labor income taxation at home on top earners. This unique behavioural weight comes from the assumption on piece-wise linearity.[19] I report as an efficiency measure the fraction of the mechanical change in tax revenue in the top tax bracket that is lost because of behavioural effects of the reform $\Phi = |dB1 + dB2|/dM$. Note that $dM = dB1 + dB2$ would imply maximisation of the government tax revenue. More generally, Φ proxies the side of the Laffer peak in the top tax bracket. As soon as the behavioural deadweight burden does not perfectly cancel out mechanical effects, the tax reform has a positive effect on overall tax revenue raised in the top tax bracket.

I turn to the calibrations of the efficiency formulas to compute efficiency costs of tax reforms in a free movement area. I take a standard estimate of labor supply elasticity of 0.1 following the literature, combined with the migration elasticities estimated in the previous section. I show in Table 8 the optimal Laffer rates computed from Proposition 1. Calibrated revenue-maximizing uniform

[19] In a standard Mirrleesian non-linear tax system, the migration term would be weighted by the overall tax liability, because top earners' migration depends on the overall amount of taxes paid in country n. See Appendix B for more details.

tax rates lie between 50-80 percent, and are on average higher than the current top marginal tax rates. By contrast, calibrated top marginal tax rates targeted on top earners' who where previously located abroad are much lower than the level of current top marginal tax rates in Europe. [20]. When the government is able to perfectly discriminate top earners with respect to their previous residence status, it therefore has incentives to implement large tax cuts on foreigners. These results therefore give a rationale for the observed state of tax competition in Europe, and the implementation of specific tax breaks for foreigners implemented in some member states. Note that optimally, individual-level migration elasticities should be weighted by individuals' respective wages. As the dataset does not provide information on top earners' wages level, my calibration does not take into account each taxpayers' weight in the actual tax revenue. In the case where the distribution of wages is strongly skewed towards the top among foreigners, the revenue-maximizing uniform tax rate on both domestics and foreigners could be lower than the one given by the current calibrations, and could be much more heterogeneous across countries.

I finally report the efficiency cost of tax reforms that is directly related to the calibrated optimal tax rates, following expressions derived in Proposition 2. The behavioural burden is a function of the current top marginal rate, labor supply and migration elasticities. The main goal of the efficiency cost calibration exercise is to relate the potential economic gains, or losses, coming from top earners' behavioural responses, to the overall effects of reforms in terms of tax revenue. When the government uses an uniform top marginal tax rate, the mechanical change in tax revenue of a small tax reform is not cancelled out by behavioural responses to taxation, because the uniform migration elasticity is lower than unity. When the government seeks to evaluate the effect of the tax reform on individuals coming from abroad, the expected behavioural burden very high.[21] Cal-

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

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

ibrated efficiency costs using the upper bounds shows that the behavioural burden coming from foreigners almost always cancels out the mechanical effect of the reform. Therefore, any tax cut targeted on foreigners will largely compensate the tax revenue loss on the foreign tax base through additional mobility flows. Again, there are large heterogeneities in efficiency costs of the reform targeted on foreigners across countries, reflecting well the differences in incentives to engage in tax competition to attract top earners located abroad. If unilaterally profitable, these types of preferential tax schemes are likely to be costly at the aggregated level. I gather in Table B.IIIdescriptive statistics on the number of top earners benefiting of such tax schemes within Europe, that amounts to roughly 40,000 individuals per year.[22] On average, the tax exemptions lead eligible foreigners to face top marginal tax rates that are approximately 30 percentage points lower than the regular top marginal tax rate applied to top earners. Therefore, at the aggregated level, the loss in European tax revenue caused by these tax schemes reaches around 1,200 millions of euros, ignoring labor supply effects.[23]

4.5 Drivers

Beside estimating top earners' migration response to taxation, we are also interested by the mechanisms that affect top earners tax-driven migration within the EU. A first logical question is to ask what is the role played by employers on top earners' reaction to taxation differentials through mobility. Because the estimation sample includes only employees, employers could contribute, or even initiate, the migration decision. For each implicit employee-employer match observed in my data, firms could internalize a part of the income tax burden faced by employees. As a result, the estimates of α_k may load a part of firm-side responses to income tax rates differentials in Europe.

The extent to which top earners' response to taxation is driven by employers' behaviour is a function of companies' bargaining power and wage setting process, and could therefore be more salient in some member states. In this section, I investigate two plausible channels through which employers could affect top earners' residence location response to taxation, which are size of the

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

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

firm of work and the transition between jobs in the labor market. I then turn to the analysis of labor mobility choices, investigating the effects of taxation rate in the choice of the country of work.

It is likely that the type of companies for which individuals are working, in terms of size, activity abroad or industry, affect the way their employees may be able to react to taxation through mobility. In theory, individuals working in bigger firms could benefit from more opportunities to work abroad. I use the information on the size of the firm where the individual works and report in column (1)-(2) of Table 10 my benchmark specification adding an interaction term between the decile of income, the log retention rate, and a dummy equal to one if the employees works for a firm with more than 50 employees. Because of computational issues, I conduct the estimation on a randomly selected subsample of the full estimation sample used in the baseline results of the estimation. Results indicate that there is no significant effect of working in a firm of bigger size on top earners' migration sensitivity to income tax differentials.

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

5 Robustness Checks

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

5.1 Changes in Occupation

Another potential channel that could affect top earners' location decisions are occupation transitions. Changes in occupations are likely to change the way individuals are treated by changes in top marginal tax rates when the change occurs between self-employment and employment. Top earners may want react to taxation changes by switching their occupation from employee to self-employed, or from self-employed to employee, at the time of their migration. Therefore, occupation transitions could be significantly correlated with top earners' location choices and changes in top marginal tax rates, and could therefore affect top earners' tax sensitivity in location decisions. To take a simple example, a top earner who is an employee of his own company in France may switch his status from employee to self-employed if he moves to Belgium (where capital income rates are very low) after a large increase in income taxation in France. I use information on current and previous occupation status to build an indicator equals to one if the individual had a different occupation in year $t-1$, focusing on occupation changes within employee and self-employed categories.[24] I reproduce the benchmark specification adding an interaction term between top net-of-tax rate, the income decile of the individual and a dummy equal to one if the individual changed his occupation. Note that if the interaction term between occupation transition and log retention rate turns out to be significant, it would raise concerns about omitted determinants of migration in the estimation through non inclusion of capital income taxes. Results in A.I indicate no evidence that individuals who change of occupation status are more or less likely to significantly react to income taxation through migration.

5.2 Tax Schemes for Foreigners

I investigate whether the non-imputation of tax breaks for foreigners may bias migration elasticities estimates. For countries where preferential tax schemes for foreigners are in place during the estimation period, I attribute the preferential tax rate τ_n^f to all foreigners in the estimation.[25] I

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

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

present the results in B.II. Results are fairly stable to the imputation of foreigners' tax schemes. Interestingly, the imputation of such schemes indicate some treatment on lower income groups, that seem to be negatively affected by the variation in top MITR. This could be explained by the fact that by contrast to more regular reforms in top tax rates, the implementation of foreigners tax schemes is sometimes directly related to migration patterns, or economic shocks that may affect the treated and control group differently. For instance, the implementation in Italy of the inbound scheme in 2010 aimed to target top skilled immigration flows after that the recession led top skilled Italians to leave the country. The case where such recession is correlated with the implementation of the scheme, and bottom earners migration patterns would lead to some bias in the estimation of the control group coefficient. Importantly, the foreigners' tax schemes are targeted to very specific populations, that represent a small portion of the top ten percent studied in this paper. As the characteristics that determine the eligiblity to such foreigners' tax breaks are not observable in our data, imputing that the entire set of foreigners are eligible to such tax exemptions does not seem plausible.

6 Conclusion

In this paper, I study the effects of top income taxation differentials on top earners' mobility in Europe, a topic of central importance in 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 European top marginal tax rates to track top earners mobility flows within the European Union. This dataset is representative of the entire population of top ten percent employees in Europe. I exploit country-by-year variations in top tax rates and the differential effects of taxation differentials on individuals of different earnings level to identify the impacts of top income taxation on top earners' location choices. I first document stylized facts on European mobility and emphazise macro-level evidence on top earners' mobility and top income taxation. I then turn to a more structural approach and exploit the individual dimension of the data to capture the importance of unobserved heterogeneities in migration decisions. I estimate a multinomial model of location choices, using differences in propensity to be treated by top marginal tax rates across earnings level. My identification exploits the differential effects of country-by-year variations in

top marginal tax rates on individuals of different earnings deciles. I recover the true effect of top marginal tax rates on the treated top tax bracket using the control group coefficient on top retention rate. As there exists a trade-off between comparability and propensity to be affected by top marginal tax changes in the choice of the control group, I report elasticities intervals, rather than points estimates. I compute upper bounds using control groups with lower earnings levels, and lower bounds using comparable control groups with non-zero treatment probability. I estimate that the elasticity of the number of top earners with respect to top income taxation that is between 0.1 and 0.3. The elasticity of foreigners -defined as movers- is especially high, lying between 0.7 and 1.7, consistently with what has been found by the literature for superstars.

Turning to underlying determinants of top earners' mobility, I find that top earners' tax driven location choices are non affected by employers' channels, such as the size of their firm or labor market transitions, suggesting that tax avoidance through mobility is mainly determined at the individual level. I then perform robustness checks on alternative sample selection, tax measures, impatriates tax scheme eligibility and plausible occupation manipulations, that do not change the baseline results. I lay out a theoretical framework considering a revenue-maximizing government in an open economy where top earners react to taxation through migration and labor supply choices. I use my results to estimate revenue-maximizing top tax rates and to quantify the efficiency cost of tax reforms across member states. The baseline calibration indicates that the behavioural burden created by an increase in the standard uniform top marginal tax in Europe accounts on average for 25% of the mechanical change in tax revenue. This demonstrates that a unilateral decrease in the uniform top marginal tax rate is never revenue-maximizing, because the overall loss in tax revenue in the top tax-bracket is non compensated by the gains through top earners' mobility. The behavioural effect created by migration responses to taxation are in the same order of magnitude that the standard labour supply elasticities that have been estimated in the literature. If the magnitudes of the migration elasticities are small for the overall population, and far below unity, they may become non trivial for redisitribution in a setting where these two behavioural margins are summed. By contrast, if the government sets different taxation rates on foreigners, the behavioural burden created by a change in the tax rate targeted on foreigners becomes very high and cancels out any mechanical change in tax revenue. In this case, I show that European governments, in order to maximize their tax revenues, have incentives to unilaterally cut the tax rate faced by top

earners coming from neighbouring countries.

There are three main take-aways in terms of public policy from this work. The first important and main result of this paper is that top earners' location choices are significantly affected by top income taxes. The results of the literature therefore hold for a broader definition of the top earners population. In my estimations, I find as expected that home bias is strong, but that top earners react significantly to tax changes when choosing their location country. My results cannot explain alone the increasing mobility trend in Europe since the 2000s, but shed light on one of the mechanisms that could help to understand it. In particular, I discuss how the large number of attractable individuals' due to a large set of alternative countries in the free mobility union mechanically increases migration elasticites, by increasing the pool of potential immigrants when lowering taxes. These effects are particularly strong for small countries included in large free mobility areas.

The second important result lies in the large foreigners mobility responses to taxation. Of course, and as it has been emphasized by the literature, this large elasticity is due to the fact that it relates to a smaller tax base, and to individuals who are by definition more likely to move. The main implication of this result is a large incentive for European governments to target individuals located abroad with different tax rates. In the case where the government is not constrained and is able to tax individuals conditionally on their previous residence, it would always be revenue-maximizing to set a lower tax rates to attract foreigners. This gives a rationale for the implementation, in many member states, of targeted tax breaks on foreigners. I show that these tax breaks are unilaterally revenue-maximizing, and therefore profitable at the level of the country that deviates from its initial tax rate, but are costly in terms of tax revenues losses at the aggregated European level. This result underlines the potential revenue and welfare effects of public policies that aim to tax mobile individuals differently compared to individuals constrained by their idiosyncratic taste for home.

The last take-away is that the European Union is not only characterized by incentives to tax differently top earners located abroad, but by large differences in these incentives across member states. My analysis captures the potential effects of the large heterogeneities at play in the current Europe, in terms of countries' size, top marginal tax rates levels and top earners' tax base composition, on tax competition. My estimates show that some member states have much higher interests to engage in beggar-thy-neighbour policies, suggesting that small countries could more easily take

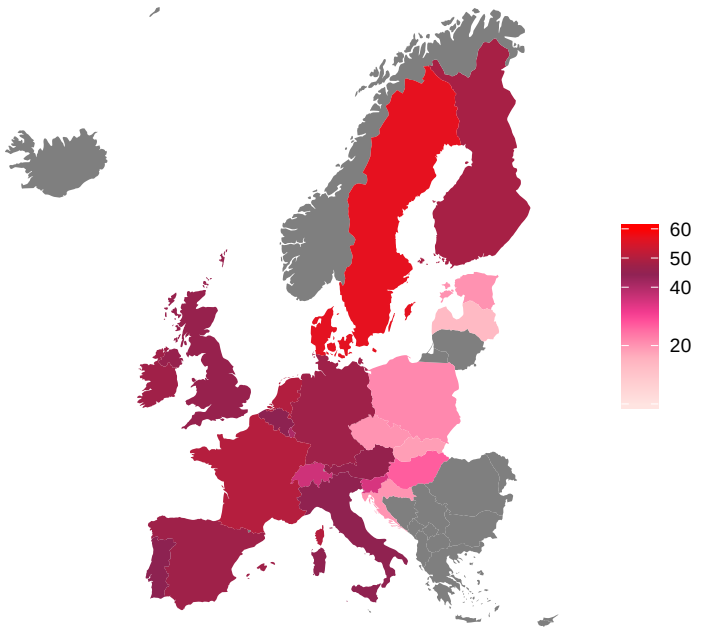
advantage of top earners' tax-driven mobility. My estimates underline that this effect is not only at play for small countries, but also, to some extent, for any country included in a large mobility area. An interesting feature of studying mobility responses to taxation within a large set of countries is to capture how the size of the population of top earners' located abroad may affect country-level optimal tax policy.

Overall, this paper emphasizes the effects of labor taxation on top earners' mobility, and aims to stress the challenges related to a free mobility area that is characterized not only by a lack of fiscal cooperation, but also by large heterogeneities across countries. The tax policy implications of the estimates point out plausible incentives within the European Union to implement tax cuts in order to attract top earners located across the border. However, this type of tax policy analysis relies on a partial equilibrium analysis, and does not take into account any general equilibrium nor spillover effects of top earners mobility, and residence, on growth, human capital accumulation or technology. An interesting direction for future research would be to quantify such effects of top earners' mobility and tax competition. These estimates may also be used to calibrate more complex and complete models of optimal taxation. In a companion paper, I use these estimates to quantify the welfare costs of tax competition along the earnings distribution.

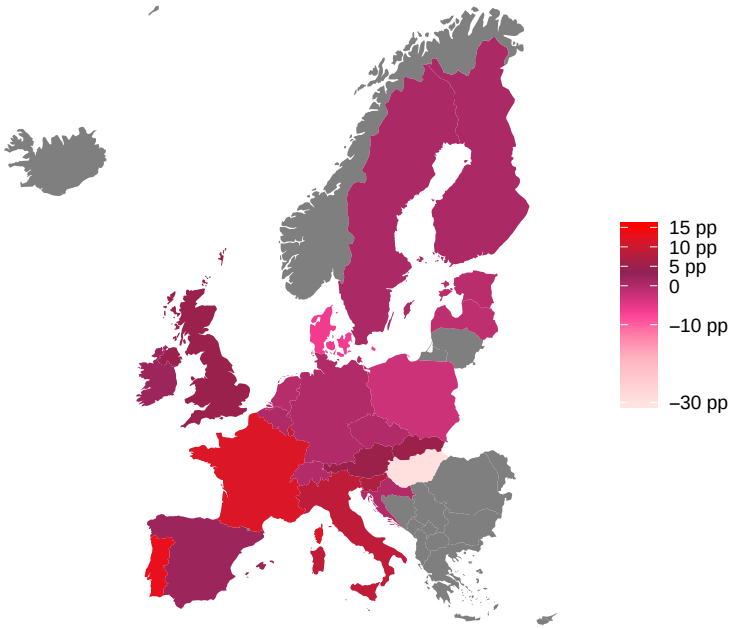
Figures

Figure 1: Differences in Top MIT Across European Countries

Panel A. Top Marginal Income Tax Rates Levels, 2009-2015

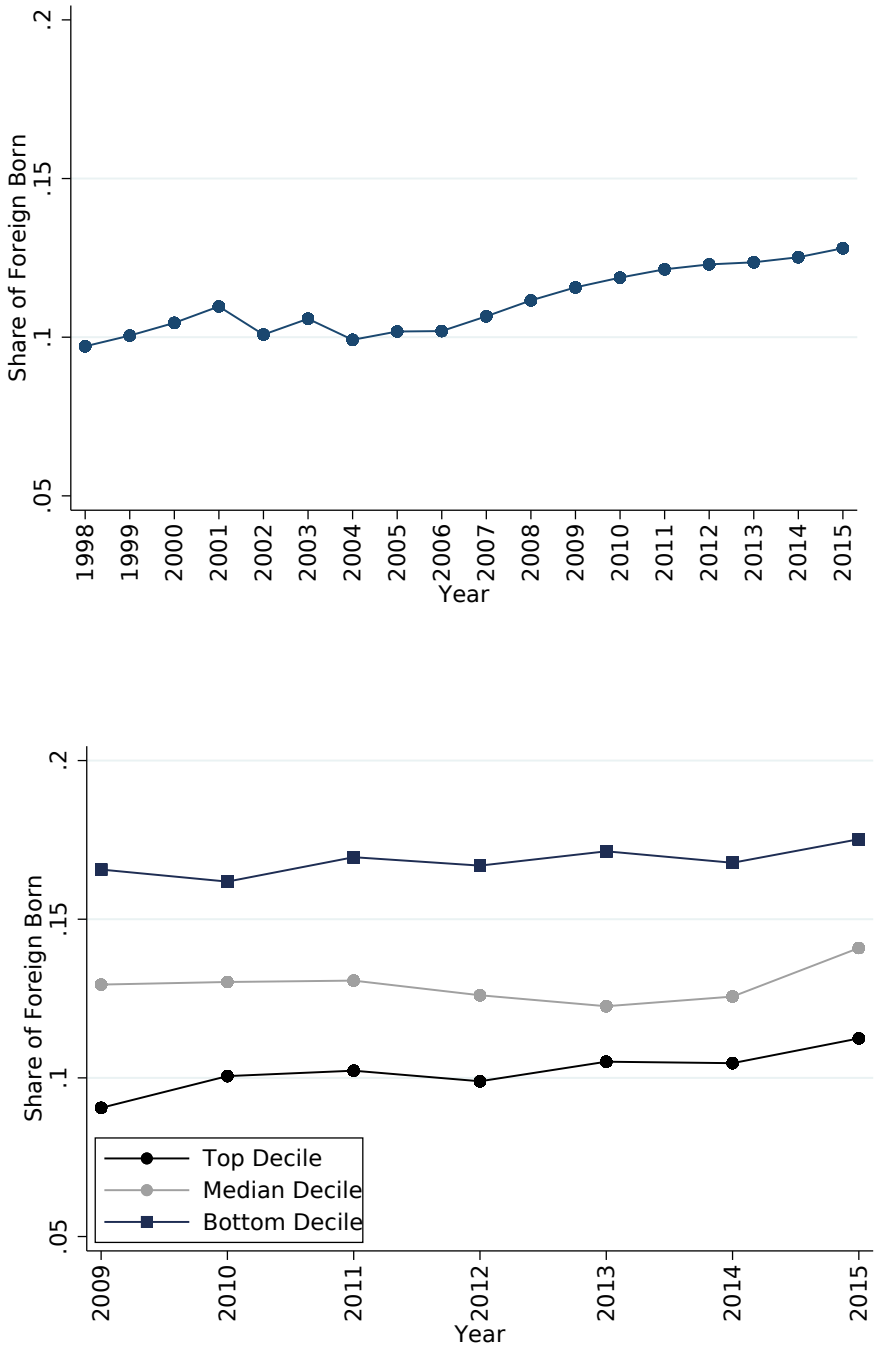


Panel B. Top Marginal Income Tax Rates Changes, 2009-2015



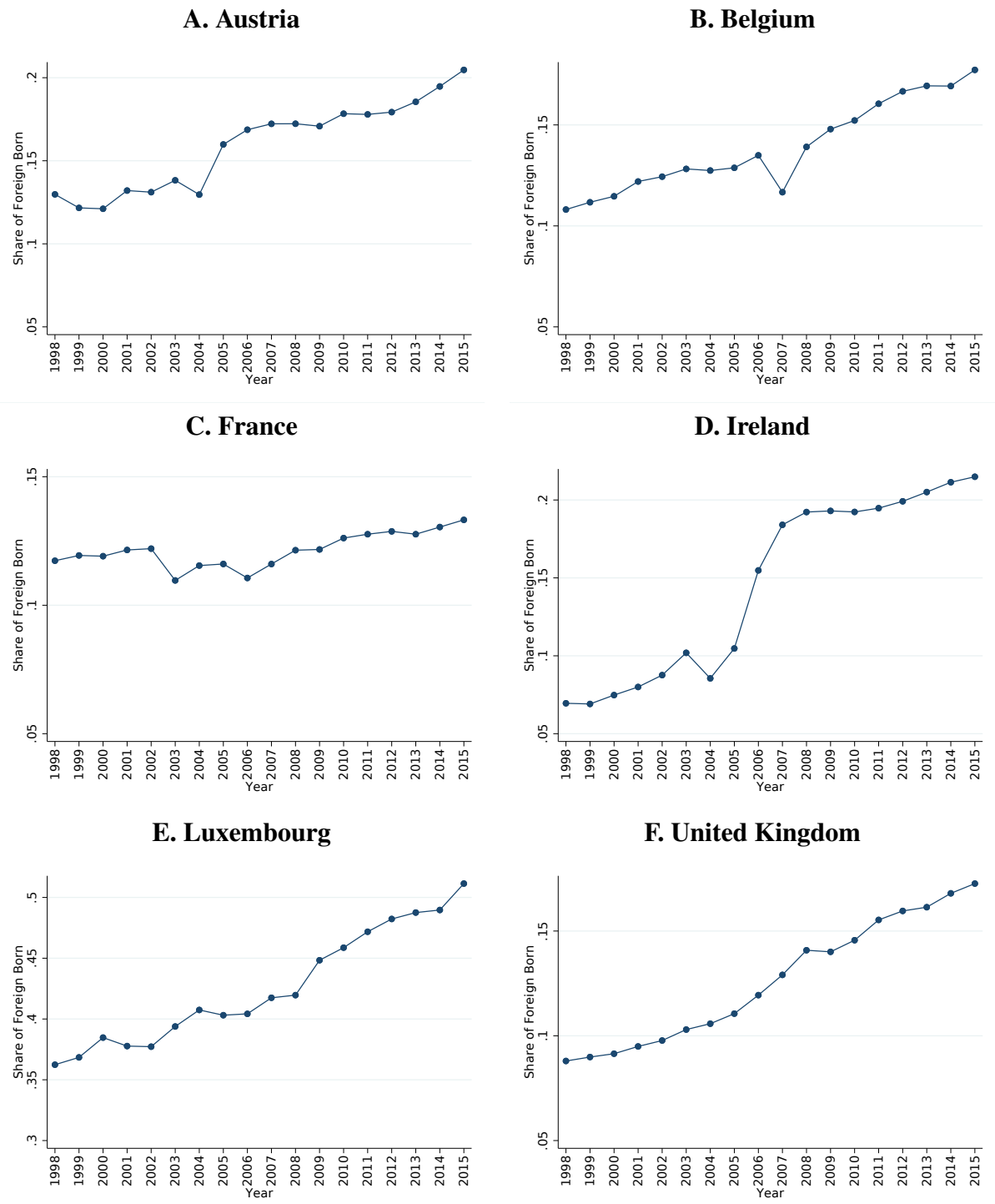
Notes: The figure shows averages and changes in top MTR over the period 2009-2015. The top MTR are collected from the OECD Taxing Wages Database. The top marginal income tax rates combine central and sub-central government marginal personal income tax rates at the earnings threshold where the top statutory income tax rate first applies.

Figure 2: **Stock of Foreign-Born Residents in Europe**



Notes: The figure shows the evolution of the share of foreign-born population in the European population. Panel A shows the evolution of the share of individuals who live in a country while being born in another country since 1998. Panel B shows the evolution of the share of foreign-born within income-decile population since 2009.

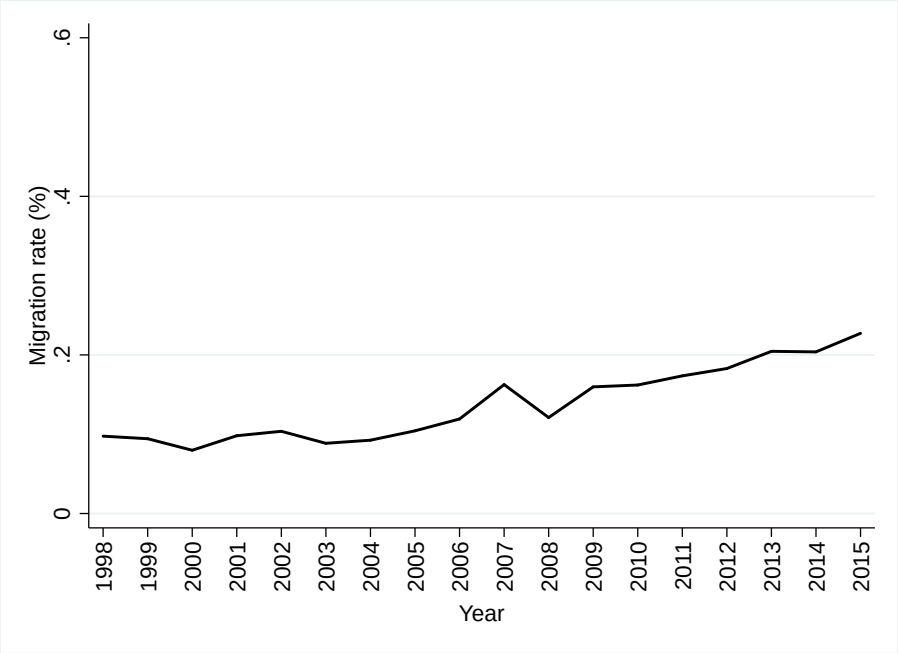
Figure 3: **Stock of Foreign-Born Residents Across European Countries Over Time**



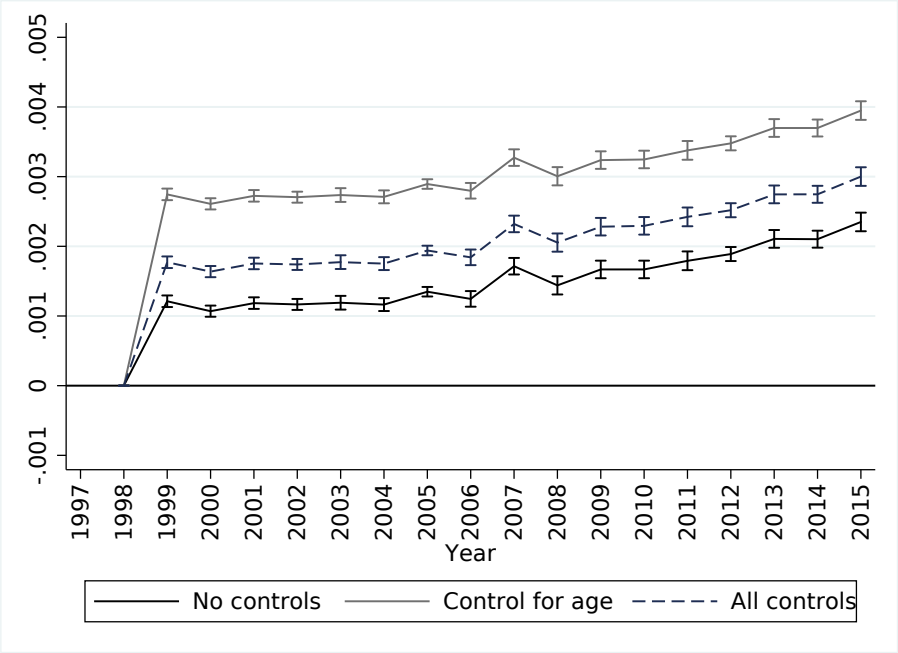
Notes: The figure depicts the evolution of the share of foreign born individuals in the overall working age population in a selected number of European countries.

Figure 4: **Evolution of Mobility in the European Union**

Panel A. Within-EU Migration Rates

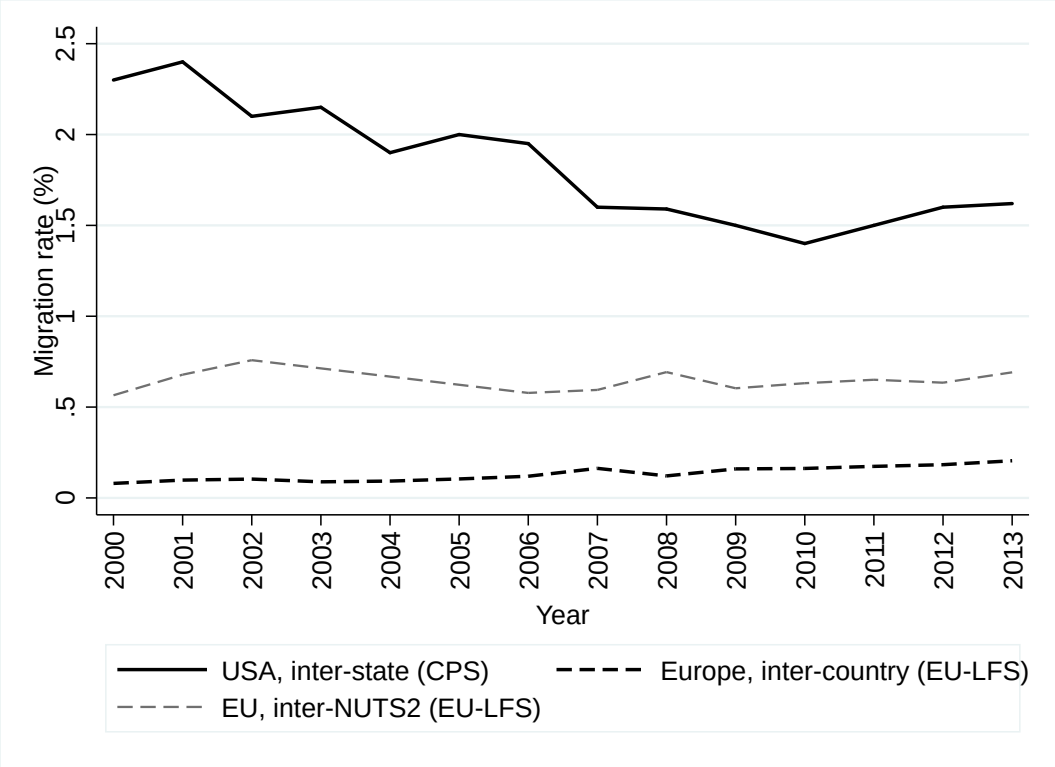


Panel B. Accounting for Demographic Changes



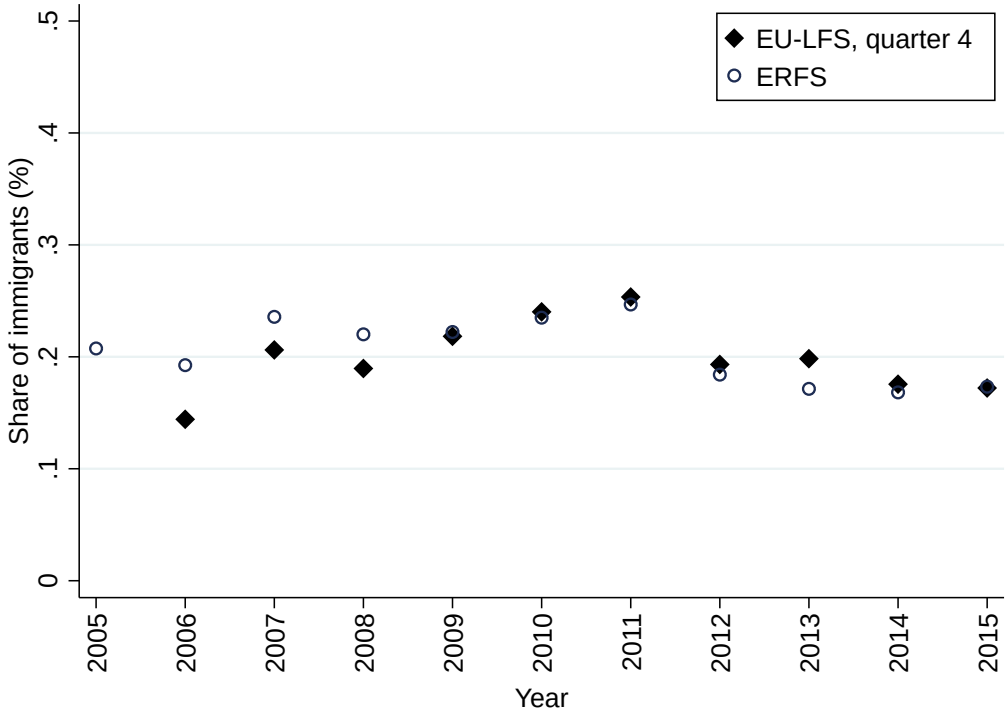
Notes: The figure shows labor mobility and migration evolution in Europe since 1998. Panel 1 shows within-EU migration rate evolution for the period 1998-2015. Migration rate is computed as the number in year N of individuals aged 18-62 who were resident of another member state in N-1, divided by the overall number of individuals aged 18-62 in Europe in N. In the bottom figure, each line shows the coefficient of years indicators from regressing whether an individual works abroad on years indicators and individual-level controls. Individual-level controls include age, education, professional status and gender. By construction, coefficients for the year 1998 are omitted in the regressions and thus set to zero for the purpose of the graph.

Figure 5: **Within-EU and Within-US Yearly Migration Rates**



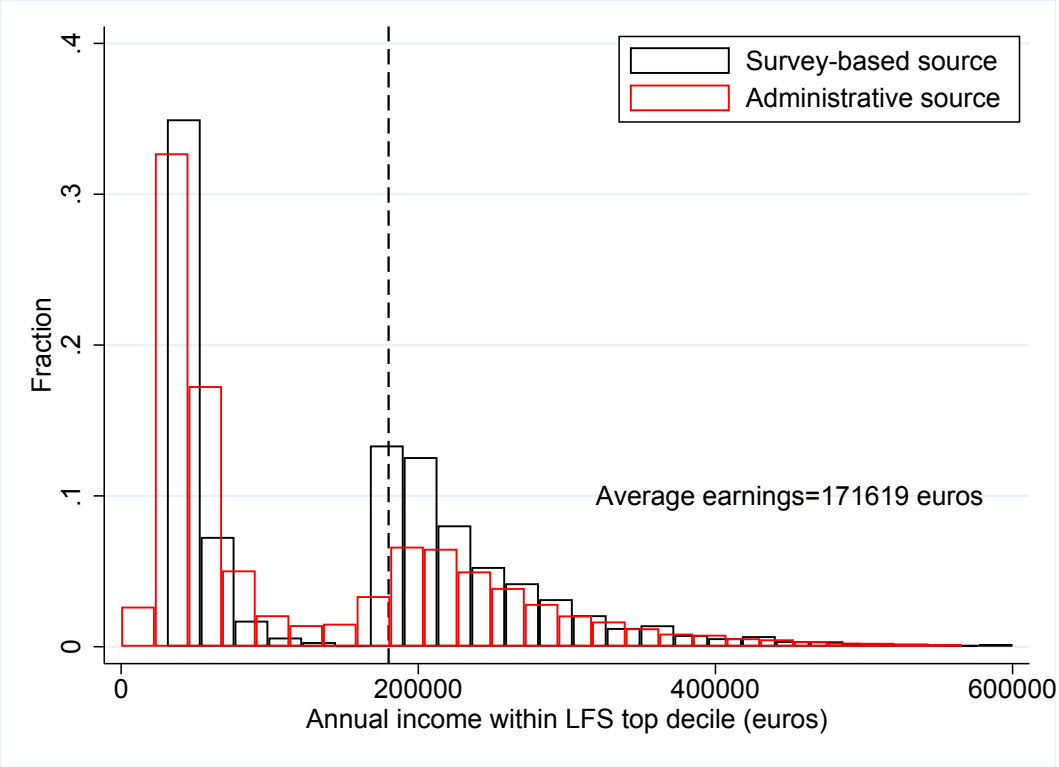
Notes: The figure compares measures of intra-Union mobility in the US and in Europe. Series for the United States are taken from Molloy et al. (2011) and are based on the Current Population Survey series on inter-state migration rates for population aged 16-64. Series for Europe are built from the EU-LFS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

Figure 6: **Consistency Between ERFS and EU-LFS**



Notes: This figure compares the EU-LFS based measure of mobility with alternative measures of yearly migration rate for the French case. ERFS is the merge between the last quarter of the French Labour Force Survey (the French part of the EU-LFS) and French administrative tax files. 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. I compute migration rate in the ERFS using the question in year N about previous residence in N-1 within and outside France (precisely, I use the answer “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 unlike other figures of the paper. This is because the EU-LFS provides yearly-level data where weights are computed to assure the representativity of the sample at the yearly level. The ERFS provides quarterly weighting that ensures the representativity of the sample at the quarter level. Therefore, it is not possible to combine the yearly and the quarterly weights when using ERFS and EU-LFS datasets.

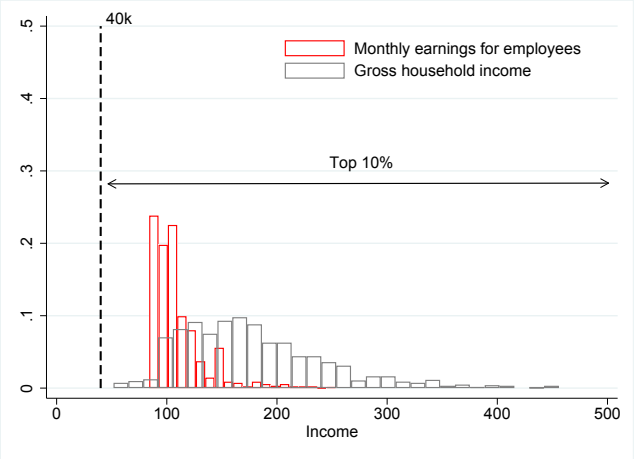
Figure 7: **Distribution of Labour Earnings Within the French Top Decile**



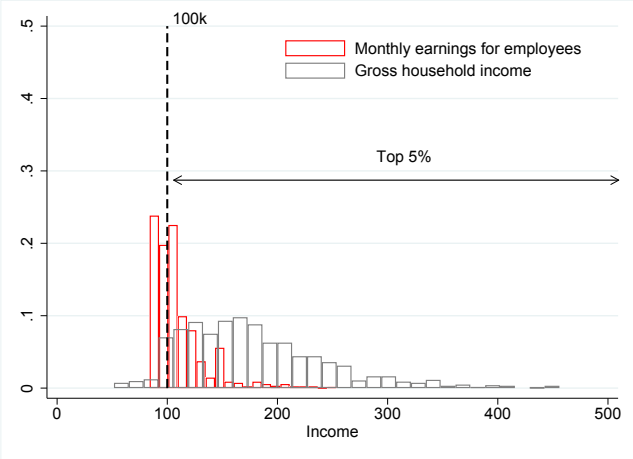
Notes: Distribution of administrative and survey measures of labour earnings in France for 2009-2015. Series are computed from the ERFS, that merges the last quarter of the French labour force survey with individual-level tax files. The survey based measure of labour earnings is monthly earnings from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

Figure 8: **Top Earnings Decile and Top Income Tax Bracket (EU-SILC)**

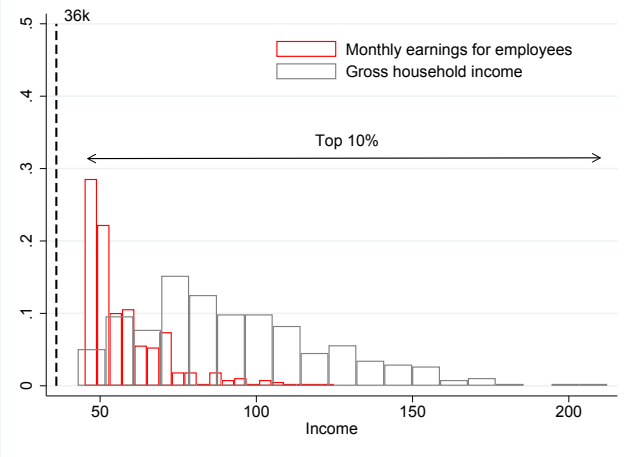
A. Luxembourg Before 2013



B. Luxembourg After 2013



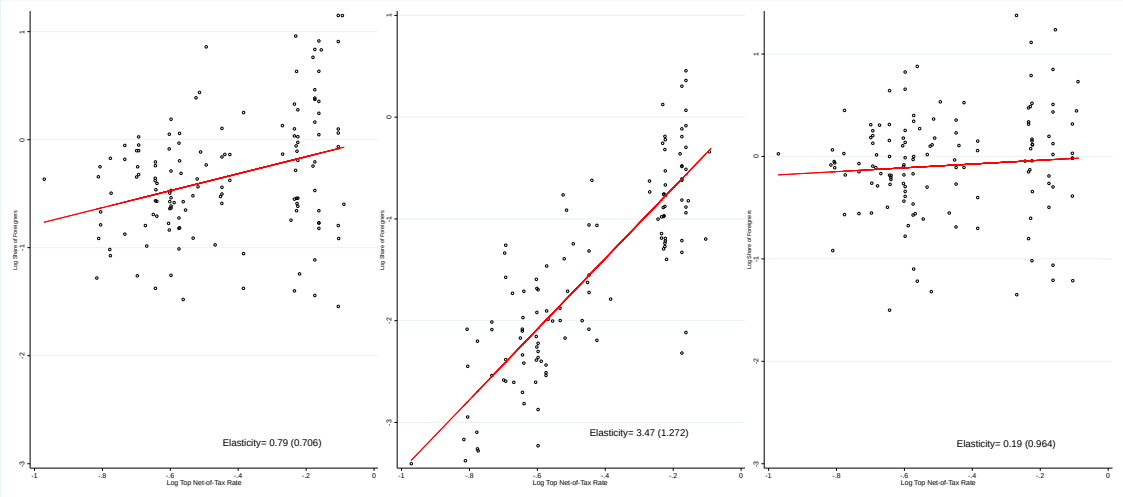
Panel C. Belgium



Notes: This Figure plots the distribution of earnings built from the EU-SILC for the top decile selected following the EU-LFS method. Individuals surveyed in the EU-SILC are ranked, in each country, according to their declared level of monthly earnings in euros, which is the common measure used to attribute earnings decile in the EU-LFS dataset. National top tax bracket thresholds are the statutory amounts established by national laws, and are collected from the OECD Taxing Wages Database.

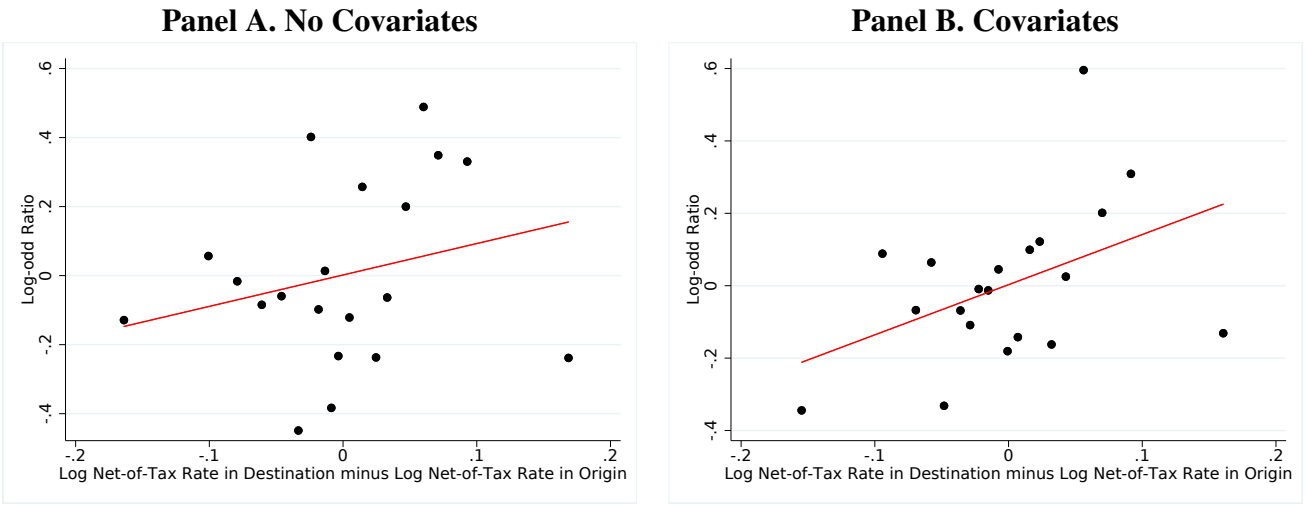
Figure 9: **Cross-Country Correlations Between Taxation and Migration, 2009-2015**

Panel A. Top 10% **Panel B. Top 5%** **Panel C. Bottom 10%**



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

Figure 10: **Effect of Top Tax Rates Differentials on Top Earners Bilateral Migration Flows**

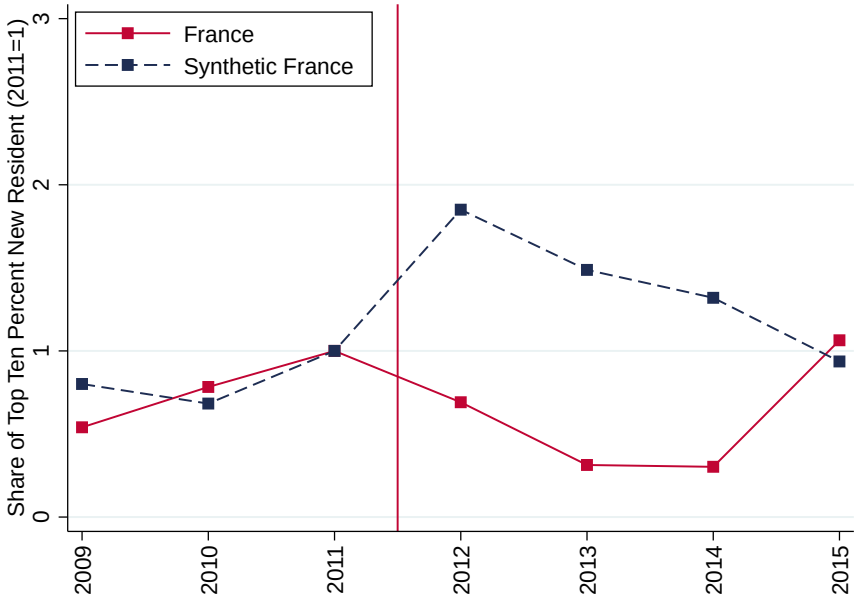


Notes: Log-odds emigration ratio are computed $log(P_{odt}/P_{oot})$, where P_{odt} is the share of individuals emigrating from country o to country d. The figure shows outmigration for a given origin-destination pair against the log retention rate differential between destination and origin country.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

Figure 11: **Effect of a French Top MITR Reform on Top Earners' Migration**

Panel A. Top Versus Bottom Earners

Panel B. France Versus Synthetic Control Group



Notes: This Figure shows the effect of a change in MITR on migration in France for the period of estimation 2009-2015. In 2012, a new tax bracket has been implemented and the top marginal tax rate was increased by 4 percentage points. Panel A depicts the share of new residents among top ten percent workers (red line) and bottom fifty workers (blue line) in France before and after an increase in the top tax bracket in 2012 that is depicted by the vertical red line. Panel A depicts the share of new resident among top ten percent workers in France (red line) against the share of new resident among to ten percent in a synthetic control group (dashed line) build following the synthetic control method described in Abadie et al. (2010).

Table 1: **Descriptive Statistics, Full Sample**

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

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

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

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

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

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

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

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

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

	Lower bounds Control group: 8th decile				Upper bounds Control group: 5th decile			
	(1)	(2)	(3)	Alt. Tax (4)	(5)	(6)	(7)	Alt.Tax (8)
log(1-τ)× top 10%	1.07	1.94***	3.32***	3.1***	.994	1.98***	3.28***	2.96***
s.e	(.674)	(.704)	(1.12)	(.940)	(.664)	(.693)	(1.10)	(.913)
log(1-τ)× 8th decile	.923	1.13*	2.58**	2.71***				
s.e	(.636)	(.627)	(1.10)	(914)				
log(1-τ)× 5th decile					-.234	.113	1.51	1.82*
s.e					(.676)	(.627)	(1.06)	(.901)
log(1-τ)× 1st decile	-0.920	-.647	.803	1.04	-1.038	-.407	.95	1.18
s.e	(.668)	(.640)	(1.12)	(.953)	(.665)	(.634)	(1.06)	(.940)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covariates × Country FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Country FE × Year	No	No	Yes	Yes	No	No	Yes	Yes
Foreign elasticity	.138	.738	.673	.581	1.10	1.67	1.58	1.10
s.e	(0.291)	(.257)	(.263)	(.310)	(.322)	(.362)	(.283)	(.279)
Uniform elasticity	.04	.16	.15	.11	.17	.25	.23	.17
s.e	(.10)	(.045)	(.041)	(.05)	(.042)	(.044)	(.044)	(.052)
Observations	35,075,335	35,075,335	35,075,335	35,075,335	35,440,093	35,440,093	35,440,093	35,440,093

Notes: *p < 0.1, **p < 0.05, ***p < 0.01. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. Estimations are based on individual-level EU-LFS sample for the period 2009-2015. The sample estimation includes all individuals in the 1st, 5th and 10th decile of labour earnings for column (5)-(8) and all individuals in the 1st, 8th and 10th decile of labour earnings for column (1)-(4). Only employees whose age is between 18 and 62 years old are selected. The data includes individuals located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Luxembourg, Latvia, 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. All of these covariates are interacted with country fixed effects. Column (3)-(4) and (7)-(8) add a country-specific linear trend. The first row reports the coefficient on the log retention rate, interacted with a dummy for being in the top ten percent of labor earnings distribution. The second row reports the coefficient on the log retention rate interacted with a dummy for being in the 8th decile of labor earnings distribution. The third row reports the coefficient on the log retention rate interacted with a dummy for being in the median decile of labor earnings distribution. The fourth row reports the coefficient on the log retention rate interacted with a dummy for being in the bottom decile of the earnings distribution. Columns (4) and (8) include a measure of the top marginal tax rate on earnings combined with social security contributions rates. Foreign elasticity is the elasticity of top ten percent new resident (movers) with respect to the net-of-tax rate. The uniform elasticity is the elasticity of the total number of top ten percent individuals with respect to the net-of-tax rate. See text for more details on the computations and definitions of the sufficient statistics.

Table 5: **Full Distribution of Earnings**

	(1)	(2)	(3)
log(1-τ)$\times$ top 10%	1.91***	1.47**	1.30**
s.e	(.597)	(.712)	(.699)
log(1-τ)$\times$ 8th-9th decile	1.63***	1.21***	1.03**
s.e	(.303)	(.374)	(.404)
log(1-τ)$\times$ 6th-7th decile	.862**	.457	.263
s.e	(.321)	(.412)	(.439)
log(1-τ)$\times$ bottom 50	-.407	-.201	-.437
s.e	(.454)	(.384)	(.417)
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	.25	.22	.60
s.e	(.544)	(.661)	(.531)
Uniform elasticity	.04	.03	.10
s.e	(.09)	(.10)	(.09)
Control: 6th-7th decile			
Foreign elasticity	.92	.89	1.42
s.e	(.563)	(.637)	(.552)
Uniform elasticity	.16	.15	.24
s.e	(.09)	(.10)	(.09)
Control: bottom 50			
Foreign elasticity	2.03	1.48	1.79
s.e	(.653)	(.695)	(.572)
Uniform elasticity	.35	.24	.31
s.e	(.11)	(.11)	(.09)
Observations	23,445,104	17,292,063	17,292,063

Notes: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Multinomial logit regressions with robust clustered standard error at the country of origin x year level in parentheses. Estimations are based on random selection of 10% of the overall EU-LFS sample described in Table 2. Only employees whose age is between 18 and 62 years old and are selected on the EU-LFS based measure of income decile. The data includes top earners located in Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Ireland, 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. All of these covariates are interacted with country fixed effects. Column (3) adds a country-specific linear trend. The first row reports the coefficient on the log retention rate, computed as $log(1-\tau)$ with τ being the top marginal tax rate in country n collected from the OECD Taxing Wages database. Foreign elasticity is the elasticity of top ten percent new residents (movers) with respect to the net-of-tax rate. The uniform elasticity is the elasticity of the total number of top ten percent individuals with respect to the net-of-tax rate.

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

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

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

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

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

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

Table 8: **Revenue-Maximizing Rates**

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

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

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

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

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

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

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

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

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

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

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

A Additional Figures and Tables

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

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

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

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

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

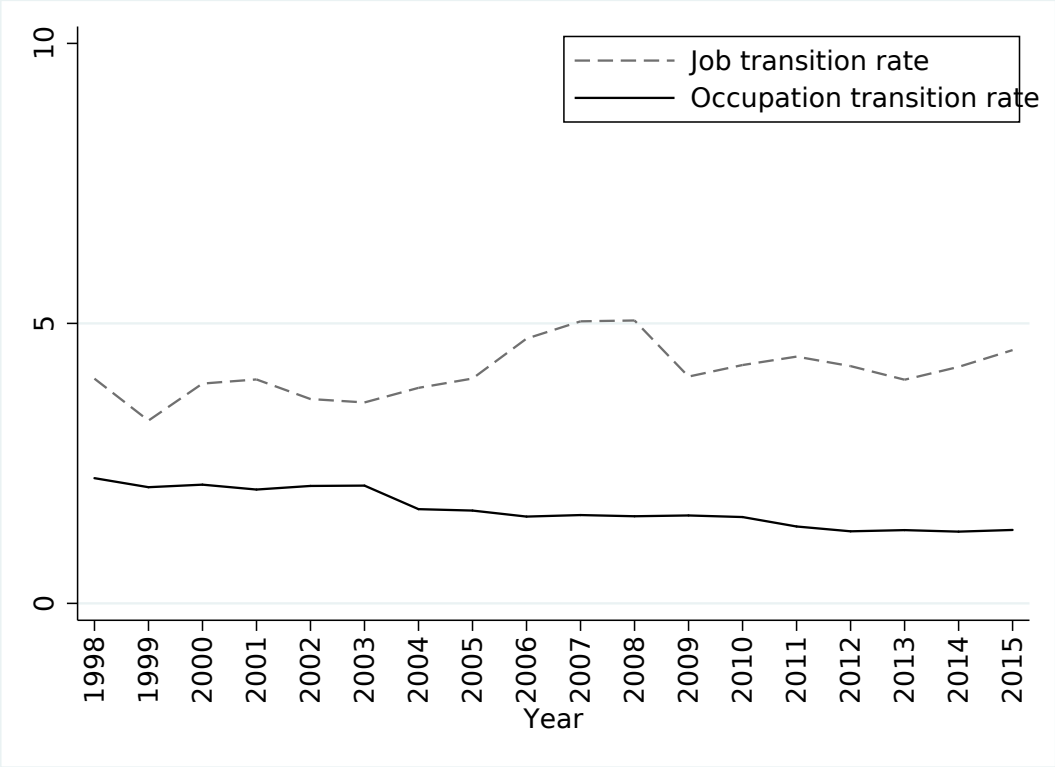
Notes: This Figure reproduces the baseline estimation imputing foreigners tax scheme eligibility in countries where such tax schemes have been implemented.

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

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

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

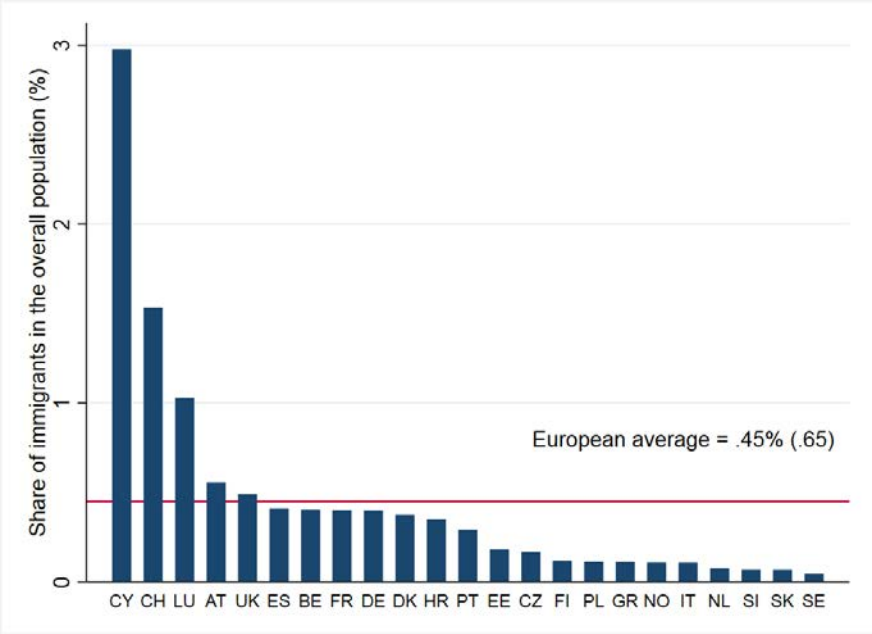
Figure A.I: **Labor Market Transitions Trend, 1998-2015**



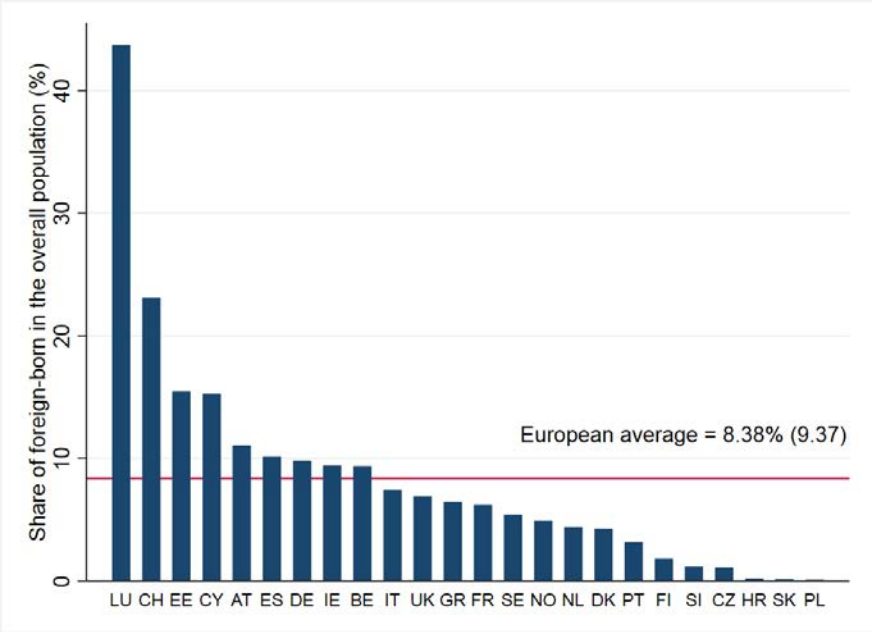
Notes: This figure depicts the evolution of transitions in the European labor market for the period 1998-2015. Job transition rate is computed as the overall number of individuals who started to work for their current employer in year N, conditional on the fact of having been an employee in year $N-1$,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

Figure A.II: **Mobility in Europe**

Panel A. Share of New Residents



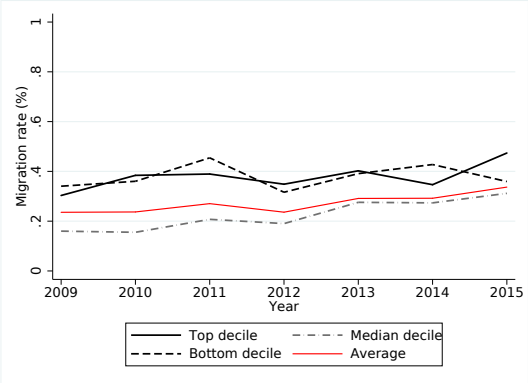
Panel B. Share of Non National Residents



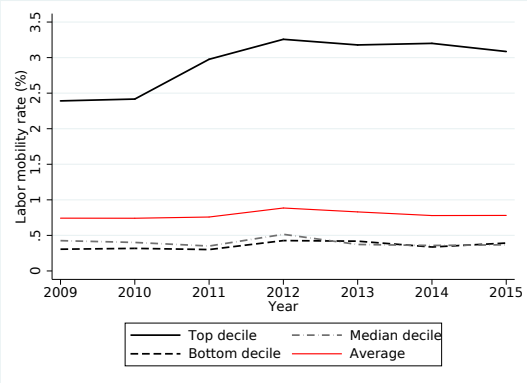
Notes: Panel A shows the share of new immigrants in the overall population for each European country included in the EU-LFS survey. New immigrants are individuals who were previously located abroad (residence-based definition of foreigners). Panel B gives the share of resident with a foreign citizenship in the population. The European average is the average of country-level averages. All the figures are computed for the year 2015.

Figure A.III: **Mobility By Income and Education Level**

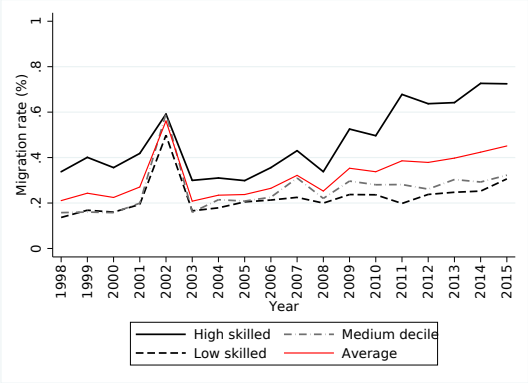
A. Migration Rate by Income Decile



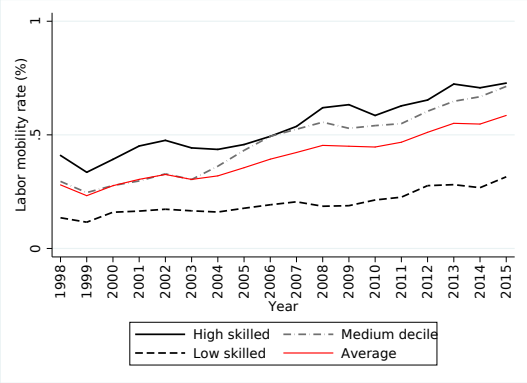
B. Labor Mobility Rate by Income Decile



C. Migration Rate by Education Level



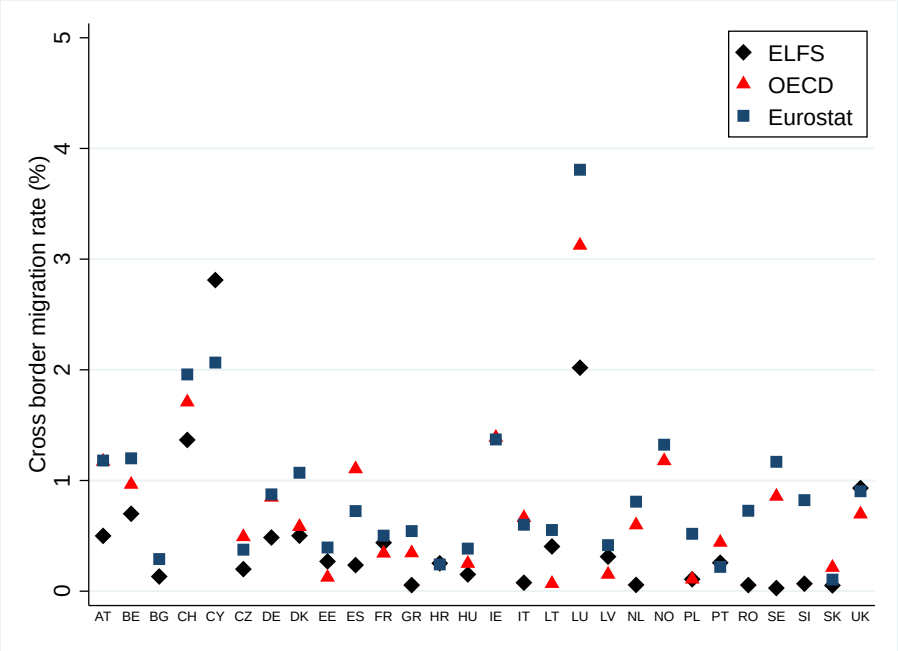
D. Labor Mobility Rate by Education Level



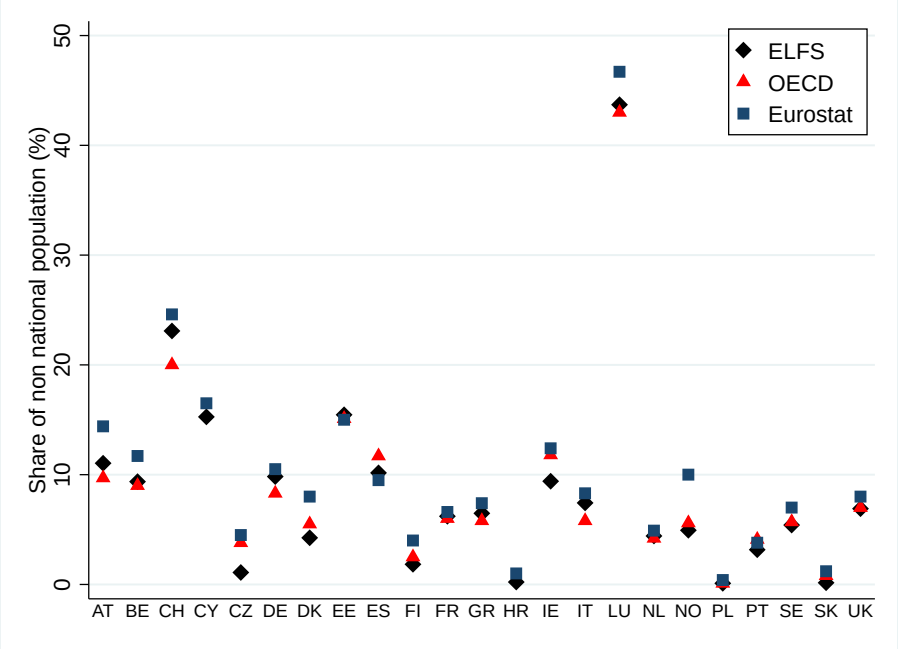
Notes: Panel A gives European migration rates by income decile. Migration rate is defined as the share of migrants in a given income category, where migrants are individuals who declared a different previous country of residence compared to the country where they are surveyed. Panel B gives European labor mobility rate by income decile. Labor mobility rate is defined as the share mobile workers in a given income category, where mobile workers are individuals working in a different country than the country where they are resident. Panel A and B are constructed for the 2009-2015 period for which we have information for income. Panel C gives European migration rate by education level, where high skilled are individuals with a tertiary education, low skilled are individuals with only primary education and medium skilled individuals with a secondary level of education. Panel D finally plots European labor mobility rate by education level.

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

Panel A. Annual Migration Flows

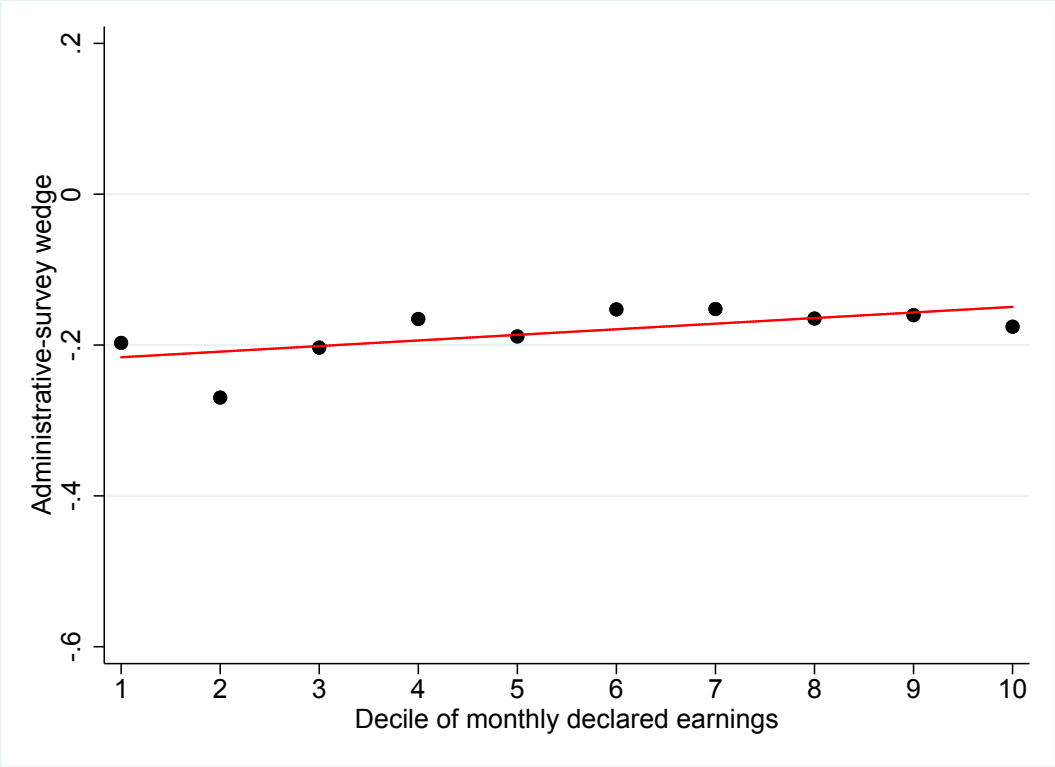


Panel B. Non-Nationals Stocks



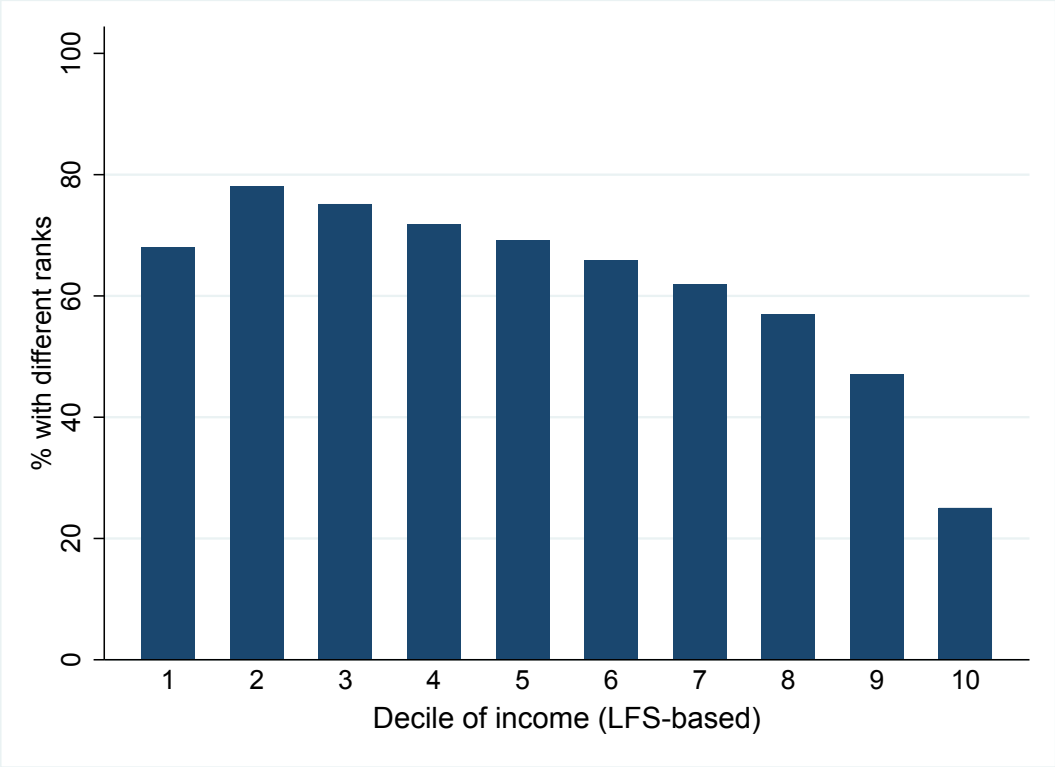
Notes: compares mobility measures from OECD, Eurostat and the EU-LFS. Migration rates and stocks from the EU-LFS are computed from the raw EU-LFS data, following the methodology described in \Autoref{sec:data}. I compute the yearly migration rates and stocks for the period 2009-2015 and the population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

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



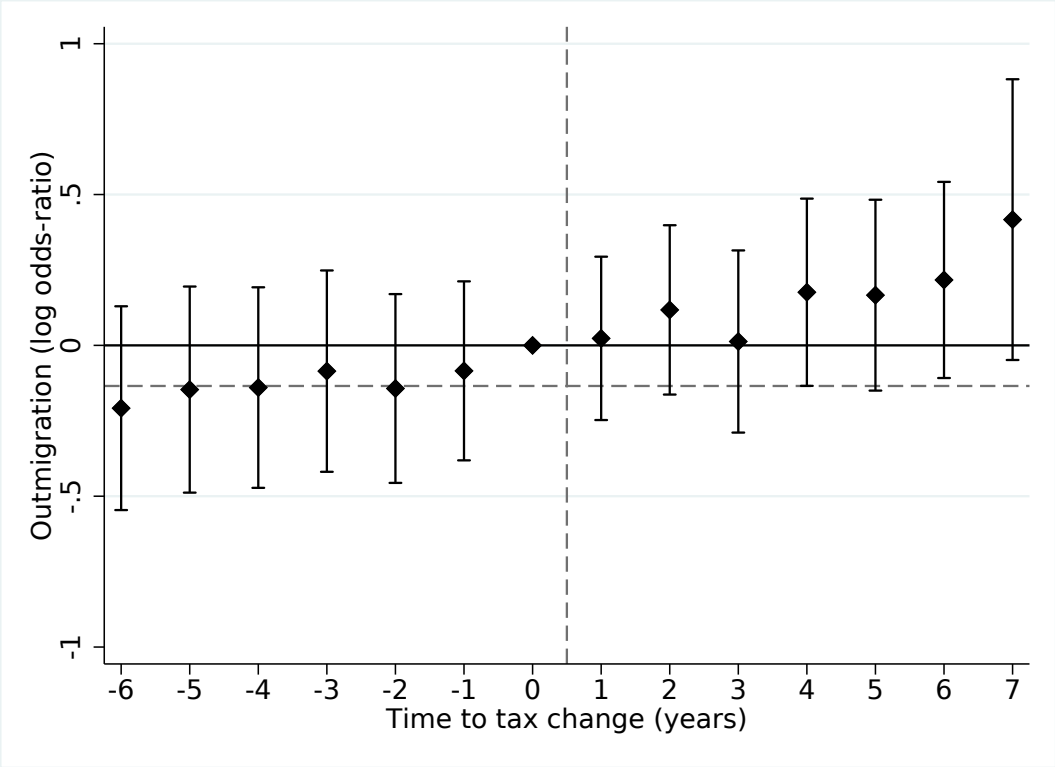
Notes: This figure plots the gap between self-reported earnings and administrative measure of wages by decile of survey-based earnings. The fitted line shows the correlation between misreporting bias in income and the ranking in labor earnings to check if mismeasurement is systematically correlated with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

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



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

Figure A.VII: Emigration of Top Earners Before and After a Change in Top MTR



Notes: I define the tax event as the highest absolute tax differential change over the period 2009-2015 within each origin x destination country cell. The tax event occurs between 0 and 1. By construction, tax increase and tax decrease have the same opposite effect on emigration. The figure plots the estimated coefficients from the equation $log(P_{odt}/P_{oot}) - log(P^0_{od}/P^0_{oo}) = \alpha_{od} + \sum_{j=-6}^{7} \beta_j 1D^0_{od}[J_{odt} = j] + year + u_{odt}$, where P_{odt} is the number of top earners moving from o to d at the calendar time of observation t, J_{odt} is the time relative to the tax change event and D_{od} is an event indicator that takes value 1 if the differential in tax change is positive, -1 if it is negative, and 0 if it does not change. The dashed black line indicates the average coefficient over the pre-treatment period. Standard errors are clustered at the country of origin $\times$ country of destination $\times$ year level.

B Derivation of Formulas for Calibrations

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

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

In the case where the government cannot impose a differential rate on foreigners, it simply maximizes $R = \tau \sum_i N_i y_i$ where both N_i and y_i are a function of the uniform net-of-tax rate. The optimal tax can be easily retrieved by studying a small deviation in the tax schedule τ. Consider an infra-marginal change in the uniform linear tax schedule $d\tau$. The small tax deviations induces a change in the government tax revenue equal to $d\tau Y$, due to a mechanical increase in tax revenue. As pre-tax earnings are endogeneously determined by a labour-leisure trade-off, the reform causes an aggregated change in earnings $-e\frac{\tau}{1-\tau}Yd\tau$. In the presence of tax competition, individuals have an extensive margin of response to the tax change through migration. Individuals react to $d\tau$ through an additional migration effect $-\varepsilon\frac{\tau}{1-\tau}Yd\tau$, that captures mobility response to the net effect of the reform on their post-tax earnings. The total effect on tax revenue is therefore given by $dR = (1 - e\frac{\tau}{1-\tau} - \varepsilon\frac{\tau}{1-\tau})Yd\tau$ 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.[26]

[26]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

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

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

case of migration.

References

Alberto Abadie, Alexis Diamond, and Jens Hainmueller. Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program. *Journal of the American Statistical Association*, 105(490):493–505, 2010.

David R. Agrawal and Dirk Foremny. Relocation of the rich: Migration in response to top tax rate changes from spanish reforms. *Review of Economics and Statistics*, 2018.

Ufuk Akcigit, Salomé Baslandze, and Stefanie Stantcheva. Taxation and the international mobility of inventors. *American Economic Review*, 106(10):2930–81, 2016.

Jon Bakija and Joel Slemrod. Do the rich flee from high state taxes? evidence from federal estate tax returns. 2004. NBER Working Paper No. 8158.

Mike Brewer, Emmanuel Saez, and Andrew Shephard. Means-testing and tax rates on earnings. *Dimensions of Tax Design: the mirrlees review*, 1, 2010.

Peter A Diamond. Optimal income taxation: an example with a u-shaped pattern of optimal marginal tax rates. *American Economic Review*, pages 83–95, 1998.

John Driscoll and Aart Kraay. Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, 80(4):549–560, 1998.

Peter Egger, Doina Radulescu, and Nora Strecker. Effective labor taxation and the international location of headquarters. *International Tax and Public Finance*, 20(4):631–652, 2013.

Jonathan Hamilton and Pierre Pestieau. Optimal income taxation and the ability distribution: Implications for migration equilibria. *International Tax and public finance*, 12(1):29–45, 2005.

Henrik Kleven, Camille Landais, Mathilde Muñoz, and Stefanie Stantcheva. Taxation and migration: Evidence and policy implications. *prepared for the Journal of Economic Perspectives*, 2019.

Henrik J. Kleven, Camille Landais, and Emmanuel Saez. Taxation and international migration of superstars: Evidence from the european football market. *American Economic Review*, 103(5): 1892–1924, 2013.

Henrik J. Kleven, Camille Landais, Emmanuel Saez, and Esben A. Schultz. Migration and wage effects of taxing top earners: Evidence from the foreigners' tax scheme in denmark. *Quarterly Journal of Economics*, 129(1):333–378, 2014.

Jonas Kolsrud, Camille Landais, and Johannes Spinnewijn. Studying consumption patterns using registry data: Lessons from swedish administrative data. 2017.

Etienne Lehmann, Laurent Simula, and Alain Trannoy. Tax me if you can! optimal nonlinear income tax between competing governments. *Quarterly Journal of Economics*, 129(4):1995–2030, 2014.

Thomas Liebig, Patrick A. Puhani, and Alfonso Sousa-Poza. Taxation and internal migration: Evidence from the swiss census using community-level variation in income tax rates. *Journal of Regional Science*, 47(4):807–836, 2007.

Vilen Lipatov and Alfons Weichenrieder. Optimal income taxation with tax competition. 2010.

James A. Mirrlees. An exploration in the theory of optimum income taxation. *Review of Economic Studies*, 38(2):175–208, 1971.

Raven Molloy, Christopher Smith, and Abigail Wozniak. Internal migration in the united states. *Journal of Economic Perspectives*, 25(3):173–96, 2011.

Enrico Moretti and Daniel J. Wilson. The effect of state taxes on the geographical location of top earners: Evidence from star scientists. *American Economic Review*, 107(7):1858–1903, 2017.

Mathilde Muñoz. How much are the poor losing from tax competition: The welfare effects of fiscal dumping in europe. *Working Paper*, 2019.

Gwenael Piaser. Labor mobility and income tax competition. *International taxation handbook: policy, practice, standards and regulation. CIMA Publishing, Oxford*, pages 73–94, 2007.

Emmanuel Saez, Joel Slemrod, and Seth Giertz. The elasticity of taxable income with respect to marginal tax rates: A critical review. *Journal of Economic Literature*, 50(1):3–50, 2012.

Kurt Schmidheiny and Michaela Slotwinski. Tax-induced mobility: Evidence from a foreigners' tax scheme in switzerland. *Journal of Public Economics*, 167:293–324, 2018.

Jesus Seade. On the shape of optimal tax schedule. 1977.

Joseph E Stiglitz. Self-selection and pareto efficient taxation. *Journal of public economics*, 17(2): 213–240, 1982.

Cristobal Young and Charles Varner. Millionaire migration and state taxation of top incomes: Evidence from a natural experiment. *National Tax Journal*, 64(2):255–286, 2011.

Cristobal Young, Charles Varner, Ithai Z. Lurie, and Richard Prisinzano. Millionaire migration and taxation of the elite: Evidence from administrative data. *American Sociological Review*, 81(3): 421–446, 2016.