Taxation and Migration: Evidence and Policy Implications*

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Abstract

In this article, we review a growing empirical literature on the effects of personal taxation on the geographic mobility of people and discuss its policy implications. We start by laying out the empirical challenges that prevented progress in this area until recently, and then discuss how recent work have made use of new data sources and quasi-experimental approaches to credibly estimate migration responses. This body of work has shown that certain segments of the labor market, especially high-income workers and professions with little location-specific human capital, may be quite responsive to taxes in their location decisions. When considering the implications for tax policy design, we distinguish between uncoordinated and coordinated tax policy. We highlight the importance of recognizing that mobility elasticities are not exogenous, structural parameters. They can vary greatly depending on the population being analyzed, the size of the tax jurisdiction, the extent of tax policy coordination, and a range of non-tax policies. While migration responses add to the efficiency costs of redistributing income, we caution against over-using the recent evidence of (sizeable) mobility responses to taxes as an argument for less redistribution in a globalized world.

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There's one for you, nineteen for me
Cause I'm the taxman, yeah I'm the taxman
Should five per cent appear too small
Be thankful I don't take it all
Cause I'm the taxman, yeah I'm the taxman

— Lyrics of *Taxman* from the Beatles' album *Revolver* (1966)

1 Motivation

Tax rates differ substantially across countries and across locations within countries. An important question is whether people choose locations in response to these tax differentials, thus reducing the ability of local and national governments to redistribute income and provide public goods. Due to globalization and the lowering of mobility costs, it has become increasingly important to pay attention to mobility responses when designing tax policy. In this paper, we review what we know about mobility responses to personal taxation and discuss the policy implications. Our main focus is on the mobility of people, especially high-income people, but we will also discuss the mobility of wealth in response to personal taxes.

It is clear that high-income individuals sometimes move across borders to avoid taxes. The media is filled with examples of famous people who, often by their own admission, engage in such tax avoidance behavior. The Rolling Stones left England for France in the early 1970s in order to avoid the exceptionally high top marginal tax rates — well above 90% — in the UK at the time.[1] Many other British rockstars moved to lower-tax jurisdictions, including David Bowie (Switzerland), Ringo Starr (Monte Carlo), Cat Stevens (Brazil), Rod Stewart (United States), and Sting (Ireland). In more recent years, actor Gérard Depardieu moved to Belgium and eventually Russia in response to the 75% millionaire tax in France, while a vast number of sports stars in tennis, golf and motor racing have taken residence in tax havens such as Monte Carlo, Switzerland and Dubai.

While these anecdotes are suggestive, two caveats prevent us from drawing any broader conclusions at this stage. First, all of the examples are from the sports and entertainment industries.

[1] Up until 1978, the UK imposed a top marginal tax rate on labor income equal to 83% and a top marginal tax rate on capital income that was even higher, a stunning 98%. Very few people had sufficiently high incomes to face these tax rates, but rock stars were among them. The Beatles' song *Taxman* quoted above was an attack on the high levels of progressive tax under the Harold Wilson governments of the 1960s and 1970s.

These industries may feature particularly high cross-border mobility both because they involve little location-specific human capital and because workers tend to be less tied to specific firms. Second, some of the examples reflect location responses to extreme top tax rates. The key question — and the one with which we are preoccupied in this paper — is if income tax rates distort the location choices of broader segments of workers? And if they do, how large are the responses and what are the implications for policy? These questions are particularly pertinent due to the recent proposals in the US and elsewhere to substantially raise the taxation of income or wealth at the top of the distribution.

2 Mobility of People

2.1 Empirical Challenges and Approaches

The idea that tax policy may affect the location decisions of individuals has a long tradition in economics. In fact, tax-induced mobility is a central mechanism in several strands of economic theory. In the local public finance literature, starting with the seminal contribution of Tiebout (1956), migration responses to local taxes and public goods provision are the fundamental force governing the sorting of individuals across jurisdictions. Related, since the contributions of Rosen (1979) and Roback (1982), the field of economic geography has focused on spatial equilibrium models in which the assumptions placed on migration elasticities are key determinants of the spatial allocation of factors and the geographic variation in prices. The optimal taxation literature has also emphasized that migration responses can have important effects on tax design and may trigger socially inefficient tax competition in uncoordinated tax settings (e.g., Mirrlees 1982; Bhagwati & Wilson 1989).

Despite being a central conceptual component in several areas of economics, direct empirical evidence on the responsiveness of individual location decisions to taxes has been remarkably scant. Table 1 provides a summary of the available literature, focusing on papers that estimate mobility responses to personal income taxes. Interestingly, only a dozen papers or so provide direct evidence on such responses and most of these papers are very recent. Two empirical challenges can explain the paucity of empirical research in this area: data limitations and identification challenges. In

what follows, we discuss these issues and describe what recent work has done to overcome them.

Data challenges Information on migration patterns combined with precise measures of earnings and tax rates in different locations is hard to come by. Traditional surveys either lack this type of information or are statistically underpowered due to small sample sizes. One way of circumventing this data limitation is to focus on alternative outcomes, such as wages, and test structural predictions of migration models under different assumptions about mobility. Feldstein & Wrobel (1998) provide an early example of this approach. Their premise is the following. In the absence of heterogeneity in preferences for different locations, a long-run equilibrium equalizes utility across locations for all individuals and therefore fixes the net-of-tax wage rate in each location. In this case, there is perfect mobility: An increase in the tax rate in a given location must be exactly offset by an increase in the wage, because otherwise every individual would move out of that location. Testing if the elasticity of wages with respect to the net-of-tax rate equals minus one is therefore a test of perfect mobility, i.e. an infinite mobility elasticity. Using cross-sectional variation in the progressivity of state income taxes in the U.S., Feldstein & Wrobel (1998) estimate very large wage responses to the net-of-tax rate and cannot reject an elasticity of minus one. However, their large standard errors imply that they also cannot reject the opposite extreme of small or zero elasticities in a number of specifications.

The recent literature has taken two different approaches to overcome these data challenges. The first approach is to focus on specific segments of the labor market for which detailed migration information is available from external sources. Examples include football (soccer) players where rich biographical information allows one to reconstruct migration patterns (Kleven *et al.* 2013), and inventors whose location decisions can be inferred from patent records (Akcigit *et al.* 2016, 2018; Moretti & Wilson 2017). The second approach is to find contexts in which administrative data with information on migration is available. One possibility is to use tax or social security records from countries with a federal structure where the internal migration across tax jurisdictions can be observed (Young *et al.* 2016; Martinez 2017; Agrawal & Foremny 2018). Another possibility is to study countries, typically Scandinavian countries, that keep migration records of all movements in and out of the country that can be linked to administrative tax records (Kleven *et al.* 2014).

Identification challenges Where data on migration patterns is available, the second fundamental difficulty is to find tax variation that is orthogonal to all other factors affecting individual location choices, such as local labor markets conditions, local amenities and public goods. The most natural route, and the one followed in much of the recent literature, is to use variation stemming from tax reforms. As we argue later, in order to provide compelling identification, such tax reforms need to provide variation both over time and across individuals *within* locations as this allows for specifications that control flexibly for confounders that vary by both time and location. Natural candidates are tax reforms that affect specific income groups (such as high-income people) and/or specific demographic groups (such as those with foreign citizenship). Specifically, Kleven *et al.* (2013) and Kleven *et al.* (2014) argue that the introduction in a number of countries of preferential tax schemes to foreigners, due to the fact that they often create large within-country variation, provide useful quasi-experiments for studying mobility responses.

Even when plausibly exogenous variation in taxes is available, a difficulty for estimating mobility elasticities is how to measure the relevant tax incentive that govern location decisions.[2] First of all, it is worth noting that location decisions, as with other extensive margin decisions, depend on the *average* rather than the marginal tax rate. Average tax rates are not always straightforward to calculate. This is one of the reasons why the recent literature has focused on workers at the top of the income distribution: At very high incomes, the top marginal tax rate is a reasonable proxy for the average tax rate and it is relatively easy to compute across countries and over time (Kleven *et al.* 2013). Conversely, at the bottom of the income distribution, the relevant average tax rate depends, not just on the tax system, but also on the potentially complicated system of welfare programs and social insurance schemes. Despite a long-standing debate about "welfare magnets" (see Borjas 1999), there is virtually no evidence on mobility responses to welfare benefits by low-income people.

However, even in samples where we can focus on top marginal tax rates, computing the relevant tax incentive for location decisions is not necessarily straightforward. Mobility responses may depend on the tax treatment of both labor income and capital income or wealth. In general, it is easier to measure tax rates on labor income than on capital income and wealth. For the latter,

[2]Calculating the elasticity of migration with respect to the net-of-tax rate relies on correctly measuring the change in the tax incentive (the denominator of the elasticity). Otherwise the elasticity estimate will be biased, even if the reduced-form effect of the reform on migration (the numerator) is correctly identified.

detailed information on the income and wealth composition of individuals and their spouses is often necessary. Absent such data, focusing on the top marginal tax rate on labor earnings can introduce measurement error in the true tax incentive, especially because some countries actively rely on specific provisions of capital taxation to attract foreign residents. Belgium is a case in point. Although its top marginal tax rate on earnings is relatively high, the fact that capital gains are exempt from taxation and *inter vivos* gifts are taxed at very low rates are often cited as reasons why a large number of wealthy French people have moved their tax residence to Uccle or Ixelles in the suburbs of Brussels.

Finally, we note that the data and identification challenges outlined above are, if anything, even stronger when studying the effects of wealth or estate taxation on migration. This literature is limited to just a few papers that focus on within-country mobility responses to the taxation of bequests (Bakija & Slemrod 2004; Conway & Rork 2006; Brülhart & Parchet 2014). These studies suggest that the location decisions of wealthy, elderly taxpayers are not very elastic to estate or inheritance taxes. However, as we discuss later, mobility responses to wealth and capital taxes are not limited to the mobility of people, because taxpayers may be able to relocate wealth and capital income without changing personal residence.

2.2 A Macro Perspective: Cross-Country Evidence

We start by adopting a macro perpective, exploring the empirical relationship between the stock of foreigners and tax rates across countries. This analysis will provide a set of useful descriptive facts regarding the migration patterns across countries, and it will serve to highlight some of the empirical challenges mentioned above.

For the reasons discussed earlier, we focus on individuals at the top of the earnings distribution. To study this population, the first step is to gather comparable micro data on migration and earnings across countries. Building on Muñoz (2019), we use survey data to construct yearly measures of the stock of foreigners in 25 European countries and the United States between 2009-2015. The data come from the European Labor Force Survey (EU-LFS) and the Current Population Survey (CPS) for the US. These surveys enable us to observe individual-level measures of citizenship, past and present location, employment, earnings and demographics.[3] Since our focus is on high-

[3]The EU-LFS dataset is the largest European survey of individuals. It is a repeated cross-section covering roughly

income people, we select individuals with labor earnings in the top 5% of the distribution in each country and year. We then compute the log share of top 5% foreigners in the overall population, where foreigners are defined as citizens of a country different from their country of residence.

The next step of the analysis is to construct a measure of the tax incentive relevant for location decisions. As argued above, while migration decisions are governed by average tax rates, it is reasonable to use the top marginal tax rate as a proxy when considering the top end of the income distribution. It is important to consider a measure of the top marginal tax rate that accounts for the distortions coming from all parts of the tax code. Specifically, we consider a tax rate measure that accounts for personal income taxes at the local and national levels, uncapped payroll taxes on workers and firms, and consumption taxes (VAT or sales taxes). Denoting the top marginal net-of-tax rate by $1-\tau$, our tax rate measure captures that, whenever the firm's labor cost increases by 1 dollar, the worker can increase consumption by $1-\tau$ dollar.[4] We construct this measure for all 26 countries for each year between 2009-2015, expanding the pre-existing series created by Kleven *et al.* (2013) and Piketty *et al.* (2014).

Importantly, because we are interested in the impact of taxes on the stock of foreigners, we need to account for the fact that the tax treatment of foreigners is sometimes affected by special tax provisions. Specifically, foreigners benefit from preferential tax treatment in a number of countries. We document the details of these schemes in Table 2. We return to the details of these tax schemes later — highlighting both their promise as sources of empirical identification and the interesting tax design questions they raise — but at this point we simply note that our tax rate measures account for the implications of these schemes.

With this data in hand, we turn to the empirical evidence. In Panel A of Figure 1, we plot the

0.3% of the overall European population per year since the 1980s. It includes detailed income information since 2009. The full list of countries in our analysis is the following: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Switzerland, United Kingdom, and United States. We provide a complete description of the data and the construction of our sample in the online data appendix.

[4]We combine the top personal income tax rate τ_i, the uncapped payroll tax rates on employees (workers) and employers (firms) τ_{pw} and τ_{pf}, and the VAT (or sales tax) rates τ_c in order to obtain our final measure of the top marginal tax rate τ:

$$1-\tau = \frac{(1-\tau_i)(1-\tau_{pw})}{(1+\tau_c)(1+\tau_{pf})}$$

Note that this formula has been written for the standard case where the employer's and employee's payroll taxes are both based on gross earnings, and where the income tax rate applies to earnings net of all payroll taxes. When this is not the case, we have adapted our computations to capture precisely country-specific rules.

average share of top-5% foreigners between 2009-15 against the average top marginal net-of-tax rate over the same period (both variables are measured in logs). The following insights emerge from the figure. First, there is a large dispersion in tax rates across countries. On the far right of the diagram, Eastern European countries like Bulgaria and the Czech Republic have high net-of-tax rates due to their flat income taxes with low rates. Interestingly, a country such as Denmark is also located on the far right of the diagram, because of their preferential tax scheme to foreigners. Second, there is also a large dispersion in the share of foreign workers at the top of the earnings distribution. While countries like Luxembourg and Switzerland have large fractions of foreigners, Eastern European countries have small shares. Third and most importantly, there is no sign of a positive correlation between the stock of foreigners and the net-of-tax rate. If anything, the correlation is negative: countries with large shares of foreigners at the top tend to be those with large tax rates at the top.

Of course, this graph has no causal interpretation. There are many country-specific factors, correlated with taxes, that can affect the relationship and explain why countries such as Luxembourg, Belgium or the United States attract a larger share of high-skill foreigners than Romania or Poland, despite having higher top tax rates on earnings. To control for such country-specific factors, we move from the correlation in levels shown in Panel A to a correlation in *changes* over time in Panel B. There we ask if the share of top foreigners increase more (or fall by less) in countries that have reduced their top tax rate by more? This correlation will not be affected by country-level factors that are fixed over time. As can be seen from the graph, based on the changes in taxes and share of foreigners migration between 2009-15, the cross-country patterns still do not provide any smoking gun for mobility responses. The relationship between taxes and migration is essentially flat. However, an issue for this analysis is that many countries experienced little or no variation in tax incentives over this period (while a few countries experienced large variation), and still their stock of top foreigners evolved very differently due to confounding time-varying factors. An example is the contrast between the United Kingdom and Ireland: they experienced greatly different migration flows over this time period — a large increase in the stock of top foreigners in the UK, a significant decline in Ireland — even though top tax rates were roughly constant in both countries.

The macro evidence presented in Figure 1 highlights some of the empirical challenges for identifying the effect of personal taxation on mobility. It shows very clearly that both immigrant

stocks and immigrant flows vary significantly across countries for non-tax reasons. Therefore, in order to provide causal evidence on mobility responses, it is imperative to control for all non-tax determinants of location decisions that vary at both the country- and year-level.

2.3 A Micro Perspective: Country Case Studies

We now turn to quasi-experimental approaches using country-specific tax reforms. These approaches, by leveraging within-country variation in tax incentives across individuals over time, effectively control for any unobserved location characteristics that vary at the country-by-year level. This gets rid of the main source of bias in the cross-country analysis presented above.

The first step of such an analysis is to explore the legislative variation in tax rates that can be used for estimating mobility responses. We continue to focus on high-income earners both because their mobility responses are particularly important for government revenue and economic efficiency, and because of the presence of rich quasi-experimental variation in the taxation of top earners. To illustrate this variation, Figure 2 shows the evolution of top marginal tax rates in twelve countries between 1980-2015. The row dimension of the figure separates different sets of countries, while the column dimension disinguishes between domestic and foreign residents. As mentioned above and documented in Table 2, the tax rates on domestics and foreigners differ in some countries due to the existence of preferential tax schemes to immigrant workers. Recall that we consider top marginal tax rates that account for the combined wedge due to personal income taxes, uncapped social security taxes on workers and firms, and value-added or sales taxes. These are the statutory rates in the tax laws of each country and their variation is therefore driven by legislation or reform.

The following points are worth highlighting. First, the top marginal tax rate on domestic residents tends to be largest in Northern Europe, intermediate in Continental Europe, and smallest in English-speaking countries. For example, the top marginal tax rate equals 75% in Sweden and 48% in the United States in 2015. Second, this cross-country pattern is less pronounced when focusing on the taxation of foreigners due to the fact that preferential foreigner tax schemes are more prevalent in high-tax countries. Among the twelve countries in the figure, such schemes have been introduced in the Netherlands (1985), Denmark (1991), Sweden (2001), France (2004), Spain

(2005), and Italy (2010). Third, the introduction of preferential tax schemes to foreigners, due to their generosity and design, create sharp variation in location incentives. They create variation over time, across countries, and across workers within countries due to their targeting to high-income people (and sometimes other eligibility criteria).

Papers by Kleven *et al.* (2013) and Kleven *et al.* (2014) argue that the introduction of special tax schemes to foreigners provide compelling sources of variation for learning about mobility responses. Let us consider the Danish tax scheme to foreigners, analyzed in detail by Kleven *et al.* (2014). This scheme was enacted in 1992 and applied to the earnings of foreign workers from June 1991 onwards. Eligibility for the scheme requires annual earnings above a threshold located around the 99th percentile of the earnings distribution. Initially, the scheme offered a flat income tax rate of 30% in lieu of the regular progressive income tax with a top marginal tax rate of 68%. The scheme could be used for a total period of up to 3 years, after which the taxpayer becomes subject to the ordinary income tax schedule.[5]

The design of the scheme lends itself to a difference-in-differences approach in which we compare the evolution of the number of foreigners above the eligibility threshold (treatments) and below the eligibility threshold (controls). Such an analysis is presented in Figure 3. It shows the stock of foreigners between 1980-2005 in the treated earnings range and in two untreated earnings ranges, between 80-90% of the threshold and between 90-99% of the threshold. The two control series are normalized to match the treatment series in the pre-reform year. The graph provides exceptionally compelling evidence of mobility responses. The treatment and control series are perfectly parallel in the ten years leading up to the reform and start diverging immediately after the reform. The gap between the series builds up gradually through the 1990s and then reaches a steady state.[6] The effects are very large: the treatment series more than doubles relative to the control series, producing an elasticity of the stock of foreigners with respect to the average net-of-tax rate equal to about 1.6.

[5] As shown in Table 2, the scheme parameters (the tax rate, the duration, and other parameters) have been revised since the initial introduction of the scheme.

[6] The similarity between the two control series rules out the main potential confounder, namely that foreigners above the threshold are displacing foreigners just below the threshold. In that case, the divergence between treatments and controls would not represent a net mobility effect, but a shift in the earnings level of foreign arrivals. However, such shifting would produce a dip in the number of foreigners just below the threshold relative to the number of foreigners further down. The completely parallel trends of the two different control groups (along with other tests provided in Kleven *et al.* 2014) are inconsistent with such a story.

While the Danish evidence is very striking, it is important to highlight that mobility elasticities — as other extensive margin elasticities — are not structural parameters. As a result, the findings in Kleven *et al.* (2014) are not necessarily transportable to other segments of the labor market or to other countries. To see that mobility elasticities can vary greatly across labor market segments, it is useful to explore heterogeneity across industries in the responses to the Danish tax scheme. Motivated by the many examples of tax-induced mobility in music, film and sports discussed in the introduction, Figure 4 splits the difference-in-differences analysis into sports & entertainment (Panel A) and all other industries (Panel B). The effects are starkly different across these sectors. While the number of foreigners increased by a factor of less than two in other industries, it increased by a factor of more than five in sports & entertainment. Much of the dramatic increase in the latter group was driven by sports, and in particular football (soccer) as analyzed by Kleven *et al.* (2013).[7]

It is important to note that the mobility responses discussed above pertain to the immigration decisions of *foreign* citizens as opposed to the emigration or return-migration decisions of *domestic* citizens. The Danish scheme allows for studying the return-migration channel, because the scheme is available to any worker — independently of citizenship — who has been a tax resident abroad for at least three years (under the initial rules) prior to claiming the scheme treatment. As shown in Table 1, Kleven *et al.* (2014) find that the mobility elasticity of Danish expatriates is extremely small. Other papers that were able to separately identify the mobility elasticities of foreigners and domestics (Kleven *et al.* 2013; Akcigit *et al.* 2016) also find much smaller elasticities for domestic workers. This difference can be explained, at least in part, by the fact that extensive margin elasticities depend on the initial base. In any country, the vast majority of workers are domestic citizens rather than foreign citizens. As a result, the elasticity of foreign immigration represents a percentage change in an initially small stock of foreigners, whereas the elasticity of domestic emigration or return-migration represents a percentage change in an initially large stock of domestics. This mechanical difference in elasticities is very important for tax policy implications, as we discuss later.

Mobility elasticities are likely to vary, not only by occupation or citizenship status, but also

[7]The fact that immigration in the sports & entertainment industry starts accellerating after four years can be explained partly by regulation in the football sector until 1995. In addition, some sluggishness in the ability of firms (such as football clubs) to take full advantage of the scheme is natural due to information and hiring/firing frictions.

across countries within the same segment of the labor force. Indeed, an important question to ask is whether mobility elasticities are large only in small countries, for the same mechanical reasons that drive the differences in elasticities between foreigners and domestic residents. Can elasticities be sizeable even for large countries that start with a large base of foreigners? Akcigit *et al.* (2016) shed light on this question. They study the effects of top tax rates on the international mobility of "superstar" inventors, i.e. those with the most and best patents. Leveraging panel data from the U.S. and European Patent Offices, they are able to track inventors over time and across countries, and to exploit the differential impact of top tax rates on inventors at different productivity and therefore income levels. They provide several country case studies, two of which are reproduced in Figure 5. Panel A considers once again the introduction of the Danish preferential tax scheme to foreigners, while Panel B considers the U.S. Tax Reform Act of 1986 which sharply reduced the top marginal income tax rate.[8] The Danish reform shows a significant effect on the share of foreign inventors in Denmark, although the mobility elasticity is smaller than that estimated by Kleven *et al.* (2014) for the full population of high-income workers.[9] Importantly, the bottom panel suggests that the Tax Reform Act of 1986 in the U.S. had a strong effect on the growth of foreign superstar inventors. In fact, the estimated mobility elasticity of top 1% superstar inventors for the US is extremely large, above 3.

In a complementary paper, Moretti & Wilson (2017) consider the mobility responses of star scientists across U.S. states — rather than across countries — over the period 1977-2010. They estimate large long-run elasticities of mobility with respect to both personal and corporate income taxes.

Are these tax-induced mobility effects only relevant for modern day economies? New historical evidence by Akcigit *et al.* (2018) shows significant effects of taxes on mobility across U.S. states. They study the effects of personal and corporate taxes over the twentieth century in the United States, using a new panel of the universe of inventors who patented since 1920; a dataset of the employment, location and patents of firms active in R&D since 1921; and a historical state-level

[8] Both panels rely on a synthetic control method, where a synthetic country is constructed as a weighted average of the other countries in the sample, in order to best fit the pre-reform time series of the treated country.

[9] Contrary to the effects on other occupations considered above, there is a lag in the effects of the reform on inventors. This can be explained by the fact that an inventor, not only has to move to Denmark, but also patent there in order to be recorded as having moved to Denmark. Note also that the elasticity here can be diluted, because the analysis lumps together inventors across all income levels, some of which are not eligible for the foreign tax scheme (income is not observable in the patent data).

corporate and personal tax database since 1900. They estimate that, over the 20th century, the elasticity of the number of inventors residing in a state equals 0.11 for inventors from that state and 1.23 for inventors not from that state. These findings are consistent with the distinction made above, in the contest of international migration, between the mobility elasticities of foreigners and domestics.

3 Mobility of Wealth

The preceding section focused on the extent to which people move across states or countries for tax reasons. It is important to note that people do not necessarily have to move themselves in order to avoid taxation. It is sufficient to move the tax base, which may be feasible in the case of capital income or wealth. In a perfectly enforced residence-based tax system, unless the individual owner changes her fiscal residence, the geographic location of capital has no impact on tax liability. However, since residence-based taxation of capital income and wealth is difficult to enforce internationally, there is in practice considerable scope for tax avoidance through geographic mobility of capital income and wealth (see e.g., Griffith *et al.* 2010). In general, we would expect capital to be more mobile than people, because it is less affected by the possibly strong and idiosyncratic preferences for specific locations.

The early empirical literature on international capital and wealth mobility relied predominantly on cross-country correlations. This body of work has been summarized by Gordon & Hines (2002) and Griffith *et al.* (2010). They argue that international tax provisions have significant effects on capital allocation, that tax avoidance through foreign investments and wealth holdings is a key threat to revenue collection and income redistribution, and that these forces have important implications for tax design.[10]

The most direct evidence on tax-related wealth mobility comes from recent work that uses creative data sources to quantify the amount of unreported wealth held in tax havens. Alstadsæter *et al.* (2018) use leaked data from HSBC Switzerland and Mossack Fonseca (the so-called "Panama Papers") linked to administrative wealth records in Scandinavian countries. They show

[10] Saez & Stantcheva (2018) derive the optimal tax rates on capital in different settings, including when capital income can be shifted abroad and there are different types of capital assets, with potentially different elasticities.

that the probability of hiding assets offshore rises sharply at the extreme tail of the wealth distribution: the top 0.01% of the wealth distribution owns about half of the leaked offshore wealth. Combining the micro data from specific leaks with estimates of the aggregate amount of offshore wealth from macroeconomic statistics (Zucman 2013), they argue that the top 0.01% evades about 25% of its tax liability by moving assets and investment income abroad. They do not estimate the response of such offshoring behavior to tax changes, but their evidence is certainly consistent with the presence of substantial tax-induced mobility of wealth by the very wealthy.

Direct evidence on behavioral responses to tax changes, but not offshoring behavior specifically, comes from an emerging literature estimating taxable wealth elasticities. One way in which taxable wealth may respond to taxes, especially at the very top of the wealth distribution, is through international mobility. As a result, this literature provides an upper bound on the size of the wealth mobility elasticity. Using a large wealth tax reform in Denmark, Jakobsen *et al.* (2019) estimate long-run elasticities of taxable wealth with respect to the net-of-tax return at the top of the wealth distribution. They find sizeable elasticities, between 0.7 and 1. Using variation in wealth taxation across Swiss cantons, Brülhart *et al.* (2017) also find large taxable wealth responses. They argue that these responses are not driven by the geographic mobility of people across cantons, but they could be affected by the mobility of reported wealth across cantons.

4 Policy Implications

What are the policy implications of mobility responses to taxes? This depends on a number of factors that we discuss in this section. A key distinction is between situations in which tax policy is uncoordinated across countries — i.e., where each country sets its tax rate without any international constraints or cooperation — and situations in which there is an element of coordination. We first consider uncoordinated tax policy and then turn to the implications of policy coordination.

4.1 Uncoordinated Tax Policy

With uncoordinated tax policy across countries, the conclusions will depend on whether there is targeted taxation of foreigners, as with the many preferential tax schemes discussed above, or a population-wide tax scheme applying to both foreign and domestic individuals. We start by

discussing targeted tax policy to foreigners.

Intuitively, if the social welfare objective of a given country depends only on its domestic residents, the optimal influx of foreigners is governed solely by the externalities they generate on the domestic residents. As a result, the optimal taxation of foreigners trades off the revenue losses from cutting taxes on immigrants against the externality gains of attracting additional immigrants. These externalities include fiscal externalities — the additional tax revenue collected due to immigration — and non-fiscal externalities such as productivity spillovers (positive) and congestion (negative). In the absence of any non-fiscal externalities, the policy prescription is particularly simple: the optimal tax rate is equal to the Laffer rate. That is, if the government does not care about the welfare of the foreigners themselves and if the only externalities they create operate through the government budget, then it is optimal to maximize the revenue collected from them (see Kleven *et al.* 2013).

These ideas can be formalized in a relatively simple manner. The theory of optimal taxation with migration responses was first analyzed by Mirrlees (1982) and reviewed by Piketty & Saez (2013) for the case without non-fiscal externalities, while the theory of welfare analysis with non-fiscal externalities was recently laid out in Kleven (2018). To simplify the analysis, let us make two assumptions. First, suppose the only behavioral response by foreigners is the migration response; labor supply conditional on moving is fixed. Second, suppose the behavior of domestic residents is independent of the external effects created by foreign immigration. Both of these assumptions are quite strong, but they provide a useful benchmark for developing intuition.

Under these assumptions, we can show that the optimal tax rate on foreigners, τ^F, is given by

$$\tau^F = \frac{1 - e^F \cdot \eta^F}{1 + \eta^F}, \tag{1}$$

where $\eta^F \equiv \frac{dN^F/N^F}{d\left(1-\tau^F\right)/\left(1-\tau^F\right)}$ is the elasticity of the stock of foreigners with respect to the net-of-tax rate, and where e^F measures the marginal non-tax externality from foreign immigration.[11] The

[11] For the technically inclined reader, the optimal tax rule in equation (1) can be derived as follows. Given the assumption of separability between the externalities from foreigners and the behavior of domestics, we define the external welfare effect of foreigners as $E^F\left(y^F N^F\right)$ where y^F denotes the average earnings of foreigners and N^F denotes the number of foreigners. The fact that we write the externality as a function of the aggregate earnings of foreigners, $Y^F \equiv y^F N^F$, as opposed to the number of foreigners is not crucial. Given foreigners are taxed separately at a flat tax rate of τ^F, the revenue collected from foreigners equals $\tau^F y^F N^F$. Denoting by μ the marginal value of government revenue, the government objective is to maximize $E^F\left(y^F N^F\right) + \mu \cdot \tau^F y^F N^F$. Absent intensive margin

elasticity parameter η^F corresponds to the estimates reported in Table 1. In the absence of non-tax externalities ($e^F = 0$), the optimal tax rule depends only on the mobility elasticity and corresponds to the well-known inverse elasticity formula for the Laffer rate. In general, the optimal tax rate on foreigners depends negatively on both their mobility elasticity and the degree to which they generate positive externalities. The foreigners targeted by the special tax schemes described above (high-income workers, researchers and scientists) are presumably considered to have especially high positive spillovers.

The result in equation (1), together with the evidence reviewed above, highlights the temptation of introducing preferential tax schemes to foreigners. For example, based on the tax scheme to foreigners in Denmark, Kleven *et al.* (2014) estimates a mobility elasticity of 1.6. An elasticity of this magnitude implies a Laffer rate on foreigners of only 38%. While this is higher than the scheme income tax rate, it is *lower* than the total top marginal tax rate when accounting for social security taxes and value-added taxes (see Figure 2). Therefore, despite its apparent generosity, the Danish scheme may be beyond the Laffer point. If we believe that top-earning foreigners coming to Denmark generate other postive externalities, then the optimal tax rate is even lower. In fact, the Danish tax scheme was originally motivated, not primarily by fiscal externalities and the Laffer logic, but by concerns about "brain drain" and the importance of high-skilled labor for economic growth and competitiveness. Our estimates imply that the fiscal externalities alone could justify the scheme.

While these arguments would seem to justify the use of preferential tax schemes to foreigners, a number of important qualifications should be emphasized. First, because mobility elasticities are not structural parameters, they may vary widely across countries and time periods. In particular, mobility elasticities depend mechanically on the size of the tax jurisdiction. This is due to both baseline effects (a small jurisdiction has a small base N^F, making η^F larger) and moving cost effects (it is less costly to move out of a small jurisdiction, making η^F larger). As the size of

responses (y^F is fixed), this yields the first-order condition for τ^F equal to

$$\frac{\partial E^F}{\partial Y^F} dN^F + \mu \left[d\tau^F N^F + \tau^F dN^F \right] = 0.$$

Defining the mobility elasticity as $\eta^F \equiv \frac{dN^F/N^F}{d\left(1-\tau^F\right)/\left(1-\tau^F\right)}$ and the marginal externality effect in terms of the marginal value of government revenue as $e^F \equiv \frac{\partial E^F/\partial Y^F}{\mu}$, we obtain the optimal tax rule in equation (1).

a jurisdiction becomes infinitesimal, the mobility elasticity goes to infinity. Conversely, as the the size of the jurisdiction approaches the global economy, the mobility elasticity goes to zero. Consistent with these conceptual ideas, the recent evidence showing large mobility responses is based predominantly on small tax jurisdictions (Denmark, Spanish regions, Swiss cantons, and US states). As a result, the incentive to offer low taxes to foreigners is stronger in small countries such as Denmark than in large countries such as the US.[12] By the same logic, the incentive to offer low taxes is stronger in subnational tax jurisdictions (a municipality or a state) than in a nation as a whole. The mechanical relationship between mobility elasticities and jurisdictional size can explain why tax havens tend to be small countries (see Kanbur & Keen 1993).

Second, we have characterized the optimal tax policy of a given country not accounting for the welfare impact on other countries. The optimal policy maximizes the net positive externality for the country in question, but this is essentially a zero-sum game: a positive externality due to foreign immigration in one country represents a negative externality due to emigration in other countries. While the externalities do not have to be symmetric (so that the game is not exactly zero-sum), these a certainly beggar-thy-neighbor policies done at the expense of other countries. Moreover, in the case of special tax schemes targeted to foreign residents — unlike broader tax setting and public goods provision — there is no clear Tiebout-sorting argument to justify the policy.

Third, the tax policy characterized above takes the policies of other countries as given. As analyzed in the literature on tax competition (see e.g., Keen & Konrad 2013), when one country lowers its tax rate, other countries have an incentive to lower their tax rate too. This could lead to a race to the bottom. While it is difficult to identify such tax competition effects empirically, the descriptive evidence on tax rates presented above is suggestive. Considering the tax rate series in Figure 2, we note that there is no clear indication of a race to the bottom. Following an international trend of reducing top marginal tax rates around the 1980s, tax rates have remained relatively flat for the last two-three decades. Some countries have introduced special tax schemes to foreigners, but there is no evidence of any broad-scaled retaliation or race to the bottom.[13] Still, it is interesting that almost all of the Northern European countries have now introduced some version of a special

[12] As shown by equation (1), a potentially offsetting effect is that negative congestion externalities (captured by $e^F < 0$) are likely to be stronger in small countries.

[13] This might be because these schemes have been introduced mostly in high-tax countries and are therefore perceived as leveling the playing field rather than creating an unfair tax advantage.

tax scheme to foreigners. This provides prima facie evidence of tax competition between similar countries located in close proximity.

Finally, the policy implications change drastically if, instead of targeted taxation of foreigners, we consider uniform taxation of foreigners and domestic residents. Under the simplifying assumption that migration is the only behavioral response, the Laffer rate in an undifferentiated tax system equals $1/(1+\eta)$ where η is the average mobility elasticity on all residents. Because domestic residents constitute the vast majority of the population in most countries, η is approximately equal to the mobility elasticity of domestic residents. As shown in Table 1, this elasticity is very close to zero and therefore the Laffer rate is very close to 1. Of course, there might be intensive margin responses that lower the Laffer rate, but the key point here is that mobility responses across countries are not important for tax policy design unless the tax system targets foreign citizenship. This is not necessarily true of mobility responses across tax jurisdictions within countries (e.g., US states or Swiss cantons) where the relevant mobility elasticity may be considerably larger.

4.2 Coordinated Tax Policy

Uncoordinated tax policy has many costs in the aggregate as each fiscal authority ignores the externalities on the other fiscal authorities (e.g., Gordon 1983). Despite these costs, a broadly coordinated tax policy is unlikely to materialize in the near future even in otherwise integrated areas such as the EU, because fiscal policy is considered a matter of national sovereignty and because the potential gains from international tax coordination may be unevenly spread (Griffith *et al.* 2010).

The issue of coordinated tax policy encompasses two main aspects. The first aspect concerns the level at which such coordination can happen. This leads to the question of the optimal size of tax jurisdictions, e.g. a collection of countries (such as the EU) or a collection of states within a country (such as the United States) that coordinate their tax policy. The second aspect concerns what parts of fiscal policy are coordinated and to what degree.

On the first issue, a literature on fiscal federalism has studied the efficiency trade-offs associated with jurisdictional size (Oates 1972, 1999). Smaller jurisdictions, as discussed above, will face larger migration elasticities and thus be more constrained in their choice of fiscal policy. They will

have an incentive to lower tax rates (e.g., through special foreigner tax schemes). On the other hand, larger jurisdictions will be less able to cater to the diverse preferences for public goods and services among their residents. Diversity of policies, which may be valuable, could be lost. As a result, there is a trade-off between the inefficiencies from tax competition and the inefficiencies from public goods provision.[14] There may also be political economy frictions and transactions costs from administering large jurisdictions, which limit the ability of many countries to coordinate their tax policies.[15]

Regarding the type and degree of coordination, a conceptual distinction is between situations where jurisdictions are contrained to set uniform policies and situations where they can — in a coordinated fashion — target taxes, transfers, and public goods to the local preferences of each jurisdiction. In the U.S., the federal government shoulders the bulk of progressive taxation, but states and municipalities have additional taxes, transfers and public goods available to cater to their residents. To provide a simple formalization of the conceptual ideas, consider a central tax authority such as a federal government or a supernational authority who sets tax policy in two regions, which we denote by A and B. To begin with, suppose the tax authority can set different tax rates in the two regions, τ^A and τ^B.[16] For simplification, assume that migration responses are the only behavioral responses to taxation, as we did in the previous section, and that any non-fiscal externalities are zero-sum across the two regions. Consider the optimal tax rate in region A. To characterize it, we define two migration elasticities: η^A is the (positive) elasticity of migration in region A with respect to the net-of-tax rate in that region, while η_A^B is the (negative) elasticity of migration in region B to the net-of-tax rate in region A. With this notation, it is possible to show that

$$\tau^A = \frac{1 - g^A - \tau^B \cdot \eta_A^B \cdot y^B / y^A}{1 - g^A + \eta^A}, \tag{2}$$

[14]There are other challenges from having large jurisdictions. Alesina *et al.* (2018) show that there is an aversion to redistributing to immigrants in the EU and the U.S., which can limit the ability to set progressive tax policy in a large and ethnically diverse jurisdiction.

[15]There is also a small literature on the optimal size of countries more generally (Alesina & Spolaore 1997), which highlights the trade-offs between the efficiencies and inefficiencies from size. The trade-offs determining the optimal country size are between economies of scale from size (of which a reduced migration elasticity is a special case) and the gains from a diversity of policies adapted to residents' heterogeneous preferences.

[16]We will assume that the aggregate tax revenue is rebated in a lump-sum fashion to all residents in the two regions. This assumption can easily be relaxed.

where g^A is the average, income-weighted value to the social planner of transferring one dollar of income to people in region A, while y^A and y^B denote aggregate incomes in the two regions.[17] The formula for τ^B is symmetric.

This formula highlights the main distinctions relative to the uncoordinated policy setting considered in the preceding section. First, any non-fiscal externalities are internalized by the central tax authority, which no longer tries to implement beggar-thy-neighbor policies to benefit one region at the expense of the other. If these externalities are zero-sum, as assumed here, they drop out of the optimal tax formula entirely. Second, the central tax authority also internalizes the fiscal externalities that occur when people move between the two regions. This fiscal externality appears in the last term of the numerator and depends on the (negative) cross-elasticity of migration between the two regions and on the level of taxes in the other region. This term makes taxes higher in both regions, all else being equal. Finally, the formula illustrates why it is valuable to differentiate policies across regions. Regions with more inequality or with more strongly redistributive preferences, as captured by a lower social welfare weight g^A, will prefer more progressive tax and transfer systems. However, the degree of progressivity and tax diversity is limited by the mobility of people across regions within the fiscal union (as captured by η_A^B) as well as by the mobility out of the fiscal union as a whole (as captured by η^A).

The elasticity for region A would be smaller if (i) the region is larger (as discussed above); (ii) if there is more tax coordination with jurisdictions that do not operate under the same fiscal authority; and (iii) if mobility is lower due to non-tax factors such as preferences and other policies. As

[17] This formula is derived as follows. Conditional on moving to region A or B, person i has heterogeneous, but exogenously given income y_i^A or y_i^B . The total income in each region is then $y^A \equiv \sum_{i\in A} y_i^A$ and $y^B \equiv \sum_{i\in B} y_i^B$. As people can freely migrate, the income in each region is a function of both net-of-tax rates, i.e., $y^A = y^A(1-\tau^A, 1-\tau^B)$ and $y^B = y^B(1-\tau^A, 1-\tau^B)$. The central authority rebates the total tax revenues in a lump-sum fashion to all residents of the jurisdiction (this assumption can easily be relaxed). Thus, the consumption of agent i in region A under this tax system is $c_i^A = y_i^A(1-\tau^A) + \tau^A y^A + \tau^B y^B$. People can have idiosyncratic preferences over the regions. g_i is the marginal social welfare weight on agent i to be interpreted as a generalized social welfare weight as in Saez & Stantcheva (2016). Let us consider the effects of a small change in the tax rate τ^A, $d\tau^A$. First, this reduces each agent's income by $y_i^A d\tau^A$, which costs $-g_i y_i^A d\tau^A$ in terms of social welfare. Aggregating across all agents, the total effect is $-\sum_{i\in A} g_i y_i^A d\tau^A$. In addition, the mechanical effect on revenues (without agents moving regions) equals $\sum_i g_i y^A d\tau^A$. Since people also move regions following the tax change, there is an additional revenue effect, equal to $-\sum_i g_i \left(\tau^A \frac{dy^A}{d(1-\tau^A)} + \tau^B \frac{dy^B}{d(1-\tau^A)}\right) d\tau^A$. Let $\eta^A \equiv \frac{dy^A/y^A}{d(1-\tau^A)/(1-\tau^A)} > 0$ be the elasticity of income in region A to the net-of-tax rate $1-\tau^A$ in the region and $\eta_A^B \equiv \frac{dy^B/y^B}{d(1-\tau^A)/(1-\tau^A)} < 0$ be the cross-elasticity of income in region B to the net-of-tax rate $1-\tau^A$ in region A. $g^A \equiv \frac{\sum_{i\in A} g_i y_i^A}{\sum_i g_i y^A}$ is the average, income-weighted welfare weight in region A. Setting the three effects to zero, rearranging, and using the definitions in the text yields formula (2).

for the latter, regulatory policies such as visa requirements and work permits, or transfer policies such as eligibility for welfare benefits and social insurance may be important. Several countries, including France, Spain and the U.S., also impose exit or expatriation taxes for residents who decide to leave, which can be viewed as another way of trying to reduce the migration elasticity of domestic residents. Mobility responses to taxes will depend crucially on the local amenities of a region, on the public goods and services provided, and on agglomeration effects. All these forces also shape the within-jurisdiction cross-elasticity η_A^B and are plausibly even stronger within jurisdictions. Regions which are more similar in terms of amenities and thus more closely substitutable, will face higher cross-elasticities and will have to set more similar tax rates than in a world without people and income mobility.

If policies are instead constrained to be uniform across the two regions within the jurisdiction, then $\tau^A = \tau^B = \frac{1-g}{1-g+\eta}$ where η is the elasticity of migration in the two regions as a whole and where g is the average, income-weighted social welfare weight in the jurisdiction as a whole. The ability to differentiate policies and adapt them to local conditions is thus lost.

As discussed above, when considering tax policy setting across independent jurisdictions (states or countries), prima facie, we do not see a race to the bottom. This suggests that some implicit coordination is taking place, perhaps because of a fear of retaliation along the tax policy or other margins. On the other hand, the preferential tax schemes to foreigners implemented in several countries present a slippery slope towards beggar-thy-neighbor policies. Getting rid of such schemes would be a limited form of policy coordination that seems desirable and potentially feasible. Partial coordination which internalizes some, even if not all, of the welfare gains from full coordination is an intermediate solution and already exists between state and local jurisdictions in the U.S. and other countries. Examples include revenue sharing and matching or categorical grants, partially centralized provision of public goods, central tax deductibility of local government taxes, or regulations of what sort of taxes and tax bases local governments can use (e.g., Gordon 1983).

5 Conclusion

There is growing evidence that taxes can affect the geographic location of people both within and across countries. This migration channel creates another efficiency cost of taxation that policy

makers need to contend with when setting tax policy. At the same time, we have cautioned against over-using these empirical findings to argue in favor of an ineluctable reduction in the level of taxation or progressivity. Let us reiterate two key caveats.

First, while the mobility responses documented in some of the recent literature are striking and perhaps surprisingly large, they pertain to specific groups of people and to specific countries. Although we are far from having to rely on the celebrity anecdotes presented in the introduction, data limitations and identification challenges have forced researchers to study the migration flows in specific countries (e.g., Denmark) or to focus on specific population internationally (e.g., superstar football players or inventors). We are still lacking systematic evidence on the mobility elasticities of the broader population and across different types of countries.

Second, the strength of the mobility response to taxes is not an exogenous, structural entity. It depends critically on the size of the tax jurisdiction, the extent of international or sub-national tax coordination, and the prevalence of other forces that foster or limit the movement of people, all of which can also be affected by policies. These forces include local or national amenities, agglomeration effects, and the provision of public goods and services. Rather than compromising redistribution or restraining free mobility in an inefficient way, these can, in a productive way, be fostered to make the country or state attractive to people.

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Table 1: **Summary of Empirical Literature on Migration Responses to Personal Income Taxes**

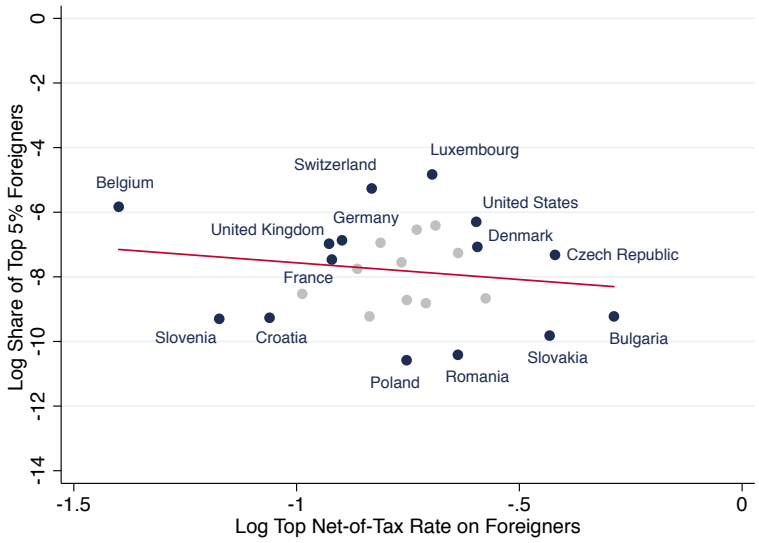
Citation	Countries	Time Period	Population	Tax Variation	Main Result	Preferred Mobility Elasticity
Agrawal & Foremny (2018)	Spain	2005-2014	Top 1% of population	Variation across Spanish regions over time	Top taxpayers are strongly mobile within Spain	.85
Akcigit *et al.* (2016)	8 OECD countries	1977-2000	Top 1% of inventors	Variation across/within countries over time	Top foreign inventors are strongly mobile internationally	Foreigners = 1 Domestics = .03
Akcigit *et al.* (2018)	8 U.S states	1940-2000	All Inventors	Variation across/within states over time	Inventors' strongly mobile within the US	Out-of-state = 1.23 In-state = .11
Feldstein & Wrobel (1998)	USA	1983/1989	Sample of full-time workers	Variation across US states	Wage changes fully offset tax changes across US states	∞
Kleven *et al.* (2013)	14 European countries	1995-2008	Top football players	Variation across/within countries over time	Top foreign footballers are strongly mobile internationally	Foreigners = 1 Domestics = .15
Kleven *et al.* (2014)	Denmark	1991-2008	Immigrants in the top 1%	Variation by earnings within country over time	Top foreign earners are strongly mobile in Denmark	Foreigners = 1.6 Domestics = .02
Liebig *et al.* (2007)	Switzerland	2001-2010	Population aged 21-64	Variation across Swiss municipalities over time	College graduates and foreigners are mobile within Switzerland	N/A
Martinez (2017)	Switzerland	1995-2000	Top 1% in canton of Obwalden	Variation across Swiss cantons over time	Rich taxpayers are strongly mobile within Switzerland	2.0
Moretti & Wilson (2017)	USA	1976-2010	Top 5% of inventors	Variation across US states over time	Top inventors' are strongly mobile across US states	1.8
Schmidheiny (2006)	Switzerland	1997	Households in and around Basel	Variation across Swiss municipalities	Rich households more likely to move to low-tax municipalities	N/A
Schmidheiny & Slotwinski (2018)	Switzerland	2001-2013	Foreigners below earnings treshold	Variation from duration threshold in tax scheme	Top earners are strongly mobile within Switzerland	N/A
Young *et al.* (2016)	USA	1999-2011	Millionaires	Variation across US states	Millionaires only moderately mobile within the US	0.1

Table 2: **Summary of Preferential Tax Schemes to Foreigners**

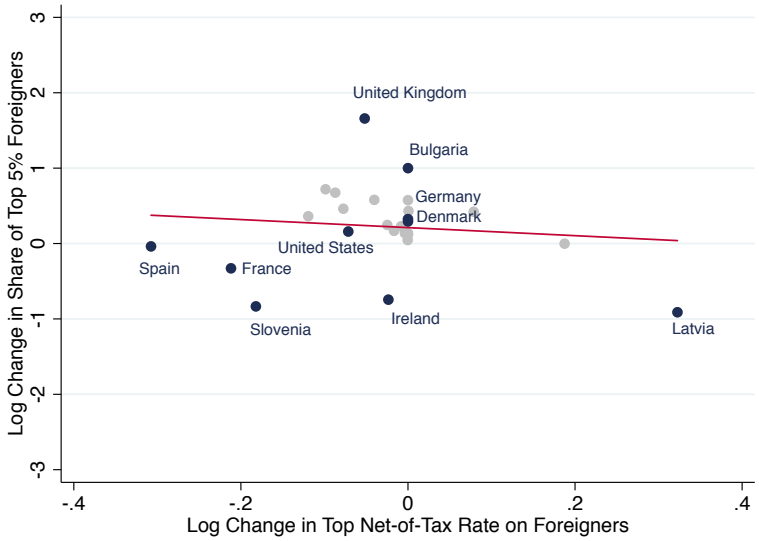
Country	Name of Scheme	Year of Implementation	Income Eligibility Criterion	Duration of Scheme	Preferential Tax Treatment
Denmark	Researchers' Tax Scheme	1991	Income above a threshold, or researcher status	3 years originally, now extended to 7 years	Flat income tax of 30% originally, now 27%
Finland	Foreign Key Employees' Scheme	1999	Income above a threshold	2 years	Flat income tax of 35%
France	Impatriates' Tax Scheme	2004	None	5 years originally, now extended to 8 years	30% of taxable income is tax exempt
Italy	Inbound Regime	2011	None	5 years	30% of taxable income was exempt originally, now 50%
Netherlands	35% Ruling	1985	Income above a threshold	5 years originally, now extended to 10 years	35% of taxable income was exempt originally, now 30%
Portugal	Non-Habitual Residents' Status	2009	None	10 years	Flat income tax of 20%
Spain	"Beckham Law"	2005	None until 2009, then income below a threshold	6 years	Flat income tax of 24%
Sweden	The Expert Tax	2001	Income above a threshold, or expert status	3 years	25% of taxable income is tax exempt

Figure 1: **Cross-Country Evidence on Mobility Responses at the Top**

A. Top 5% Foreigners vs Top Net-of-Tax Rates (Levels)

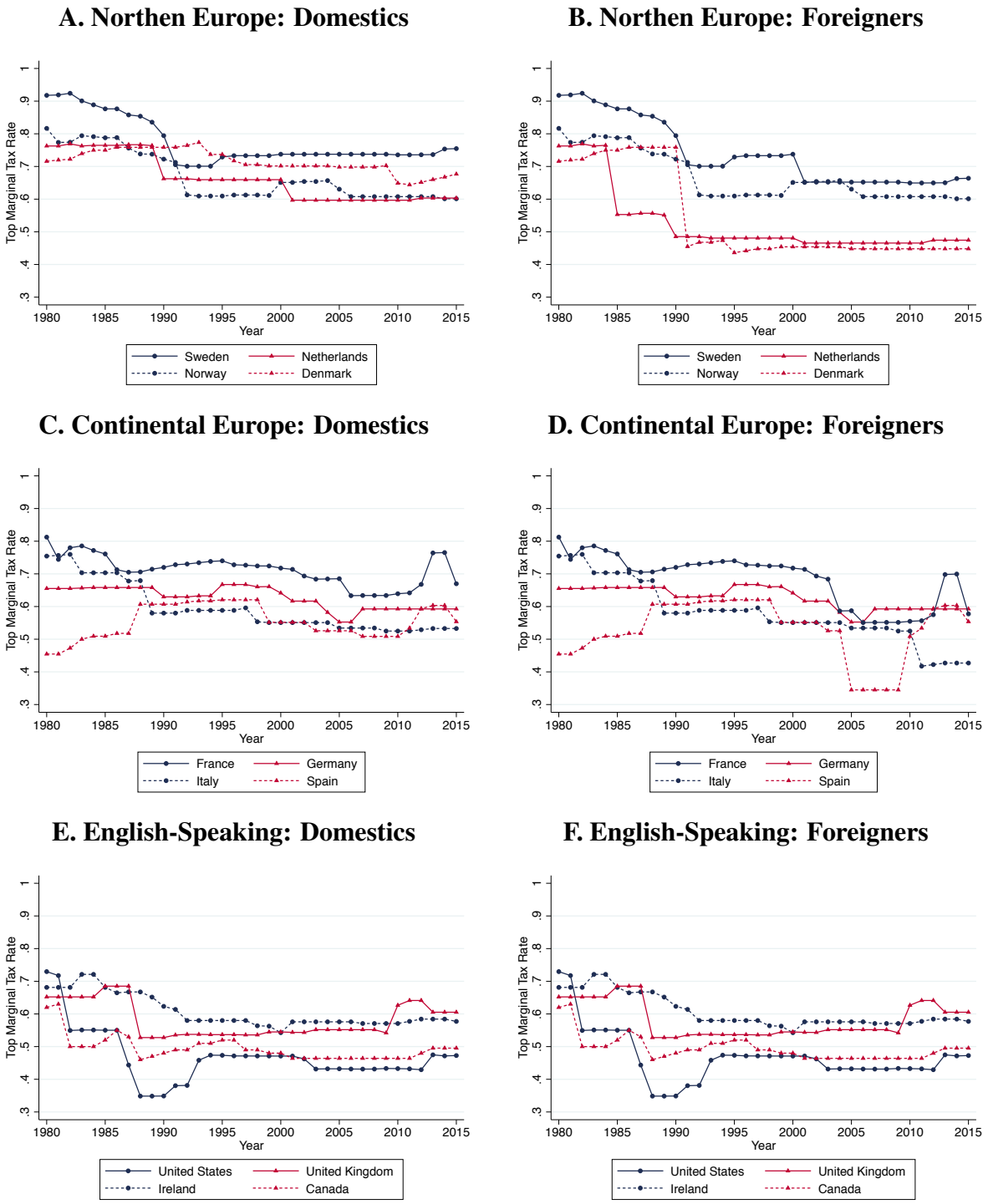


B. Top 5% Foreigners vs Top Net-of-Tax Rates (First Differences)



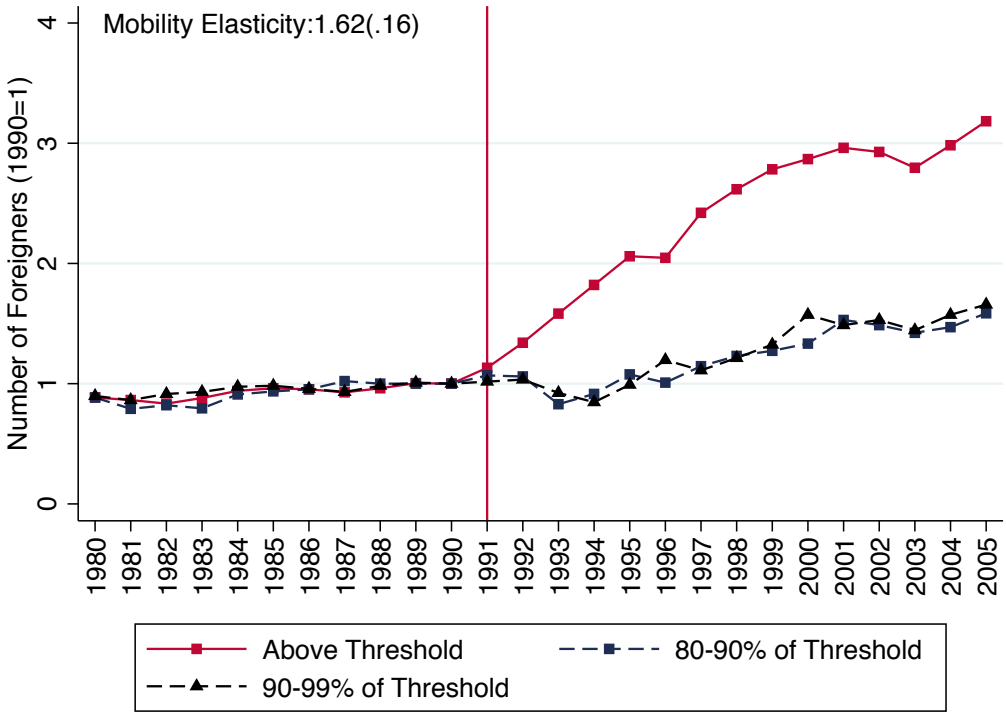
Notes: The figure shows cross-country correlations between log shares of top earning foreigners and log top marginal net-of-tax rate on earnings, for 25 European countries plus the United States. Shares of top earning foreigners are computed from the EU-Labor Force Survey, and the Current Population Survey for the U.S, and defined as the number of foreigners who have earnings in the top 5% of the distribution divided by the total population of domestic residents. The top marginal net-of-tax rate on earnings accounts for personal income taxes, uncapped payroll contributions and consumption taxes. Panel A plots the average log share of top foreigners over the period 2009 to 2015 against the average log top marginal net-of-tax rate on earnings for foreign residents over the same period. Panel B plots the same correlation but in first-difference, focusing on variation between 2015 and 2009. See text and Online Data Appendix for details.

Figure 2: **Top Marginal Tax Rates on Earnings 1980-2015**



Notes: The figure depicts the evolution of top marginal tax rates (MTRs) on earnings in 12 OECD countries from 1980 to 2015. Our measure of top MTRs includes top income tax rates, uncapped employer and employee payroll taxes, and consumption taxes. Top MTRs on foreigners also account for the provisions of foreigners' tax schemes summarized in Table 2. See Online Appendix A for details.

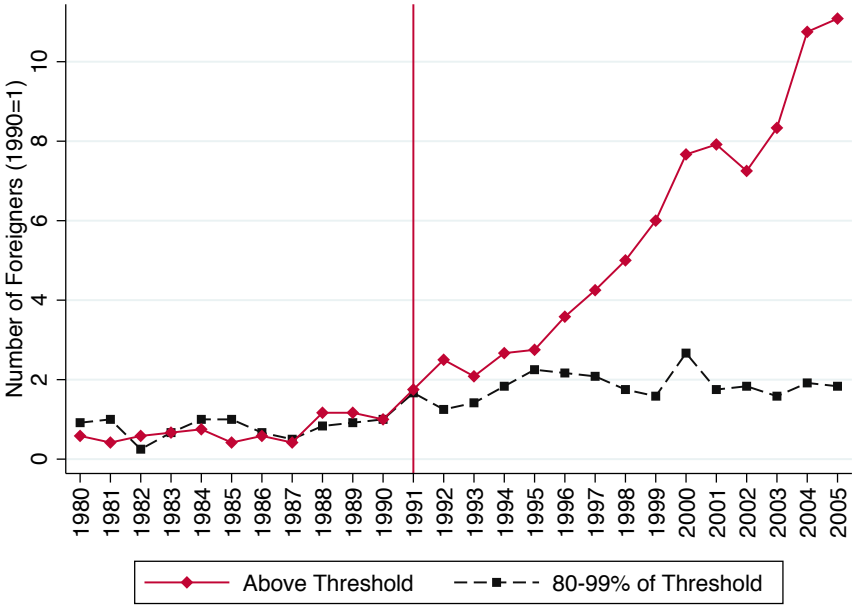
Figure 3: **Migration Effects of the Danish Tax Scheme**



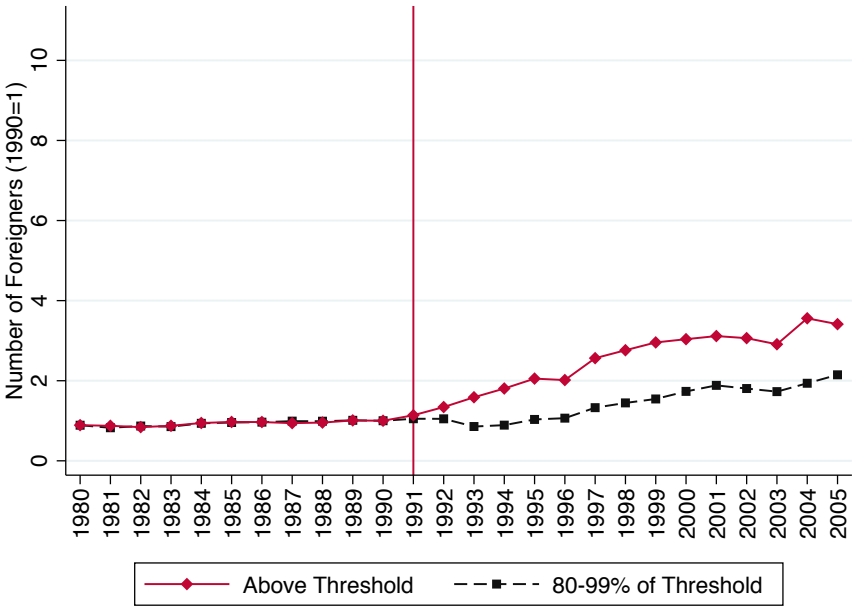
Notes: Originally produced by Kleven *et al.* (2014). The 1992 Danish tax reform, represented by a red vertical line, introduced a preferential tax scheme for foreign workers with earnings above an eligibility threshold, arriving in Denmark in or after 1991. The figure reports the evolution of the number of foreigners with earnings above the eligibility threshold from 1980 to 2005. It also reports the evolution of the number of foreigners in two control groups: individuals with earnings between 80% and 90% of the threshold and those with earnings between 90% and 99% of the threshold. All series are normalized to one in 1990 and numbers are weighted by duration of stay during the year for part-year foreign residents.

Figure 4: **Migration Effects of the Danish Tax Scheme by Industry**

A. Foreigners in Sports & Entertainment

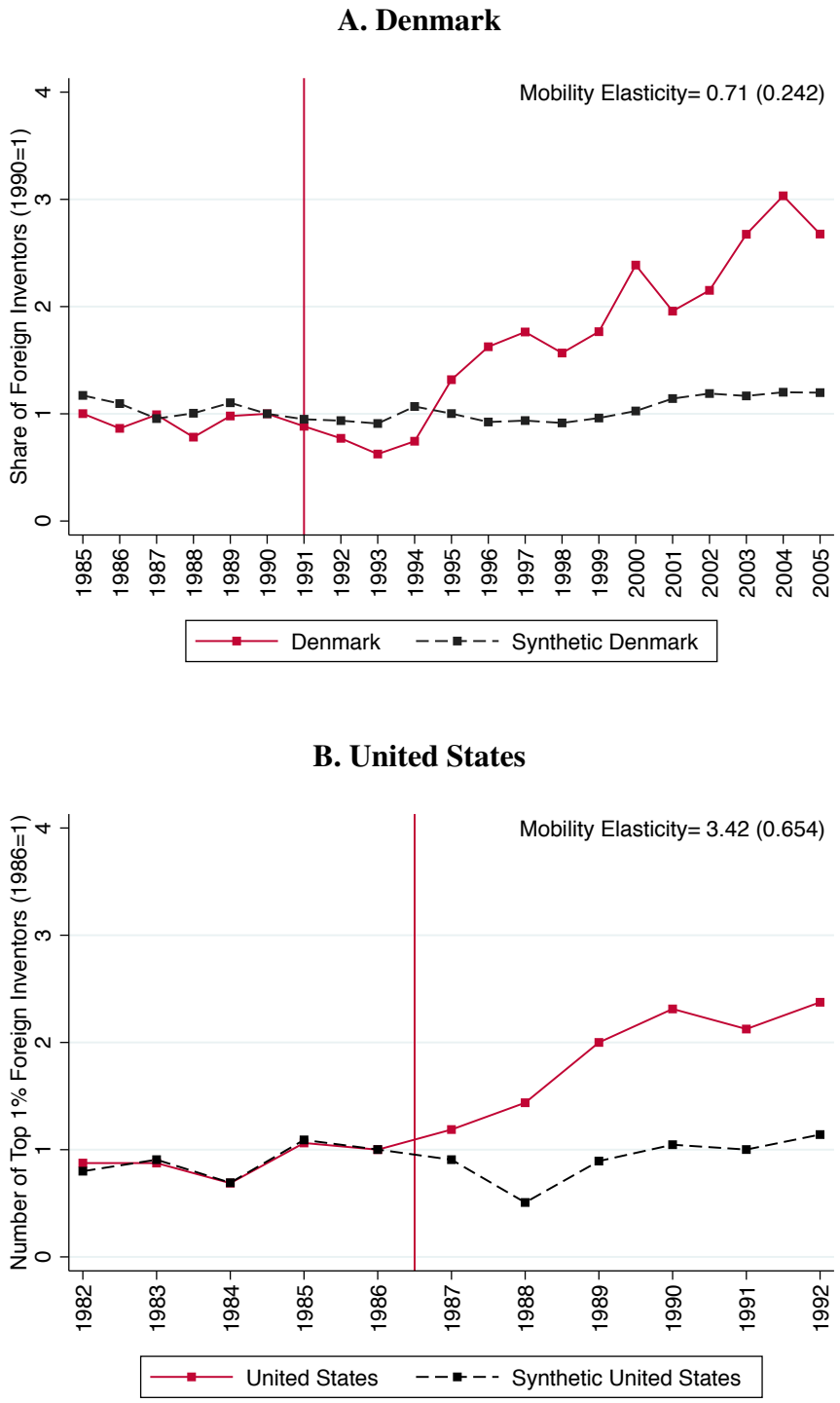


B. Foreigners In All Other Industries



Notes: Originally produced by Kleven *et al.* (2013). The 1992 Danish tax reform, represented by a red vertical line, introduced a preferential tax scheme for foreign workers with earnings above an eligibility threshold, arriving in Denmark in or after 1991. The figure reports the evolution of the number of foreigners with earnings above the eligibility threshold separately for the sports and entertainment sector (Panel A) and all other industries (Panel B). In each panel, we also report the evolution of the number of foreigners in a control group of individuals with earnings between 80% and 99% of the threshold. All series are normalized to one in 1990 and numbers are weighted by duration of stay during the year for part-year foreign residents.

Figure 5: **Migration Responses by Inventors**



Notes: Originally produced by Akcigit *et al.* (2016). The figure shows inventors' migration response to two major tax reforms in Denmark and the United States. Panel A focuses on the 1992 Danish reform, which introduced a preferential tax scheme for foreign workers with earnings above an eligibility threshold, arriving in Denmark in or after 1991. The panel depicts the evolution of the share of foreign inventors, normalized to 1 in 1990, in Denmark and in a synthetic control country, constructed as a weighted average of all other countries in the sample, in order to best match the pre-reform series for Denmark. Panel B focuses on the 1986 Tax Reform Act, which lowered top marginal income tax rates in the US. The panel shows the number of foreign inventors belonging to the top 1% of the distribution of citation-weighted patents in the US, and in a synthetic control country. Both series are normalized to 1 in 1986.

Online Data Appendix

A Data Construction

A.1 Top Marginal Tax Rates

Top marginal tax rates series were initially computed by Kleven *et al.* (2013) and Piketty *et al.* (2014). We expand the time period of these historical series until 2015 for the following 15 countries: Canada, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. We further compute novel top marginal tax rates series from 2009-2015 for 15 additional countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Luxembourg, Poland, Romania, Slovakia, and Slovenia, following the same methodology as described below.

Individual Income Taxes For the individual income tax components of the top marginal tax rate, we use the top statutory marginal tax rate, taking into account exemptions and deductions rules. For countries which have a local income tax rate, we use the representative average local top marginal income tax rate. The main sources used are the OECD (annual) *Taxing wages* publications since 1980 and the PriceWaterhouseCoopers (annual): *Worldwide Tax Summaries*. As tax rules may be complex, we supplement these sources with specific country-level data obtained directly from domestic sources to cross-check our final measures of top income tax rates. We further use country-level sources to take into account specific tax schemes for foreigners, that are summarized in Table 2 of the paper. When the preferential scheme is a flat tax rate for foreigners, we use this flat rate as our measure of the top marginal income tax rate for foreigners. If the preferential regime takes the form of a tax exemption that is proportional to taxable income, we compute the top personal income tax rate for foreigners as the regular top marginal income tax rate reduced proportionally by the tax exemption rate.

Payroll Taxes Our top marginal tax rates account for *uncapped* social security contributions and payroll taxes at both the employer and employee level. The main sources used are the OECD (annual) *Taxing wages*, PriceWaterhouseCoopers (annual): *Worldwide Tax Summaries,* and country-

level specific data from social security administrations.

Consumption Taxes We also include VAT rates in our computation, using the standard VAT rate that applies to the broader set of goods. The main source we used is OECD (annual) *Consumption tax trends* and the European Commission (2009): *Taux de TVA appliqués dans les Etats membres de la Communauté européenne*. For the US, we used average sales tax rates.

Top Marginal Tax Rates We combine the top personal income tax rate τ_i, the payroll tax rates on employees (workers) and employers (firms) τ_{pw} and τ_{pf}, and the VAT (or sales tax) rates τ_c in order to obtain our final measure of the top marginal tax rate τ. This measure captures the total tax wedge: when the employer increases labor costs by 1 dollar, the employee can increase consumption by $1-\tau$ dollars. The formula for $1-\tau$ is given by

$$1-\tau = \frac{(1-\tau_i)(1-\tau_{pw})}{(1+\tau_c)(1+\tau_{pf})}$$

Note that this formula has been written for the standard case where the employer's and employee's payroll taxes are both based on gross earnings, and where the income tax rate applies to earnings net of all payroll taxes. When this is not the case, we have adapted our computations to capture precisely country-specific rules.

Foreigners' Tax Schemes We collected information on foreigners' tax schemes since 1980 in OECD countries, using various national level sources and individual countries' tax codes. Additional information on the foreigners' tax schemes can be found in the following country-specific sources

- Italy:

https://www.altalex.com/documents/leggi/

- France:

http://www11.minefi.gouv.fr/boi/boi2005/5fppub/textes/5f1205/5f1205.htm

- Netherlands:

http://www.voorbij-partners.com/pagina.asp?pid=16&l=end

- Spain:

https://www.boe.es/buscar/doc.php?id=BOE-A-2005-9875

- Sweden:

https://forskarskattenamnden.se/andrasprak/taxationofresearchworkersboard/

- Finland:

https://www.vero.fi/en/individuals/tax-cards-and-tax-returns/arriving_in_finland/work_in_finland/

- Denmark:

https://skat.dk/

- Portugal:

https://www.pwc.pt/pt/fiscalidade/2017/pwc-non-habitual-tax-residents.pdf

A.2 Cross-Country Analysis

In order to conduct the cross-country analysis presented in Figure 1 of the paper, we combine our top marginal tax rates series with shares of foreigners in the top 5% of the income distribution. We do this for 25 European countries during the period 2009-2015. These European countries' shares were originally computed by Muñoz (2019); the share of top 5% foreigners in the United States were computed using the Current Population Survey (CPS) for the same period. We describe each computation in more detail next.

A.2.1 European Series

The shares of foreign top earners are computed using the European Labor Force Survey (EU-LFS).[18] The EU-LFS is the largest European survey providing annual micro data on the labour

[18] https://ec.europa.eu/eurostat/fr/web/microdata/european-union-labour-force-survey

participation of people aged 15 and more, in and outside the labour force. It is conducted every year in 33 participating countries: the 28 members of the Union, the three EFTA countries (Switzerland, Norway, and Iceland) and two candidate countries (former Republic of Macedonia and Turkey). It is designed as a continuous quarterly survey since 2004, with interviews spread uniformly over all weeks of a quarter. The participation in the EU-LFS for surveyed individuals is compulsory for fourteen of the participating countries. On average, the achieved sampling rate in the EU-LFS is approximately 0.3% of the total European population.[19] Surveys are implemented by National Statistics Institutes, and aggregated by Eurostat, which also corrects for non-responses and applies yearly weighting methods. This allows to use the survey at the yearly level and to conduct cross-country comparisons.

To build the share of foreign top earners in the overall population, we use the information on citizenship and income provided by the EU-LFS.[20] The information on individuals' nationality is available since 1995, and allows us to select non-citizens, that we define as "foreigners."[21] The EU-LFS also provides the decile of labor earnings for surveyed earners since 2009. Information on the level of earners' monthly labor earnings is collected during the interview, but is not provided in the micro-data. The LFS instead directly provides the income decile of each earner.[22] Importantly, this decile is based on labor income only, and does not take into account any other source of income, such as capital income.[23]

To go at a finer level than the top 10%, we proceed to a matching on characteristics and build an imputed measure of income, using the European Survey on Income and Living Conditions (EU-SILC). The EU-SILC is a detailed individual-level annual European survey that gives precise information on various sources of income, such as monthly labor earnings, gross household income, and capital income and wealth taxes for the period 2005-2015. The main advantage of

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

[20] The EU-LFS also provides information on individuals' country of birth, which could also have been used for the exercise. However, this information is not available for all European countries (e.g., it is missing for Germany). Thus, we chose to define "foreigners" based on citizenship rather than country of birth.

[21] People with dual citizenships will also be counted as citizens.

[22] Norway and Sweden did not provide the information on decile of income and we are therefore unable to include them in our analysis.

[23] 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 taxes and National Insurance Contributions. It includes regular overtime pay, extra compensation for shift work, seniority bonuses, regular travel allowances and per diem allowances, tips and commissions, and compensation for meals.

the EU-SILC dataset is that it shares a large set of common variables with the EU-LFS, and that these covariates are coded and defined in exactly the same way in the two surveys. We take advantage of this common set of covariates to perform an exact matching on characteristics within the EU-LFS top decile of the income distribution. We match individuals according to their gender, age, country of residence, country of birth, marital status, ISCED education level, number of hours worked by week, the size of the firm where they work, and an indicator variable if they have a managerial position. We use the imputed measure of gross earnings to define the top 5% of the income distribution within the top 10% selected by the EU-LFS. We also restrict our analysis to individuals whose are between 18 and 62 years old. We compute the share of top 5% foreigners as the share of non-citizen earners aged 18-62 who fall in the top 5 percent of the labor earnings distribution of their residence country, relative to the overall population of individuals aged 18-62 of their residence country. The final result is a series from 2009 to 2015 of the share of top 5% foreigners for 25 European countries: Austria, Belgium, Bulgaria, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, and the United Kingdom.

United States Series

We complement our series on the shares of top 5% foreigners in these 25 European countries with a series of the share of top 5% foreigners in the US. We use the March supplement of the Current Population Survey (CPS ASEC sample), that provides yearly information on individuals' income and citizenship, with supplemental data on poverty, geographic mobility/migration, and work experience. The ASEC data therefore allows to obtain cross-sectional yearly information on foreigners' stocks and incomes that are comparable to the European data. To be consistent with the series built from the EU-LFS, we define foreigners as non-citizens. We further use the information on wage earnings to select the top five percent earners, among those of ages between 18 and 62. We compute the share of top five percent foreigners as the share of non citizen earners aged 18-62 who fall in the top five percent of the labor earnings distribution, relative to the overall population of individuals aged 18-62.

B Supplementary Table

Table B.I: **Migration Rates and Foreigners' Stocks At the Top of the Earnings Distribution**

Country	Migration Rates (%)		Foreigners' Stocks (%)	
	Top 10%	Top 5%	Top 10%	Top 5%
Austria	.31	.16	6.4	3.4
Belgium	1.1	.87	14	11
Bulgaria	.36	.59	.30	.56
Croatia	1.3	-	.31	.64
Czech Republic	.30	.43	2.1	2.5
Denmark	.43	.41	4.9	3.0
Estonia	.75	.58	6.7	5.0
France	.45	.30	3.9	2.4
Finland	-	-	1.3	.83
Germany	.45	.21	5.4	4.6
Hungary	.39	.27	.81	.57
Italy	.04	.04	2.3	.88
Ireland	-	-	12	9.5
Latvia	.65	.37	7.8	7.2
Lithuania	.33	.28	.71	.66
Luxembourg	2.4	2.2	54	43
Netherlands	-	-	2.3	2.8
Poland	.14	.12	.33	.15
Portugal	.30	.29	1.3	.82
Romania	.06	.03	.18	.16
Slovakia	.51	.32	.78	.79
Slovenia	.10	.31	.49	.37
Spain	.12	.11	3.9	2.5
Switzerland	2.3	1.5	26	19
United Kingdom	1.5	.93	11	8.7
United States	.26	.26	5.7	5.6

Notes: This table shows average migration rates and foreigners' stocks in the top 5% and the top 10% of the earnings distribution over the period 2009-2015, using data from the EU-LFS, and the CPS for the United States. The migration rate is the share of individuals that changed their country of residence relative to the previous year. The foreigners' stock is the share of non-citizens within the top five percent (respectively top ten percent). Finland, Ireland, and the Netherlands did not provide information on previous residence. It was not possible to impute the top 5% of the earnings distribution in Croatia due to data constraints. See Appendix A for details.