

Income Taxation: A Cross-Country Comparison*

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Abstract

This paper studies income taxes for over thirty countries over the last forty years. We use micro-data from the Luxembourg Income Study and show that income tax systems worldwide are approximated remarkably well by a two-parameter log-linear effective tax function. Using this functional form, we estimate country- and year-specific effective tax functions to study the evolution of average taxation and income tax progressivity across countries and over time. Our paper provides several insights into the nature of income tax systems. First, we show a positive association between a higher average level of taxation and greater progressivity. Second, we focus on the dynamics of income tax progressivity and discover a positive association between progressivity and economic development, with wealthier countries exhibiting higher income tax progressivity. Third, we find variations in progressivity across different family structures, with married couples with children experiencing the highest progressivity and childless singles facing the lowest. Finally, combining our microdata with additional survey data from France, Italy, the United Kingdom, and the United States in 2016, we find that the features of the income tax systems in these countries are not what their citizens desire. In particular, people want lower average tax rates and higher income tax progressivity.

Keywords: Taxation; Income tax progressivity; Family structure; Desired taxes

JEL Codes: E62, H20, H30

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1 Introduction

Income tax systems are inherently complex. Income taxes depend on statutory tax rates, deductions, credits, and how taxpayers file their returns. The complexity escalates when comparing income tax systems across countries, as policies and institutions differ substantially. However, accurately measuring an income tax system’s key features is crucial for economists and policymakers. On the one hand, economists need a precise characterization of the tax system as input to study the role of tax policy in economic behavior both at the individual and aggregate levels. On the other hand, policymakers need an accurate assessment of the income tax progressivity to design redistribution and social insurance policies.

Given the importance of accurately measuring the income tax system, this paper has three main objectives. First, we aim to systematically describe and compare the effective income taxes over time and across countries. Second, we aim to provide estimated effective tax functions that can be incorporated into structural models to answer, for instance, questions related to redistribution and the impact of income taxes on economic behavior. Third, we want to measure the distance between people’s desired and effective income taxes.

We use household-level microdata from the Luxembourg Income Study (LIS) Database to achieve these goals. Several reasons make LIS the ideal dataset for our analysis. First, it covers many countries and spans a long time. Second, it harmonizes international data, facilitating comparisons of variables across countries and over time. Third, it contains detailed information on labor and capital income, public social benefits, taxes, contributions, demographic characteristics, and employment. We use this rich dataset to estimate effective income tax functions for over thirty countries in the last forty years. Effective income tax functions characterize the empirical relationship between taxes paid and pre-tax income and summarize the intricacies of income tax systems using a parsimonious functional form. Specifically, we use the log-linear tax function pioneered by [Feldstein \(1969\)](#) and popularized by [Benabou \(2000\)](#) and [Heathcote, Storesletten, and Violante \(2017\)](#) to quantify the average level of taxation and the degree of progressivity of income tax systems worldwide.

Our findings can be summarized as follows. First, we show that the log-linear tax function is an excellent approximation of income tax systems worldwide. While this was known for the US ([Heathcote, Storesletten, and Violante, 2017](#)) and a limited number of other countries, we show that our two-parameter tax function provides a very high approximation quality for all the countries and years in our sample. Therefore, our estimated tax functions can be used in any macroeconomic model requiring a parsimonious characterization of the income tax system of the country it is studying. Our results can also be used in empirical work that wants to control for the features of the income tax system in a given country and year.

Second, we provide novel insights into the dynamics of the average level of taxation and progressivity. We start by documenting a positive correlation between income tax progressivity and the average level of taxation. Notably, throughout all years in our sample, countries with a higher degree of progressivity also impose a higher average level of income taxation. Then, we describe large differences in income tax systems by country. For instance, wealthy northern European countries such as Germany and the Netherlands consistently exhibit some of the highest progressivity and average tax rates over time. In contrast, other countries (such as Brazil, Colombia, and Peru) do not present effective income taxes despite having progressive statutory income tax systems. We also document dramatic changes in progressivity over the last forty years. For instance, the progressivity parameter in the United States in 2018 is about 40% lower than in 1980. Similarly, the progressivity parameter in the United Kingdom and Canada decreased by 33% and 25%, respectively, between 1995 and 2018.

Third, we uncover large differences in income tax progressivity by economic development. In particular, we show a positive relationship between income tax progressivity and development. We proxy economic development by median pre-tax income and GDP per capita and find that the wealthiest countries (such as Belgium, Germany, and the Netherlands) display the highest income tax progressivity. Despite this general trend, we also find a large dispersion in progressivity between countries with similar levels of development. For instance, in 2013, Belgium and the United States had nearly identical median pre-tax income, but Belgium's progressivity (as measured by the related parameter in our tax function) was three times as large as that of the United States.

Fourth, we find significant differences in progressivity across family structures. In particular, our results suggest that childless singles face the lowest progressivity across countries and over time, while married couples with children enjoy the highest. To reach this conclusion, we estimate tax functions separately for four groups of families: married couples with children, married couples without children, single parents, and childless singles. We show that conditional on the presence of children, progressivity varies significantly by marital status. In particular, the progressivity parameter for married couples without children is, on average, 25.3% larger than that of childless singles. At the same time, the progressivity parameter for married couples with children is, on average, 26.4% larger than that of single parents. Then, conditional on marital status, the presence of children also leads to considerable changes in progressivity. On average, the progressivity parameters for married couples with children and single parents are 18.5% and 5% higher than that for married couples without children and childless singles, respectively.

Finally, we combine our estimated tax functions with survey data from [Alesina, Stantcheva, and Teso \(2018\)](#) to quantify the differences between people's desired and effective income tax rates. We find that French, Italian, British, and American people in 2016 would prefer their

income tax systems to feature lower average tax rates and higher progressivity than they do. [Alesina, Stantcheva, and Teso \(2018\)](#) conducts a survey in which, among other questions, French, Italian, British, and American respondents are asked to report their desired average tax rate for four quantiles of the income distribution: the top 1%, the top 2–10%, the top 11–50%, and the bottom 50%. We combine their results with our microdata to measure the distance between desired and effective average tax rates. We find that in all four countries, people want lower average tax rates along most of the income distribution. For instance, Americans want the average tax rate on the upper middle class (i.e., the top 11–50%) to be over 58% (about 13 percentage points) lower than it is. We then use our tax function and the data on the desired average tax rate to compute desired income tax progressivity. In this case, we find that people desire higher tax progressivity. For instance, Italians want the tax system to be over three times more progressive than it is, which translates into marginal tax rates that are over 19% higher than they are. We take advantage of the rich demographic information [Alesina, Stantcheva, and Teso \(2018\)](#) collect to study how desired taxes vary by age, education, employment status, and political view. While we do not find much variation by age, education, and employment status, we document large differences in desired taxes by political leaning. For instance, we find that the realized average tax rates are the closest to the desires of the supporters of the political party representing the government in charge.

Our paper offers several contributions. First, we provide a parsimonious method for comparing income tax systems across countries using a two-parameter log-linear tax function. Second, we estimate tax functions by country and over time and make them available for researchers interested in approximating the income tax system. Third, we document differences in the dynamics of income tax progressivity by the level of economic development and family structures. Finally, we provide a framework to compare effective and desired income taxes, which can be extended to other countries and years using our estimated tax function and new survey data on desired taxes.

The remainder of the paper is organized as follows. Section 2 positions our paper within the context of the relevant literature. Section 3 describes the LIS data and the sample selection and outlines the estimation strategy. Section 4 describes how income tax progressivity varies by economic development and family structure. Section 5 compares desired and effective income taxes. Section 6 concludes.

2 Related Literature

Our paper relates to four branches of the literature. First, it connects to the rich literature on approximating the income tax and transfer system with a log-linear function of pre-tax

income. The “log-linear approach” was pioneered by [Feldstein \(1969\)](#) and [Benabou \(2000\)](#) and widely popularized by [Heathcote, Storesletten, and Violante \(2017\)](#). While there are various approaches to modeling the income tax and transfer system, these papers advocate for the log-linear specification due to its simplicity—requiring only two parameters that can be estimated by ordinary least squares—and its excellent fit to the data.¹

Numerous papers have used the log-linear tax function to study the income tax and transfer system in the United States. [Heathcote, Storesletten, and Violante \(2020\)](#) use data from the Congressional Budget Office to study tax progressivity between the late 1970s and 2016. They find that the level of progressivity in 2012–2016 is the same as in 1979–1983. [Wu \(2021\)](#) uses CPS data to study the evolution of tax progressivity between 1978 and 2016. He finds that the income tax in the US has become less progressive since the late 1970s. [Fleck, Heathcote, Storesletten, and Violante \(2021\)](#) use CPS data to study the progressivity of the tax and transfer system at the US state level. They estimate effective tax functions for each of the 50 states and find substantial heterogeneity in progressivity across states. Finally, [Borella, De Nardi, Pak, Russo, and Yang \(2023\)](#) use PSID data to study the evolution of effective tax rates between the late 1960s and 2016. They find substantial variation in the average level of taxation and income tax progressivity, both over time and across marital status.

A handful of recent papers have applied the log-linear tax function to countries other than the US. [García-Miralles, Guner, and Ramos \(2019\)](#) use administrative tax data for Spain to study the distributions of pre- and post-tax income and tax liabilities between 2002 and 2015. They find that the log-linear tax function approximates the Spanish personal income tax system well. [Kaas, Kocharkov, Preugschat, and Siassi \(2020\)](#) study homeownership in Germany and shows that the log-linear tax function provides a good approximation of the German income tax and transfer system. [Tran and Zakariyya \(2021\)](#) use the log-linear tax function to study the evolution of income tax progressivity in Australia after 1999.

Second, our paper connects to the literature on cross-country comparisons of tax progressivity. [Chang, Chang, and Kim \(2018\)](#) study optimal income taxation in 32 OECD countries. They estimate income tax progressivity using a log-linear tax and transfer function, although they do not study the evolution of taxes over time or across family structures. [Holter, Krueger, and Stepanchuk \(2019\)](#) argue that income tax progressivity is a crucial determinant of the additional tax revenue governments can generate by increasing the level of labor income taxes. They use a log-linear tax function and compare progressivity measured by the progressivity

¹There are numerous ways of modeling the tax function, ranging from a simple proportional tax on income to the arctangent tax function in [Kurnaz and Yip \(2020\)](#), passing through the popular three-parameter tax function of [Gouveia and Strauss \(1994\)](#).

wedge across OECD countries between 2000 and 2007.² They find substantial heterogeneity in tax progressivity, with the most progressive taxes in Denmark and the least progressive in Japan. [De Magalhaes, Martorell, and Santaeulalia-Llopis \(2019\)](#) use micro-data to estimate the progressivity of transfer systems in 32 countries and study its relationship with economic development. [Ayaz, Fricke, Fuest, and Sachs \(2021\)](#) study how optimal income taxes should respond to an increase in public debt in five European countries. They find that income taxes should be less progressive in response to increased fiscal pressure. [Bick, Fuchs-Schündeln, Lagakos, and Tsuijiyama \(2022\)](#) analyze how structural changes in labor supply affect cross-country differences in hours worked. They estimate log-linear tax functions for childless singles in numerous OECD countries but do not study the evolution of income taxes over time.

Third, our paper relates to the literature on income taxation by family structure. Most studies in this literature have focused on the differences in income taxation between married couples and singles. [Guner, Kaygusuz, and Ventura \(2012\)](#) study tax reforms taking into account the large changes in female labor supply and demographic structure that occurred in the US over the last decades. [Guner, Kaygusuz, and Ventura \(2014\)](#) estimate and compare tax functions using a wide variety of functional forms to systematically describe how income taxes in the US in 2000 varied by income, marital status, and the number of children in a household. [Malkov \(2022\)](#) studies the optimal income taxation of couples and singles in the US. He estimates log-linear tax functions for the US and argues that, compared to the current system, the government should decrease progressivity for couples and increase it for singles.

Fourth, our paper connects to the literature on perception and desires for income tax policy. We build on [Alesina, Stantcheva, and Teso \(2018\)](#), whose data we use to compare desired and effective income taxes in 2016 in Section 4. [Alesina, Stantcheva, and Teso \(2018\)](#) design and run a survey to study people's beliefs about intergenerational mobility and economic fairness for five countries in 2016. Importantly, they ask respondents about the desired average income tax rates for four income groups: the top 1 percent, the 2 to 10 percent, the 11 to 50 percent, and the bottom 50 percent. In Section 4, we use their data and compare people's desired average tax rates and implied tax progressivity to what we estimate from LIS. Among the many papers on preferences for redistribution, our paper relates to those that focus on perceived and desired features of the income tax system. [Slemrod \(2006\)](#) analyzes the relationship between tax perceptions and support for regressive tax reforms in the US. In particular, he finds that the misconception that high-income people would pay more taxes under a flat income tax or

²The progressivity tax wedge between two arbitrary incomes $y_2 > y_1$ is given by

$$PW(y_1, y_2) = 1 - \frac{1 - T'(y_2)}{1 - T'(y_1)},$$

and measures how marginal tax rates increase between the two income levels.

a retail sales tax is strongly associated with support for such regressive tax reforms. [Gideon \(2017\)](#) uses data from the US in 2011 to evaluate the bias in people's perceived average and marginal tax rates. He finds evidence of systematic errors in perceived tax rates. In particular, people tend to underestimate the marginal tax rate for the top tax bracket, misperceive the degree of income tax progressivity, and overestimate their average tax rate. [Fernández-Albertos and Kuo \(2018\)](#) use survey data from Spain to measure people's perceived placement in the income distribution and whether knowing one's true placement affects preferences for income tax progressivity. They find that people hold biased beliefs about their position in the income distribution and that revealing one's true placement increases the support for higher income tax progressivity. [Stantcheva \(2021\)](#) runs a large-scale survey of American taxpayers to, among other things, evaluate their knowledge of income tax policy. She finds that respondents who hold left-leaning economic and political ideologies believe income taxes are lower and less progressive than right-leaning respondents. She also finds partisan differences in beliefs about the efficiency and effects of income taxes. [Kalleitner and Bobzien \(2023\)](#) use survey data from Austria to study the relationship between tax perceptions and support for redistributive taxation. They find that poorer Austrians perceive lower levels of tax progressivity than richer ones. They also show that modifying progressivity perceptions increases support for redistributive taxation among the rich and decreases support among the poor.

3 Estimation

3.1 Data

The Luxembourg Income Study (LIS). We use micro-data from the Luxembourg Income Study (LIS) Database. LIS collects and harmonizes micro-data from 55 countries starting in the 1970s. LIS combines well-known datasets, such as the Current Population Survey for the United States and the German Socio-Economic Panel for Germany, and provides an aggregated micro-dataset that includes labor and capital income, public social benefits, private transfers, taxes and contributions, demography, employment, and consumption. [Ravallion \(2015\)](#) provides a detailed overview of the LIS dataset, details its development over time, and discusses some data limitations.

Numerous papers have used LIS. Among others, [De Nardi, Ren, and Wei \(2000\)](#) uses it to study income redistribution policies and the trade-off between redistribution and efficiency. [Chiuri and Jappelli \(2010\)](#) uses LIS data to analyze the patterns of homeownership for older adults across OECD countries. [Laun and Wallenius \(2016\)](#) uses LIS to assess the role of social insurance for the cross-country differences in the labor supply of older workers. [Chang, Chang,](#)

and Kim (2018) uses LIS to estimate a tax and transfer function for 32 OECD countries and compare the observed level of progressivity with the optimal one stemming from an optimal income taxation problem.

Sample Selection. We use 11 LIS waves spanning from the early 1970s to 2019. Although LIS covers 55 countries in total, the number of countries observed in each wave varies. For instance, LIS includes the United States since the first wave in the 1970s but records information about Japan only starting in 2008. We start from all the countries available in a specific wave and select those for which we have data on all the inputs we need to estimate the tax function: gross household income, income taxes, and public social benefits. For this reason, we have to exclude countries like Mexico, which is in the LIS dataset starting from the second wave but only reports after-tax income.

To ensure a consistent and comparable time unit across countries, we operate at the wave level.³ When we observe a country for more than one year in a wave, we pool these years into the same wave to estimate the tax function for that wave.⁴ Thus, the number of countries in our final sample varies by wave, ranging from a minimum of 5 countries in the first wave to a maximum of 31 countries in wave 8. However, we observe four countries for all 11 LIS waves: France, Germany, the United Kingdom, and the United States.

For each country-wave pair, we select working-age households whose head is aged 25 to 60. We restrict our attention to “standard” households, comprising (1) one-person households; (2) married couples without children; (3) married couples with children; and (4) single parents. Therefore, we exclude households in which other relatives or non-relatives cohabit with the four groups described above. We select only standard households to have comparable households across countries. Figure A-1 shows that most households with heads aged between 25 and 60 qualify as “standard.” When we pool all countries and waves together, the mean share of standard households is 89 percent, and the median is 91.4 percent, suggesting that most households are indeed “standard.”

Table A-1 in Appendix I.1 shows the countries in our sample, the waves we observe them in, and the number of observations in each country and wave. Our final sample consists of 7,625,531 household-wave observations for 37 countries, observed over different waves.

Income Definitions. Our results on effective taxes depend crucially on the definitions of pre- and post-tax income. Household pre-tax income is given by the sum (for the head and the spouse, if a spouse is present) of labor income, capital income, pensions, public social benefits,

³Table A-1 in Appendix I.1 shows the mapping from wave number to calendar year.

⁴LIS may cover different years for different countries in a given wave. For instance, the first LIS wave includes CPS data for the US for each year between 1979 and 1982 but covers the 1979 French Tax Income Survey only.

and private transfers, while post-tax income is defined as pre-tax income minus income taxes and social security contributions. Taxes are defined as compulsory payments to the government based on the current income earned.^{5,6} Public social benefits include transfers from government insurance and assistance programs. Appendix I.3 describes the income components in detail. Our pre-tax and post-tax income definitions are very close to [Borella, De Nardi, Pak, Russo, and Yang \(2023\)](#).

The monetary quantities that make up our income definitions need to be adjusted to be comparable across waves and countries. First, we need Consumer Price Indices (CPIs) to compare real amounts over time within a country. Second, we need Purchasing Power Parity indicators (PPPs) to compare real amounts across countries. Using 2017 as the base year, the adjustment factor for country i in wave t is computed by LIS as:

$$LISPPP_{i,t} = \left(\frac{CPI_{i,t}}{100} \right) PPP_{i,2017},$$

To convert monetary quantities into 2017 USD PPP, we divide nominal amounts in each country and wave by the corresponding LIS PPP. All financial quantities reported in the paper are measured in 2017 USD PPP, which we refer to, for convenience, as 2017 dollars.

3.2 Estimating the Effective Income Tax Function

This section starts by describing our tax function and estimation strategy. Then, we present the results for the estimated effective income tax system.

Log-Linear Tax Function. Following [Feldstein \(1969\)](#), [Benabou \(2000\)](#), [Heathcote, Storesletten, and Violante \(2017\)](#), and [Borella, De Nardi, Pak, Russo, and Yang \(2023\)](#), we model taxes T on total income Y as:

$$T(Y) = Y - (1 - \lambda)Y^{1-\tau}. \quad (1)$$

The associated average and marginal tax rates are given by:

$$\frac{T(Y)}{Y} = 1 - (1 - \lambda)Y^{-\tau}, \quad (2)$$

$$T'(Y) = \frac{\partial T(Y)}{Y} = 1 - (1 - \lambda)(1 - \tau)Y^{-\tau}. \quad (3)$$

⁵For the United States, taxes include both federal income taxes and state income taxes.

⁶Taxes on current income as defined by LIS exclude direct taxes on windfall incomes such as inheritances, profits, and capital gains.

Equation (2) shows that the parameter λ corresponds to the average tax rate when income is equal to 1 unit and thus captures the notion of the level of taxation in the economy. The parameter τ captures the degree of progressivity of the income tax system. In particular, the elasticity of post-tax income with respect to pre-tax income, $\partial \log(Y - T(Y)) / \partial \log(Y)$, is equal to $1 - \tau$. The tax system is progressive when $\tau > 0$, regressive when $\tau < 0$, and flat with marginal and average tax rates both at λ when $\tau = 0$. Taking logs of Equation (1) yields:

$$\log(Y - T(Y)) = \log(1 - \lambda) + (1 - \tau) \log(Y). \quad (4)$$

Estimation Strategy. We estimate Equation (4) by regressing the logarithm of post-tax income on a constant and on the logarithm of pre-tax income in each country and in each wave using the definitions of income described in Section 3.1.

$$\log(\text{after-tax income})_{i,c,t} = \alpha_{c,t} + \beta_{c,t} \log(\text{pre-tax income})_{i,c,t} + \varepsilon_{i,c,t}, \quad (5)$$

where the dependent and independent variables are the log post-tax income and log pre-tax income for household i of country c in wave t . We allow for country-wave-specific regression coefficients $\alpha_{c,t}$ and $\beta_{c,t}$. We run weighted regressions using the LIS-provided household-level cross-sectional weights to obtain results representative of the population of each country in each wave. The OLS estimates are denoted by $\hat{\alpha}_{c,t}$ and $\hat{\beta}_{c,t}$.

We compute the parameter λ from the estimated constant and the parameter τ from the estimated coefficient on the log of pre-tax income. In particular, comparing the regression equation (5) with the log-linear tax function (4) shows that

$$\hat{\lambda}_{c,t} = 1 - \exp(\hat{\alpha}_{c,t}), \quad \text{and} \quad \hat{\tau}_{c,t} = 1 - \hat{\beta}_{c,t}.$$

Thanks to the large sample size, the tax parameters are tightly estimated, and the confidence intervals are very narrow.⁷ Moreover, we find that this tax function fits the data remarkably well, which we now turn to.

⁷We construct the 95% confidence intervals as

$$\left[1 - \exp(\hat{\alpha}_{c,t} + 1.96 \times \hat{se}(\alpha)_{c,t}), 1 - \exp(\hat{\alpha}_{c,t} - 1.96 \times \hat{se}(\alpha)_{c,t}) \right]$$

for λ , and

$$\left[1 - (\hat{\beta}_{c,t} + 1.96 \times \hat{se}(\beta)_{c,t}), 1 - (\hat{\beta}_{c,t} - 1.96 \times \hat{se}(\beta)_{c,t}) \right]$$

for τ .

3.3 Fit of the Tax Function

As Heathcote, Storesletten, and Violante (2017) shows, the log-linear tax function in Equation (1) is a good approximation of the US federal income tax system. We show that this result holds not only for the US but also extends to the income tax systems in all countries in our sample. For example, Figure 1 plots the logarithm of post-tax income as a function of the logarithm of pre-tax income for Canada, Denmark, Finland, Norway, the UK, and the US in wave 10 (corresponding to 2015–2017).⁸ In particular, to draw these graphs, we first select our sample of standard households with heads aged between 25 and 60, and then construct weighted percentiles by country and wave. These graphs show that the relationship between post-tax income and pre-tax income is approximately log-linear in each country we consider and at all points of the log pre-tax income distribution, except for the first percentile.

In Figure 2, we show that the R^2 from the regressions we use to estimate our tax functions is remarkably high. In particular, we run the regression in Equation (4) wave-by-wave and country-by-country, and we report the distribution of the R^2 from these regressions. The distribution is significantly skewed to the right and has a mean of 0.976 and a median of 0.984. Even in the thin left tail, the R^2 is larger than 0.85, meaning that, at its worst, the log-linear tax functions still explain over 85 percent of the variation in post-tax income. In particular, the lowest R^2 is 0.86 and corresponds to Italy in wave 6. The results on R^2 corroborate our finding that a log-linear tax function approximates well the income tax systems of the countries in our sample. In Appendix I.5, we show that the validity of our results on the goodness-of-fit of our tax function is not challenged by the imputation and simulation procedures used by LIS and the country-specific datasets that LIS utilizes.

4 Results

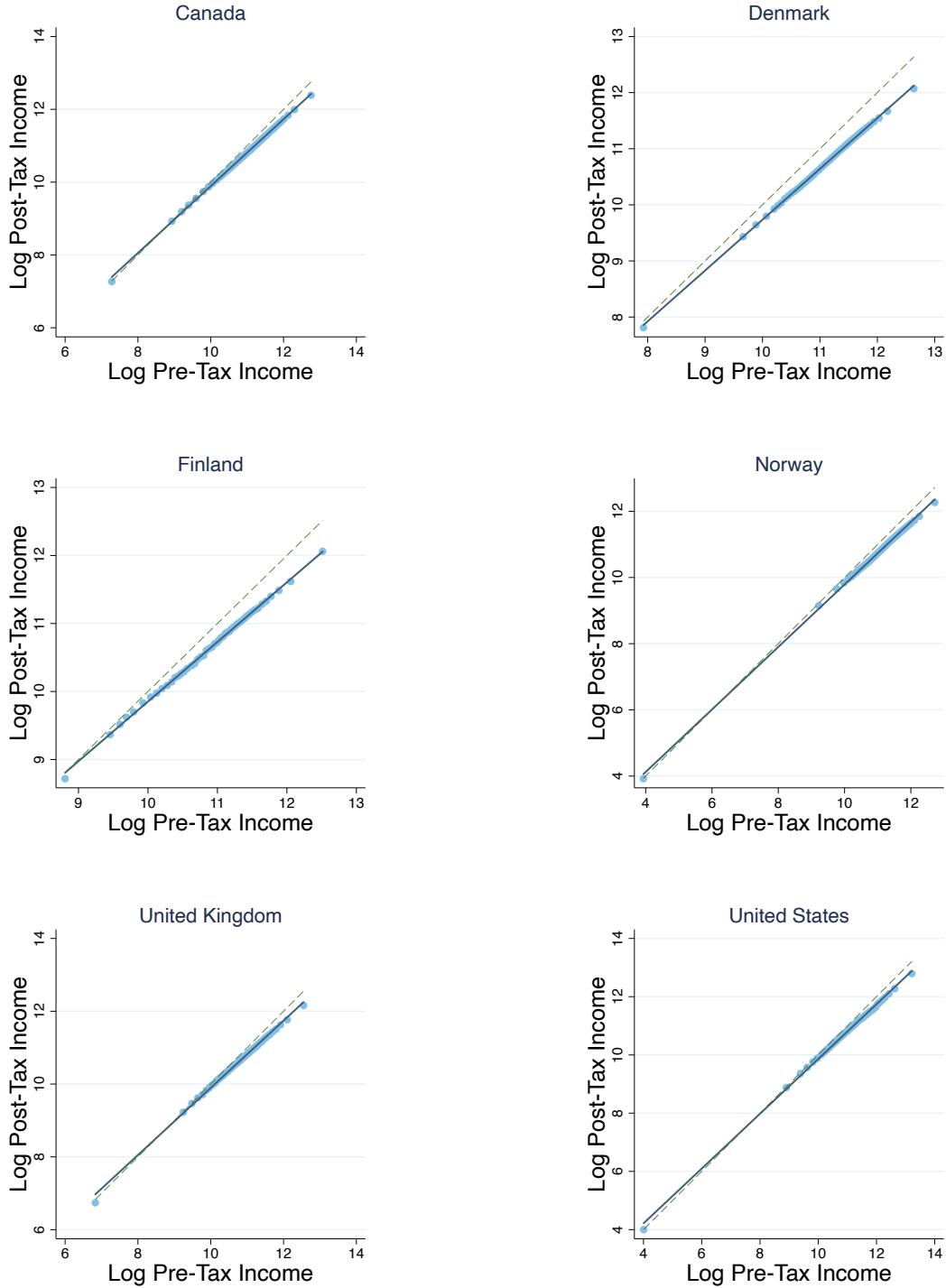
4.1 Tax Progressivity and Average Tax Level

After establishing that the log-linear tax function is a good approximation of the income tax systems of the countries in our sample, we discuss a few findings arising from the estimated effective tax functions.⁹ We start by comparing the average level of taxation and progressivity across countries. In Figure 3, we plot the estimated tax parameters for wave 8, as we have the

⁸Due to space limitation, we show six countries in the main text. We show the fit of the tax function for the remaining countries in wave 10 in Appendix I.4. The results for waves other than wave 10 are available upon request.

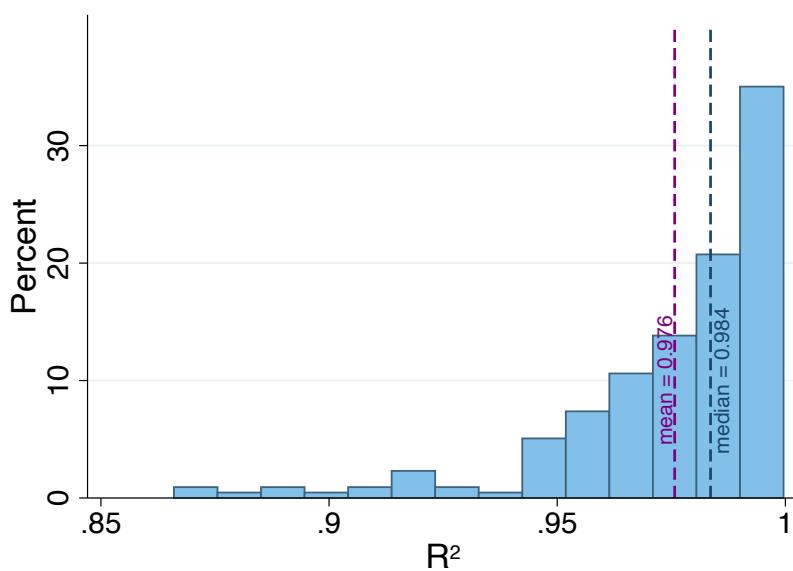
⁹Here, we focus on the results in the cross-section. In Appendix III, we also plot and discuss the evolution of our estimated tax parameters over time.

Figure 1: Goodness of Fit of the Log-Linear Tax Function



Notes: Log post-tax income as a function of log pre-tax income, Wave 10. Post-tax income is defined as pre-tax income minus income taxes. Each dot is a percentile of the log pre-tax income distribution. The dashed line is the 45-degree line. The solid line is the OLS fitted line.

Figure 2: Distribution of R^2



Notes: Distribution of the R^2 from year-by-year and country-by-country regressions of log post-tax income on log pre-tax income.

highest number of countries in this wave. We present the results for the remaining waves in Appendix II, which also displays the pre-tax median income in each country and in each wave.

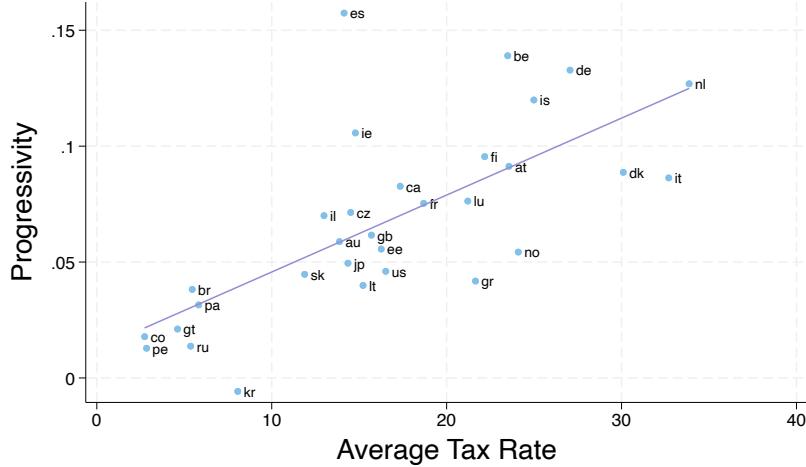
In Figure 3, we plot progressivity, as measured by the parameter τ , as a function of the average tax rate for the median household in each country, that is, the household earning the median pre-tax income in each country.¹⁰ Figure 3 displays several interesting facts. First, a higher degree of progressivity is associated with a higher average tax rate for the median household. This positive correlation is present in each wave and shown by the positively-sloped fitted lines in Figures 3, A-5, A-6, and A-7.

Second, Figure 3 shows that higher-income northern European countries such as Germany (DE), Belgium (BE), and the Netherlands (NL) display some of the highest progressivity and average tax rates in every wave. This finding is consistent with several previous studies. Chang, Chang, and Kim (2018) finds that Germany and the Netherlands have some of the highest levels

¹⁰One can obtain the “raw” parameter λ using the values of the average tax rate, progressivity, and median income we show here. In particular, letting $\hat{\lambda}$ denote the average tax rate and y denote the median pre-tax income, the corresponding λ is obtained as:

$$\lambda = 1 - \frac{1 - \hat{\lambda}/100}{y^{-\tau}}.$$

Figure 3: Tax Progressivity and Average Tax Level



Notes: Tax Parameters Across Countries. Progressivity as a function of the average tax rate in wave 8. The average tax rate is evaluated at the median income of each country. The solid lavender line is the OLS fitted line.

of progressivity in 2016, while Holter, Krueger, and Stepanchuk (2019) shows that this is true also in the period between 2000 and 2007.¹¹

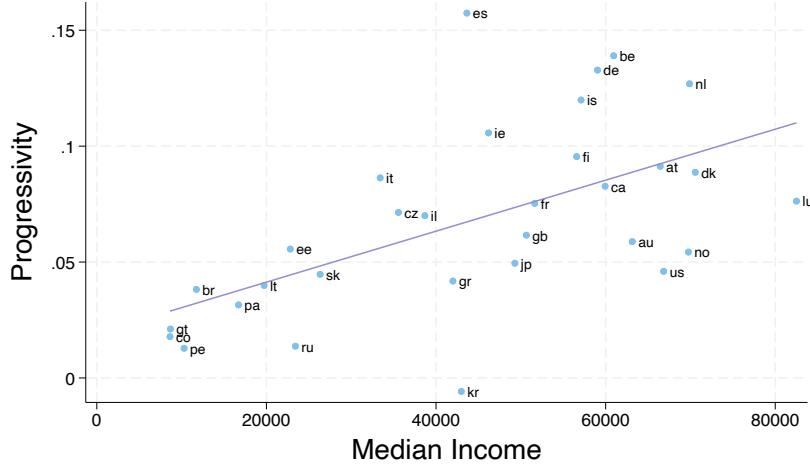
Finally, several countries with progressive statutory income taxes do not exhibit progressive effective taxes. For example, Brazil, Colombia, Peru, and the Republic of Korea have progressive statutory income taxes, but their effective tax system is almost flat in all waves.

4.2 Progressivity and Economic Development

In this Section, we investigate the relationship between income tax progressivity and economic development. In particular, we measure economic development by median pre-tax income (or GDP per capita in Appendix IV) and plot its relationship with income tax progressivity. Figure 4 shows that richer countries also display higher income tax progressivity. For instance, countries such as Belgium, Germany, and the Netherlands consistently rank among the wealthiest countries and have the highest degree of income tax progressivity. Figure 4 shows the pattern for LIS wave 8 and the results for the other waves are relegated to Appendix IV, where we find a consistent positive relationship between tax progressivity and development.

¹¹ Although Chang, Chang, and Kim (2018) uses LIS data for 2016, their progressivity estimates are substantially higher than ours for every country. This is because they estimate a tax and transfer function and, therefore, their parameter τ reflects the progressivity embedded in the tax and transfer system rather than in income taxes alone. Thus, we expect their estimates to be higher than ours. Table 1 in Heathcote, Storesletten, and Violante (2020) also shows that using a tax and transfer function leads to higher estimates of progressivity than using a tax function.

Figure 4: Tax Progressivity and Development



Notes: Progressivity as a function of median income in LIS wave 8. Progressivity is measured by the parameter τ . Income is measured in 2017 USD PPP. The solid lavender line is the OLS fitted line.

Appendix IV also uses an alternative measure of development, GDP per capita from the Penn World Tables (see [Feenstra, Inklaar, and Timmer \(2015\)](#) for a description of the Penn World Tables). The results obtained using GDP per capita line up closely with those obtained using median income. In particular, Figures A-12-A-14 confirm that there is a consistently positive relationship between progressivity, median income, and GDP per capita after Wave 4 (corresponding to 1995) when we have enough observations in the sample. This result is consistent with [Bick, Fuchs-Schündeln, Lagakos, and Tsuiyama \(2022\)](#), which finds that higher GDP-per-capita countries also display higher income tax progressivity.¹²

Despite the systematic relationship between tax progressivity and development, Figure 4 also shows large dispersion in progressivity for countries with similar median income levels. For instance, many countries have a median income between 60,000 and 70,000 dollars but display vastly different progressivity levels. Take Belgium (BE) and The United States (US) as an example, which have a similar median income level. However, Belgium's progressivity parameter is three times as large as that of the United States. On the other hand, there are also many countries with considerably different median income levels but similar income tax progressivity. For instance, Czechia (CZ), Israel (IL), France (FR), Canada (CA), and Luxembourg (LU) display almost the same level of progressivity, even though Canada's median income is almost twice as large as Czechia's.

¹²[De Magalhaes, Martorell, and Santaeulalia-Llopis \(2019\)](#) document a negative correlation between the level of transfer progressivity and GDP per capita. There are two main differences between our results and theirs. First and most importantly, their sample covers mostly poor countries while our sample covers the full span of development stages. Second, they study the progressivity of the tax and transfer system rather than that of taxes alone.

4.3 Progressivity and Family Structure

In the previous Sections, we focused on standard households to get a comprehensive view of the dynamics of income tax progressivity. In this Section, we evaluate whether income tax progressivity differs across household types. In particular, we split our sample into the four categories that make up our notion of a standard household: (1) married couples with children, (2) married couples without children, (3) single Parents, and (4) singles without children.¹³

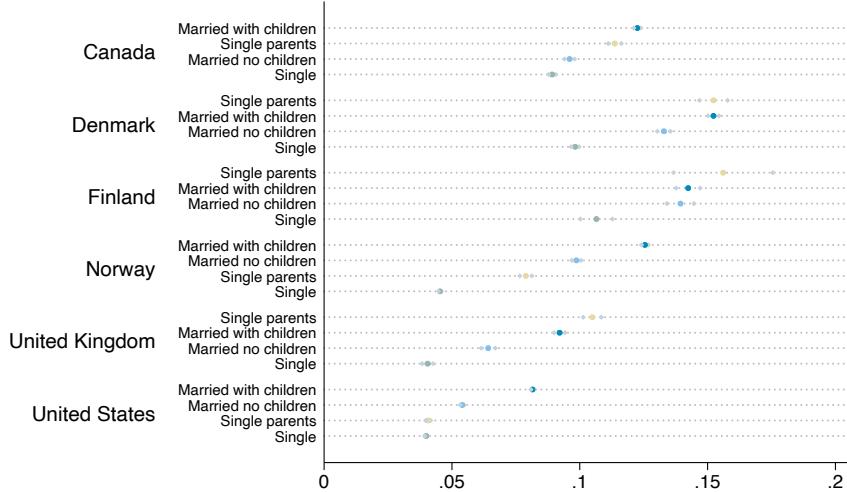
We highlight several interesting patterns from this analysis. First, we observe large and significant differences in progressivity by family structure in all countries and years. Figure 5 reports the point estimates for the progressivity parameter τ and the 95% confidence intervals in wave 8 and shows that the tightly estimated progressivity parameter significantly differs across family structures. To save space, we report the estimates for the remaining countries and waves in Appendix VI.

Second, conditional on the presence of children, progressivity varies by marital status. In particular, the progressivity parameter for married couples without children is 25.3% higher, on average, than that of childless singles. Similarly, the progressivity parameter of married couples with children is 26.4% higher, on average, than that of single parents. A few notable examples are Norway in 1995, where the progressivity parameter for married couples without children is 3.5 times that of childless singles, and the United States in 2010, where the progressivity parameter of married couples with children is more than double that of single parents. The differences in progressivity by marital status are due to the marriage bonuses embedded in joint taxation (which applies to countries such as France, Germany, Ireland, Spain, Switzerland, and the United States), different statutory taxation by marital status, and different credits and deductions that apply to legally married couples.

Third, conditional on marital status, the presence of children leads to large changes in progressivity. In particular, on average, the progressivity parameter for married couples with children is 18.5% higher than that of married couples without children. The difference in progressivity parameter between single parents and childless singles is smaller, but the one for single parents is still 5.9% higher on average than that of childless singles. Figure 5 shows that, for instance, in 1985, the progressivity parameter for Danish married couples with children is more than double that of married couples without children, while, in 2010, the progressivity parameter of British single parents is 1.5 times that of childless singles. One reason behind these differences is that, in most countries, families with dependent children enjoy higher credits and deductions than their childless counterparts.

¹³In Appendix V, we show large changes in household composition over time. In particular, we show a general shift from being married and having children to not being married and not having children.

Figure 5: Income tax progressivity by family structure



Notes: LIS wave 8. The dots are the point estimate for the progressivity parameter τ , and the gray diamonds mark the 95% confidence interval. For each country and wave, family structures are ranked and shown in ascending order of progressivity.

Fourth, although there are numerous differences across countries and waves, a stable pattern emerges. In particular, for the majority of our country-wave observations, childless singles face the lowest progressivity, while married couples with children the highest. In Figure 5, for instance, married couples with children display the highest progressivity in most countries and waves.

Our results line up with previous ones in the literature. [Guner, Kaygusuz, and Ventura \(2014\)](#) estimates progressivity in the United States in 2000 for married and single households with and without children. They find that, regardless of the presence of children, married couples face higher progressivity than singles. Our results for the United States in wave 5 (corresponding to 2000) confirm this finding. In particular, Table A-7 shows that the progressivity parameter for married couples without children is 1.4 times that of childless singles, while the one for married couples with children is almost double that of single parents. [Malkov \(2022\)](#) uses an optimal income taxation approach to conclude that married couples in the United States should be taxed less progressively than singles. Our estimates suggest that the current US tax system does the opposite since, regardless of the presence of children, married couples face higher progressivity than singles in all waves.

To further investigate the effect of family structure on effective income taxes, we run the following regression:

$$y_{h,c,t} = \sum_h \beta_h \mathbb{I}\{\text{household type} = h\} + \gamma_{c,t} + \varepsilon_{h,c,t},$$

Table 1: Tax and Family Structure

	(1)	(2)	(3)	(4)
	λ	τ	Average	Marginal
Childless singles (base)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
Couples without children	-0.327** (0.130)	0.012*** (0.003)	0.018*** (0.002)	0.025*** (0.003)
Couples with children	-0.779*** (0.130)	0.021*** (0.003)	0.004** (0.002)	0.021*** (0.003)
Single parents	-0.513*** (0.130)	0.010*** (0.003)	-0.054*** (0.002)	-0.040*** (0.003)
Constant	-1.260*** (0.092)	0.083*** (0.002)	0.182*** (0.001)	0.247*** (0.002)
Country-Wave FE	Yes	Yes	Yes	Yes
Observations	868	868	868	868
R-squared	0.64	0.81	0.96	0.95

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the estimates of the household-type fixed effects. Column (1) reports the results for the tax parameter λ , (2) for the tax parameter τ , (3) for the average tax rate facing a median-income household, and (4) for the marginal tax rate facing a median-income household. We set childless singles as the base group.

where the dependent variable $y_{h,c,t}$ is a variable of interest (for example, the tax function parameters $\lambda_{h,c,t}$ and $\tau_{h,c,t}$ for household type h in the country c at wave t ,) β_h captures the household-type fixed effects, and $\gamma_{c,t}$ denotes the country-wave fixed effects. We set childless singles as the base group and normalize the levels of the country-wave fixed effects so that the constant term represents the average level of the dependent variable in the base group.

We report the regression results in Table 1. We consider four dependent variables: the tax function parameters, $\lambda_{h,c,t}$ and $\tau_{h,c,t}$, and the average and marginal tax rate for a household with median income in each country-wave-household-type group. For each of these four dependent variables, we compare the estimated household-type fixed effects, β_h , across family structures. In particular, the household-type fixed effects capture the difference in the outcome variable between each group and the base one. For instance, $\beta_h = 0.012$ for couples without children in Column (2) of Table 1 means that the difference in the progressivity parameter τ between married couples without children and childless singles (the base group) is 0.012.

Column (1) of Table 1 shows that the tax function parameter λ (which captures the average level of taxation) is largest for singles, smaller for couples without children, even smaller for single parents, and is the smallest for couples with children. As we discussed in Section 3, conditional on the income level, a higher λ implies a higher average level of taxation. Therefore, our results suggest that childless singles face the highest average level of taxation, while married couples with children face the lowest.

Column (2) reports the estimates of the household-type fixed effects when we use the progressivity parameter as the dependent variable in the regression. These results confirm that childless singles face the lowest progressivity, while married couples with children experience the highest.

The results in Column (1) allow us to compare families with a different structure but with the same pre-tax income. To make our comparison across family structures more meaningful, we report the regression results for the average and marginal tax rates for a median household in its respective group in Columns (3) and (4). The very small household-fixed effect for couples with children in Column (3) highlights that the median couple with children pays a very similar average tax rate to the median single household. Column (3) also shows that a median single household is subject to an average tax rate of 18.2%, while a median couple with children faces an average tax rate of 18.6%. Single parents are subject to the lowest average tax rate, which is 5.4 percentage points lower than that for singles. At the same time, couples without children pay the highest average tax rate, which is 1.8 percentage points higher than the one for singles.

Finally, Column (4) reports the results for the marginal tax rate for the median household in each group. Similarly to what we observe in Column (3), these results show that single parents pay the lowest marginal tax rate, whereas couples without children pay the highest. In particular, median single parents are subject to a marginal tax rate of 20.7%, while median couples without children face a marginal tax rate of 27.2%.

5 Desired Income Taxes

As discussed in Section 2, we use data from [Alesina, Stantcheva, and Teso \(2018\)](#) (AST hereafter) to compare desired and effective income taxes. They collect data for France, Italy, the United Kingdom, the United States, and Sweden in 2016. The 10th wave of LIS (corresponding to surveys carried out around 2016) has data on all these countries except Sweden, allowing us to compare desired and effective tax rates for these four countries. In particular, we compare desired and effective average tax rates, the implied progressivity parameter τ and related marginal tax rates, and desired and effective average and marginal tax rates by demographic characteristics.

As discussed in Section 2, AST collects data on the desired average income tax rates for four income groups: the top 1 percent, the 2 to 10 percent, the 11 to 50 percent, and the bottom 50 percent. To compare their results to ours, we must assume that their respondents report the average tax rate for the average income for each group that we compute from LIS.

5.1 Average Tax Rates

We start by comparing the desired tax rates collected by AST with the effective average tax rates from the data. Using our LIS sample, we compute average tax rates by income group by computing the (properly weighted) average of the average tax rate facing each household in each wave-country-group cell. In particular, we construct the average tax rate for each observation in LIS as one minus the ratio of post-tax and pre-tax income.

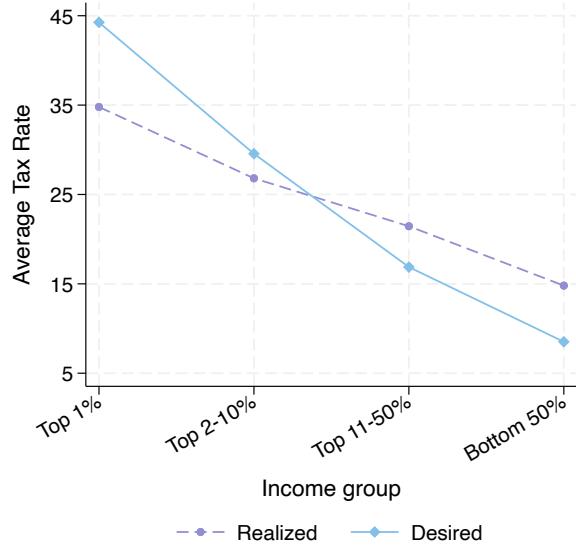
Figure 6 plots our results (which are tabulated in Table A-8 in Appendix VIII). This figure shows that the tax systems in France, Italy, the UK, and the US impose average tax rates that are different than what people desire. The differences between desired and realized tax rates range from as little as plus 1.5 percentage points for the bottom 50% of the income distribution in the UK to as much as minus 13.6 percentage points for the top 2–10% of the income distribution in the US. The differences in percentage terms are even larger. For instance, French respondents want average tax rates on the top 1% to be 27.2% higher than they are, while American respondents want average tax rates on the top 11–50% to be 58.1% lower than they are.

Figure 6 also shows that Italian and American respondents desire lower taxes along the entire income distribution. In both countries, people especially want lower taxes on the upper-middle class (top 11–50% of the income distribution). In particular, Italians desire a 15.9% average tax rate (compared to the realized 24.5%), while Americans desire a 9.4% average tax rate (compared to the realized 22.3%). On average, along the income distribution, Italians desire average tax rates that are 24.2% lower than they are, while Americans would like average tax rates to be 40.1% lower than they are.

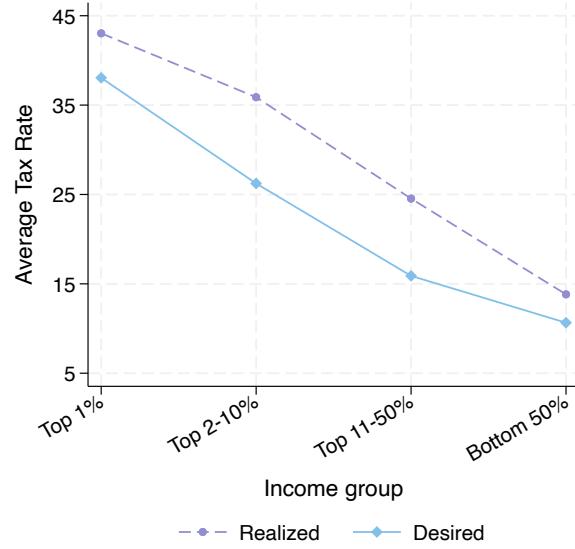
In turn, French and British respondents desire higher average tax rates for the richest but lower tax rates for the other income groups. In particular, the French desire higher tax rates for the top 1% and 2–10% to be 27.2% and 10.3% higher, respectively. The British want average tax rates to be 13.4% higher for the top 1%, instead. Respondents in both countries want the average tax rates for the lower-income groups to be lower. For instance, the French want taxes on the bottom 50% to be 42.5% lower, while the British want average tax rates on the same group to be 18.1% lower.

Figure 6: Desired vs. Realized Average Tax Rates by Country

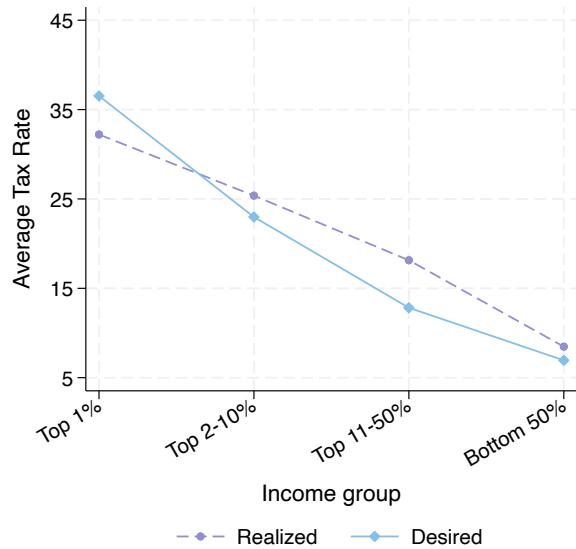
(a) France



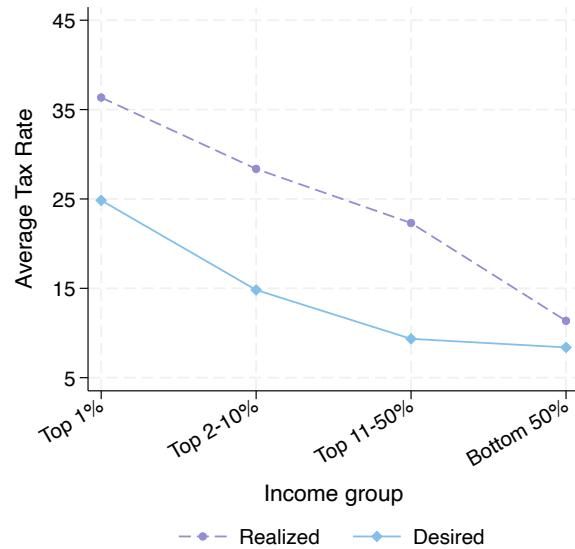
(b) Italy



(c) UK



(d) US



5.2 Progressivity

After quantifying the differences between desired and realized average tax rates, we turn to differences in desired and realized income tax progressivity. We focus on two measures of progressivity: the tax function parameter τ and the marginal income tax rate.

We retrieve the desired progressivity $\hat{\tau}$ using the AST data on desired average tax rates. In particular, let α_i be the average by country of the average tax rates reported by AST for $i = \{\text{top 1\%}, \text{top 2\%-10\%}, \text{top 11\%-50\%}, \text{bottom 50\%}\}$. Using our tax function, we can write:

$$1 - \alpha_i = (1 - \hat{\lambda})\bar{Y}_i^{-\hat{\tau}}, \text{ for } i = \{\text{top 1\%}, \text{top 2\%-10\%}, \text{top 11\%-50\%}, \text{bottom 50\%}\},$$

where $\hat{\tau}$ denotes the desired progressivity parameter and \bar{Y}_i average pre-tax income in each group calculated from LIS.

Taking logs, this becomes

$$\log(1 - \alpha_i) = \log(1 - \hat{\lambda}) - \hat{\tau} \log(\bar{Y}_i).$$

Therefore, we can derive $\hat{\tau}$ by fitting the above equation for each country. In practice, we run a country-specific OLS regression (with four observations, one for each group) of $\log(1 - \alpha_i)$ on a constant and log average pre-tax income in each group calculated from LIS, $\log(\bar{Y}_i)$. The negative of the coefficient on log average pre-tax income yields $\hat{\tau}$, which we compare to the country-specific progressivity parameter τ estimated in Section 3. Table 2 displays this comparison. In all countries, people want the income tax system to be more progressive than it is. The difference between effective and desired income tax progressivity parameters ranges from as low as 40% for the US to as much as 225% for Italy.

Table 2: Comparison of Effective (τ) and Desired ($\hat{\tau}$) Progressivity

Country	τ	$\hat{\tau}$
France	0.08	0.20
Italy	0.04	0.13
UK	0.06	0.15
USA	0.05	0.07

Once we have computed $\hat{\tau}$, we can compute the desired marginal tax rates, which are easier-to-interpret measures of income tax progressivity. To calculate the desired marginal tax rate, we use the following relationship between average and marginal tax rates implied by our tax

function.

$$\frac{1 - T'(\bar{Y}_i)}{1 - \frac{T(\bar{Y}_i)}{\bar{Y}_i}} = 1 - \hat{\tau}, \quad \text{for } i = \{\text{top 1\%, top 2-10\%, top 11-50\%, bottom 50\%}\}$$

Rearranging the equation above, the desired marginal tax rate is

$$T'(\bar{Y}_i) = 1 - (1 - \hat{\tau}) \left(1 - \frac{T(\bar{Y}_i)}{\bar{Y}_i} \right), \quad \text{for } i = \{\text{top 1\%, top 2-10\%, top 11-50\%, bottom 50\%}\}$$

where we use the desired progressivity parameter $\hat{\tau}$ and the desired average tax rates from the AST data. We compare the desired marginal tax rate to the effective one for each income group, which we compute using our estimated tax functions for each group's average pre-tax income we compute from LIS.

Figure 7 plots the differences in desired and realized marginal tax rates and displays several interesting results. First, Europeans tend to want higher marginal tax rates for everyone. This is particularly true in France and the UK, where, on average, people would like marginal tax rates to be 26.7% and 31.2% higher, respectively. In turn, people in the US want lower marginal tax rates for all income groups, especially for the upper middle class (top 11–50% of the income distribution).

Second, in Europe, the difference between desired and realized marginal tax rates decreases along the income distribution. Indeed, the French, Italian, and British want marginal tax rates to be much higher for the top 1% but not much higher for the bottom 50%. This is particularly visible in Italy. Here, people want taxes on the top 1% and top 2–10% to be 50.1% and 26.6% higher, respectively. However, the marginal tax rates on the remaining income groups are very close to the corresponding realized ones.

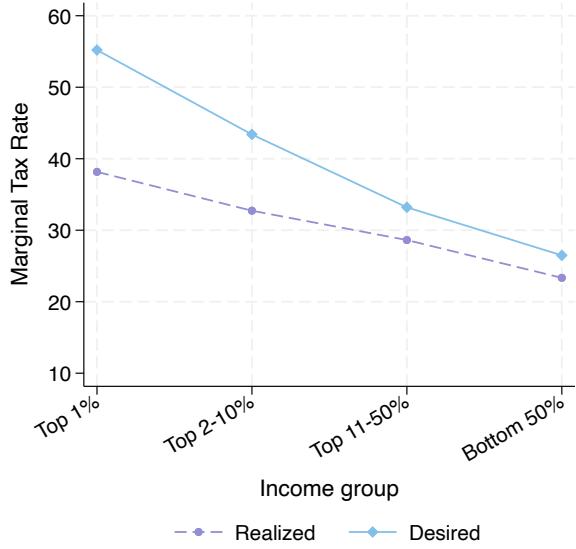
Finally, our results on the marginal tax rates confirm the findings on the progressivity parameter τ . People in all countries want the tax system to be more progressive than it is. Combining these results with those on desired average tax rates, we can conclude that people want an income tax system that imposes lower average tax rates but higher income tax progressivity.

5.3 Heterogeneity in Desired Taxes

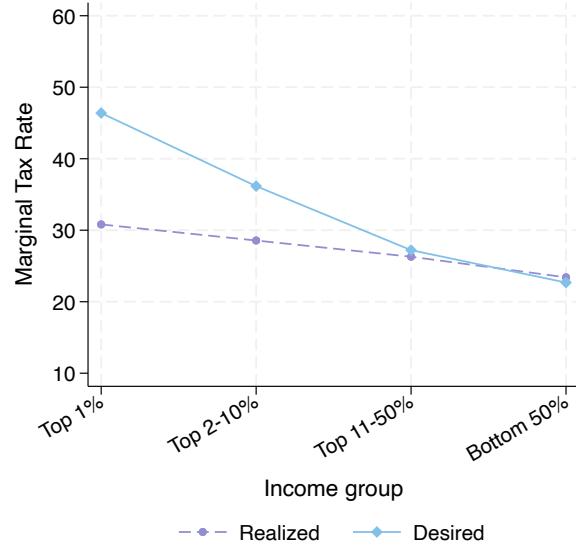
AST collects demographic data that we can use to ascertain if differences between desired and effective income taxes change by group. In particular, we compute desired taxes by 10-year age bins between 18 and 69, by education (college vs. non-college-educated people), employment status, and political leanings (that is, whether people identify with a left, center, or right

Figure 7: Desired vs. Realized Marginal Tax Rates

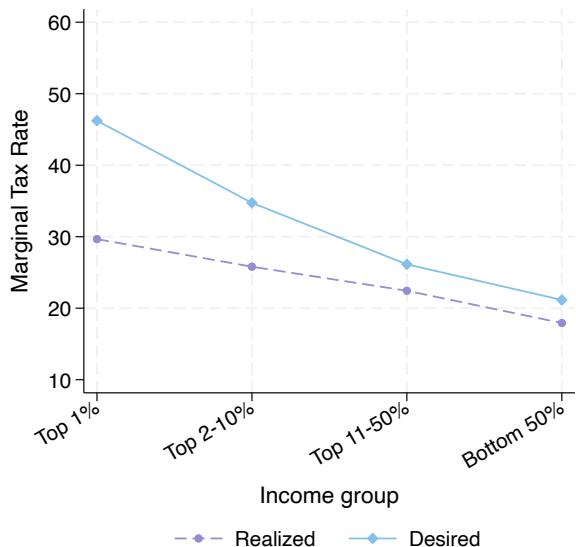
(a) France



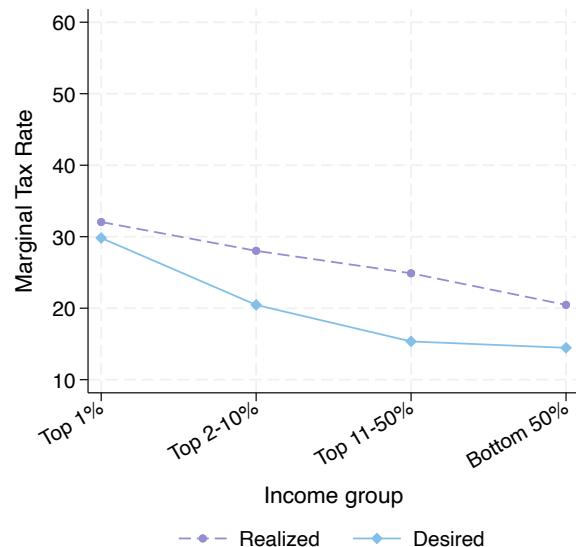
(b) Italy



(c) UK

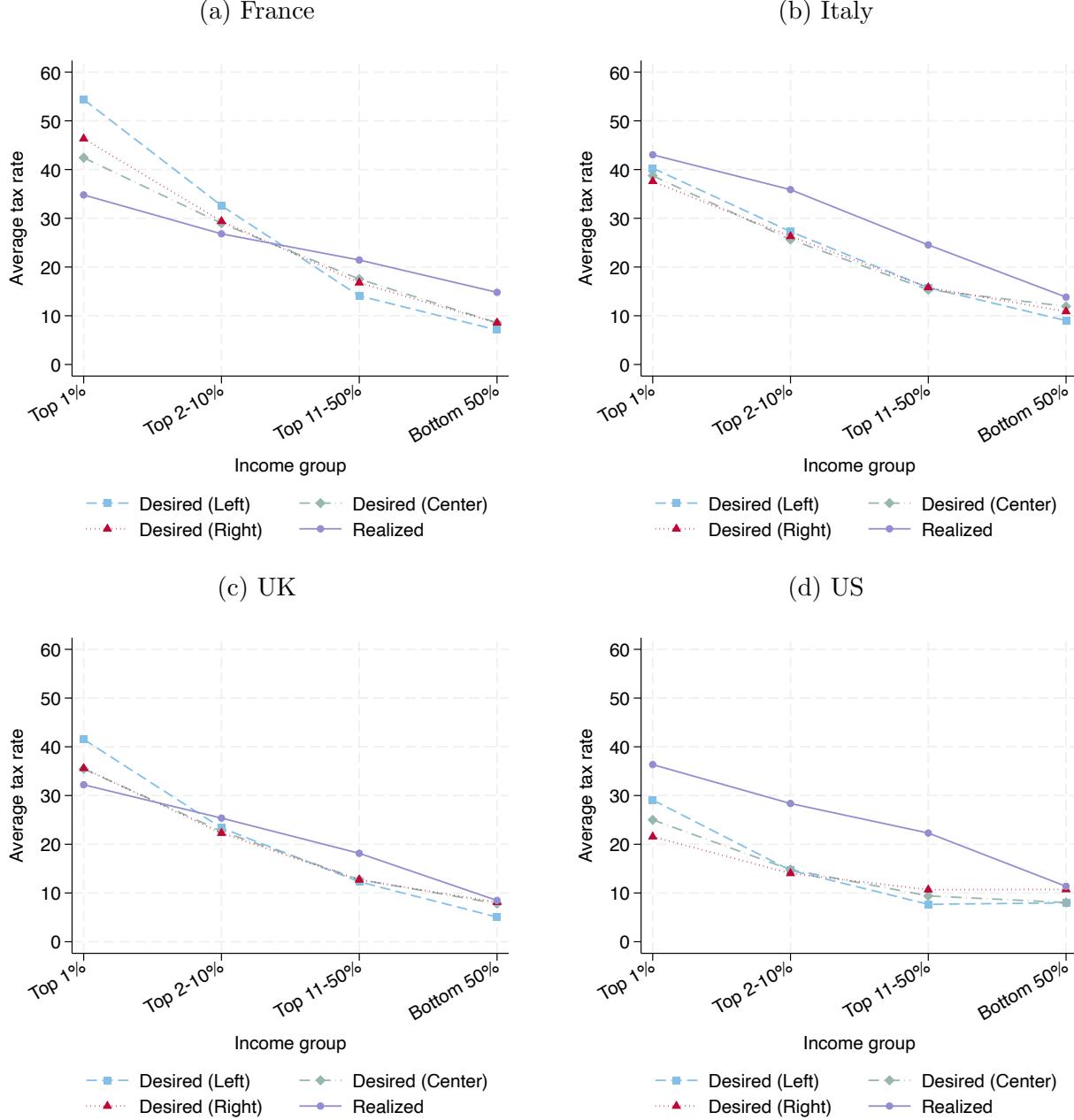


(d) US



political view). Figures A-19-A-21 in Appendix VIII show that there are no major differences in desired tax rates by age, education, and employment status. However, Figures 8 and 9 show more variation in desired average and marginal tax rates by political leaning.

Figure 8: Desired Average Tax Rates by Political Leaning



We compute desired average tax rates by political leaning by taking the average (by political leaning) of the AST-collected average tax rates for each group. Figure 8 (and the related Tables A-10 and A-11 in Appendix VIII) shows that desired average tax rates differ by political leanings. Differences are especially pronounced for tax rates on the top 1%. For instance, in the

US, left-leaning respondents would like a 29.1% average tax rate for the top 1%, while right-leaning ones would prefer a 21.6% rate. The distance between realized and desired tax rates is generally the lowest for respondents with the same political orientation as the government in charge. For instance, left-leaning respondents' desired tax rates are the closest to the realized ones in Italy. This is consistent with the center-left government in charge in Italy in 2016. Similarly, center and right-leaning desires are the closest to the realized tax rates in the UK. This is consistent with the Conservative government in power in the UK in 2016. Thus, average tax rates in 2016 are generally close the desires of the supporters of the governments in charge.

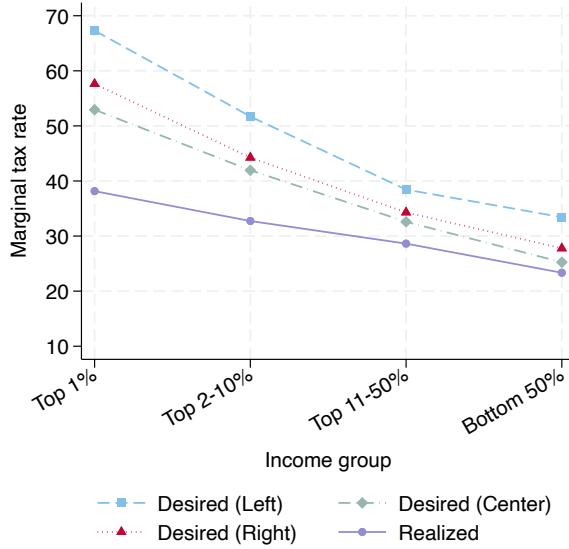
We then compute desired marginal tax rates by political leaning by adapting the procedure described in Section 5.2. In particular, we first calculate the desired progressivity parameter $\hat{\tau}$ by political leaning and then use the AST-collected desired average tax rates to compute desired marginal tax rates. Figure 9 shows large differences in desired marginal tax rates by political leaning. These differences are especially pronounced for the highest income group. For instance, France has a realized marginal tax rate for the top 1% of 38.2%. This corresponds to a desired marginal tax rate for the same group of 67.3% for left-leaning respondents and 57.6% for right-leaning ones. The differences by political leaning tend to shrink along the income distribution, as shown in Italy and the US. In these two countries, desired tax rates for the bottom 50% of the income distribution do not significantly vary with political views. Figure 9 also shows that effective marginal tax rates are not always close to those desired by the supporters of the governments in charge. For instance, despite having left-wing governments in charge, marginal tax rates in Italy and France are the closest to those desired by right and center-leaning respondents. In turn, in the UK and in the US, the effective marginal tax rates are closest to those desired by the supporters of the governments in charge (right and left-wing, respectively).

6 Conclusions

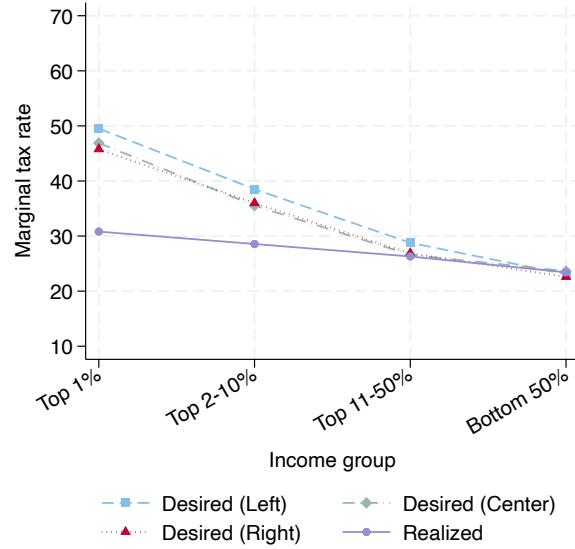
We study effective income taxes worldwide by estimating effective income tax functions over the last forty years. We start by showing that a two-parameter log-linear effective tax function approximates income tax systems worldwide remarkably well. We then analyze the dynamics of average taxation and progressivity and document a positive correlation between a higher average level of taxation and income tax progressivity. We then focus on the dynamics of income tax progressivity and uncover a positive relationship between progressivity and the level of economic development and large variations of progressivity across family structures. Finally, we combine the microdata on income and taxes with the survey data on desired taxes from France, Italy, the United Kingdom, and the United States in 2016 to measure the distance between people's

Figure 9: Desired Marginal Tax Rates by Political Leaning

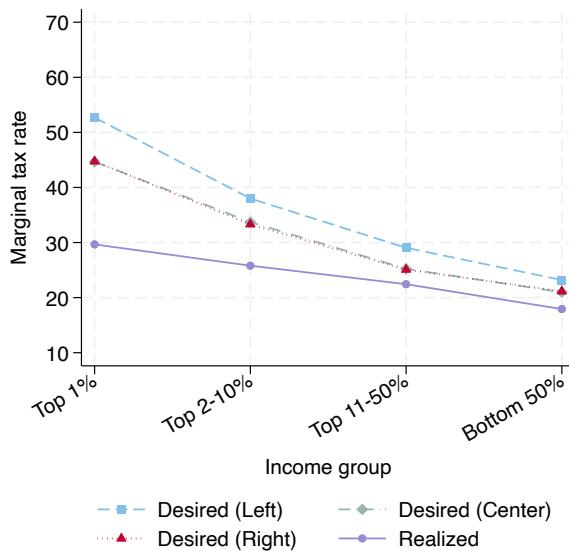
(a) France



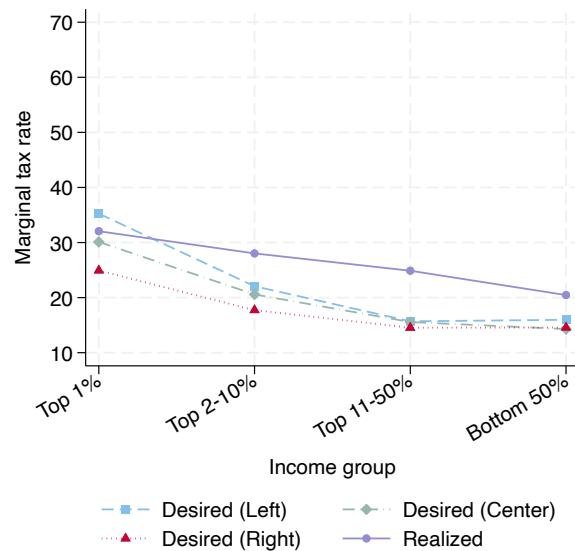
(b) Italy



(c) UK



(d) US



desires for income taxes and the ones they actually face. The paper provides numerous results and contributions.

First, we prove that a two-parameter log-linear tax function provides an excellent approximation of income tax systems around the world over the last forty years. While this is known for the United States and a limited number of other countries, we show that this result holds for over thirty countries over the last forty years. Therefore, our estimated tax function can be readily used in empirical and structural work that needs a parsimonious approximation of the income tax system. For instance, our estimated tax functions can work as inputs in a structural model that requires a simple function to map pre-tax income into the post-tax income used to make consumption and savings decisions.

Second, we document considerable variation in average taxation and progressivity across countries and years. We show a positive association between average taxation and progressivity, with Northern European countries such as Germany and the Netherlands imposing the highest average tax rate and progressivity. We also show large changes in both average tax rates and progressivity over the last forty years.

Third, we focus on the dynamics of income tax progressivity along two dimensions: economic development and family structure. Here, we show that progressivity varies significantly across levels of economic development. We document that richer countries display higher progressivity. Then, we document large and significant differences in progressivity by family structure. We estimate separate tax functions for four types of households and showed that marriage and the presence of children lead to higher progressivity. In particular, we show that childless singles face the lowest progressivity across countries and over the years while married couples with children face the highest.

Fourth, we combine the microdata on income and taxes with the survey data on desired taxes in [Alesina, Stantcheva, and Teso \(2018\)](#) to compare people's desired features of the income tax system with those they actually face. We study France, Italy, the United Kingdom, and the United States in 2016 to show that income tax systems are not what people desire them to be. In particular, our results indicate that people generally want lower average tax rates but higher income tax progressivity. We also show that, while desires do not vary much by age, education, or employment status, there is a considerable variation by political views. By quantifying the distance between the desires of people of different political leanings and the effective tax rates, we find that the realized average tax rates are the closest to the desires of the supporters of the political party representing the government in charge in 2016, but this is not always true for marginal tax rates.

We would like to highlight one caveat about interpreting and comparing our results to those in the literature. Most of our analyses focus on the progressivity embedded in income taxes

alone rather than the whole tax and transfer system. In many countries, however, transfers play a crucial role in progressivity and redistribution. Hence, tax and transfer functions (which include transfers in the measure of post-government income) may lead to vastly different estimates of progressivity than ours. Our approach is suitable for those interested in analyzing the progressivity embedded in income taxes and those wanting to incorporate a tax function in their structural models and model transfers separately.

The most promising avenue for future research relates to expanding the comparison between desired and realized features of the income tax system. Following in the footsteps of [Alesina, Stantcheva, and Teso \(2018\)](#), we could run our own survey to elicit desired tax rates for the other countries in our sample to investigate systematic differences between desires and realizations. We could also elicit desires for tax rates on different family structures, which we could compare to our estimated tax functions. Finally, it would be very interesting to also ask respondents about their perceived average tax rates to evaluate whether, beyond wanting income taxes to be different, they have an accurate perception of what their effective tax rates actually are.

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APPENDICES FOR ONLINE PUBLICATION

I LIS data

I.1 Details on Our Sample

Country	Code	Wave 1 1980	Wave 2 1985	Wave 3 1990	Wave 4 1995	Wave 5 2000	Wave 6 2004	Wave 7 2007	Wave 8 2010	Wave 9 2013	Wave 10 2016	Wave 11 2019
Australia	au						7,375	5,844	10,121	8,381	9,812	8,149
Austria	at						9,355	11,046	11,491	10,653	10,670	6,865
Belgium	be		4,789	4,636		10,183	11,579	10,264	10,836	10,360		
Brazil	br						70,845	135,253	65,621	86,448		
Canada	ca	7,094	12,464	23,850	70,294	49,255	45,803	42,267	45,330	57,776	25,089	
China	cn				12,155							
Colombia	co				101,550	224,936	270,445	360,223	356,371	351,783	228,934	
Czechia	cz		9,828	16,700	4,768	2,501	6,149	4,693	3,980	4,388		
Denmark	dk	7,404	7,784	46,532	49,301	50,183	51,713	50,175	50,256	50,093		
Dominican Republic	do						4,346					
Estonia	ee				3,396	2,170	2,476	2,484	2,827	3,117		
Finland	fi	8,580	8,677	6,632	7,527	7,627	7,004	5,968	6,850	6,116		
France	fr	22,189	25,588	19,188	40,924	184,623	64,755	65,597	92,296	87,391	84,209	26,883
Germany	de	29,367	38,192	18,651	23,690	37,109	22,242	20,196	32,372	33,706	33,336	12,368
Greece	gr						3,054	2,659	3,854	9,577		
Guatemala	gt						7,737	7,483	6,505			
Iceland	is					1,981	1,960	2,002				
Ireland	ie					3,059	9,013	7,841	7,483	8,938	7,550	2,196
Israel	il	3,199	3,271	3,137	7,766	12,134	11,929	11,717	17,247	16,706	5,474	
Italy	it					4,120	3,927	3,880	3,404	2,997		
Japan	jp						1,399	1,172	942			
Lithuania	lt							7,365	6,778	6,635	2,342	
Luxembourg	lu					2,461	2,746	3,726	2,527			
Netherlands	nl		2,953	3,582	2,966	6,686	7,069	6,831	6,491	21,041	6,811	
Norway	no	2,879	4,920	6,366	9,590	8,833	133,489	136,934	142,070	145,059	152,910	
Panama	pa						6,801	6,868	6,055	5,624		
Peru	pe					9,923	11,822	11,134	15,250	18,826		
Poland	pl			19,318								
Republic of Korea	kr						17,540	7,709	7,189	5,495		
Romania	ro			34,508								
Russian Federation	ru							8,567	50,219	150,981	62,965	
Slovakia	sk		9,920			3,187	3,061	2,877	5,593	7,545	2,386	
Spain	es						6,923	6,797	6,186	6,805		
Sweden	se	7,302	6,570	8,645	9,522	8,699	9,839					
United Kingdom	gb	3,889	3,955	4,026	58,703	74,064	51,621	45,040	41,549	34,511	32,489	10,558
United States	us	37,907	33,734	68,128	156,838	211,945	145,505	143,646	138,279	119,357	119,007	71,083
Total obs.		100,654	137,195	183,244	454,938	790,167	715,885	989,027	1,172,639	1,125,318	1,264,445	625,013
Total countries		5	10	14	15	17	23	30	31	30	27	15

Table A-1: Countries in our sample, associated ISO code, and number of observations in each wave. Blank cells denote waves for which we do not have the data we need to estimate tax functions for a certain country.

I.2 Share of Standard Households

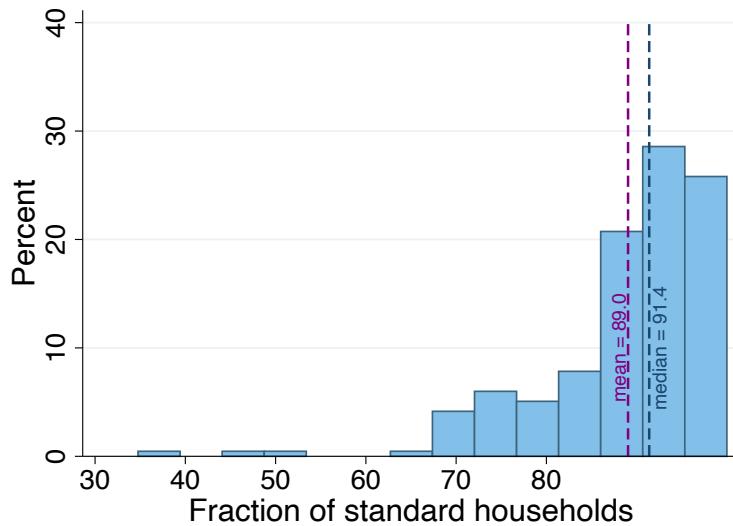


Figure A-1: Share of households with heads between 25 and 60 that qualify as Standard Households. Results for all countries and all waves in our sample.

I.3 Income Components

We take the components which define our measures of pre-tax and post-tax income directly from LIS. Therefore, we report the LIS definitions here.¹⁴

Labor income. Total income from the labor of all household members, including cash payments and value of goods and services received from dependent employment, profits/losses and value of goods from self-employment, as well as the value of own consumption.

Capital income. Cash payments from property and capital (including financial and non-financial assets), including interest and dividends, rental income and royalties, and other capital income from investment in self-employment activity. It excludes capital gains, lottery winnings, inheritances, insurance settlements, and all other forms of one-off lump sum payments.

Pensions. Total pension income from all pillars (private, occupational, public), all types (insurance, universal, assistance), and all functions (old-age, disability, survivors). Includes voluntary individual pensions, mandatory individual pensions, occupational pensions, employment-related public pensions, universal pensions, and assistance pensions.

¹⁴These definitions can also be found in the codebook at: https://www.lisdatacenter.org/wp-content/uploads/files/data-lis_codebook.pdf

Public social benefits. Cash Social Security transfers (excluding public pensions) stemming from insurance, universal or assistance schemes, and in-kind social assistance transfers.

Private transfers. Cash transfers and value of in-kind goods and services of a private nature that do not involve any institutional arrangement between the individual and the government or the employer. Includes transfers provided by non-profit institutions, other private persons/households, and other bodies in the case of merit-based education transfers.

Income taxes and contributions. Income taxes and Social Security contributions paid. Expenditures on income taxes are defined here as compulsory payments to the Government based on the current income earned, including both the amount withheld at source and the amount directly paid at the moment of the tax adjustment. Social security contributions are payroll taxes from wage and salary workers for the first and second pillars of social insurance: social security, health plans, unemployment insurance, etc.

I.4 Fit of the Tax Function in Wave 10

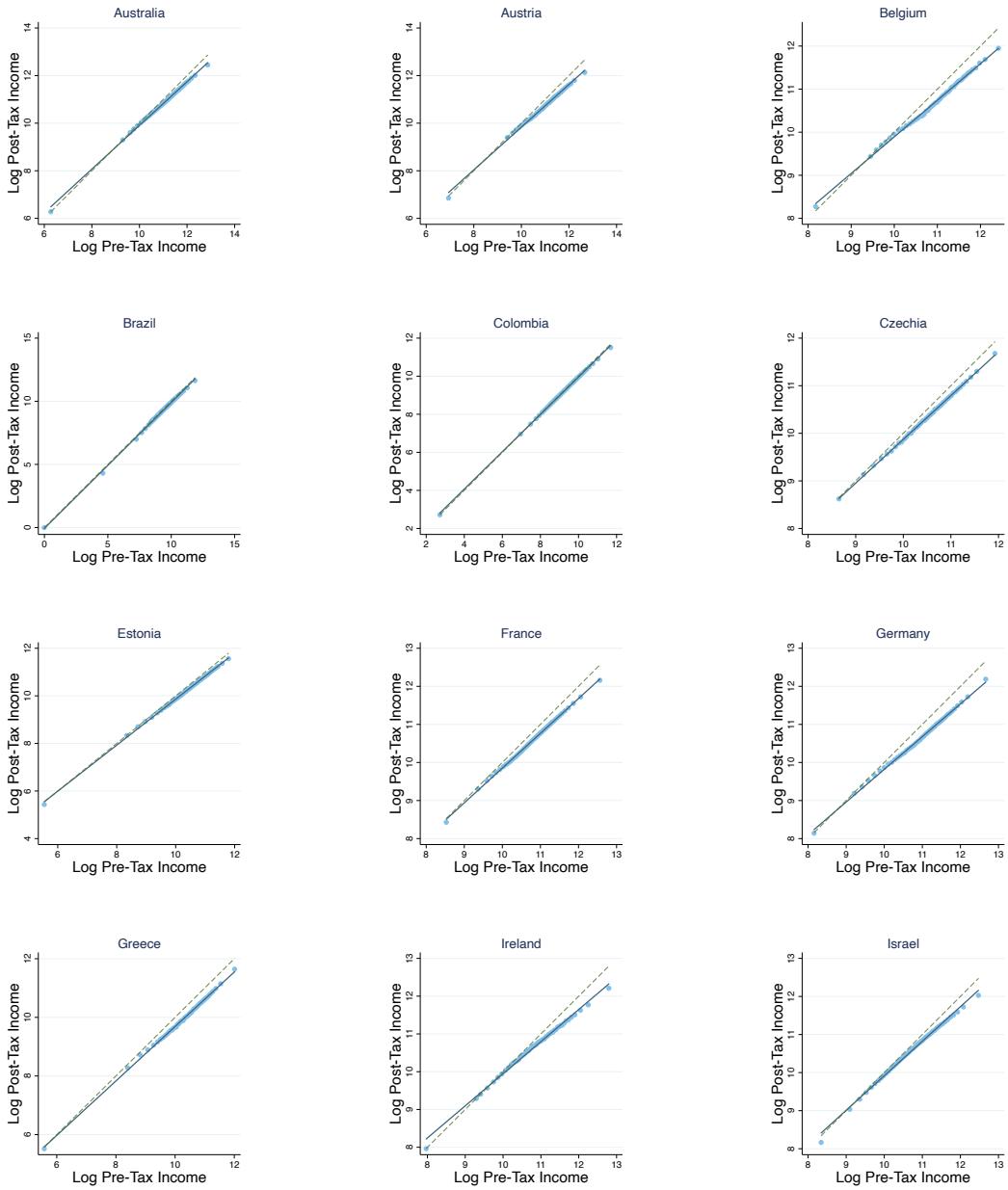


Figure A-2: Log post-tax income as a function of log pre-tax income, Wave 10. Post-tax income is defined as pre-tax income minus income taxes. Each dot is a percentile of the log pre-tax income distribution. The dashed line is the 45-degree line. The solid line is the OLS fitted line.

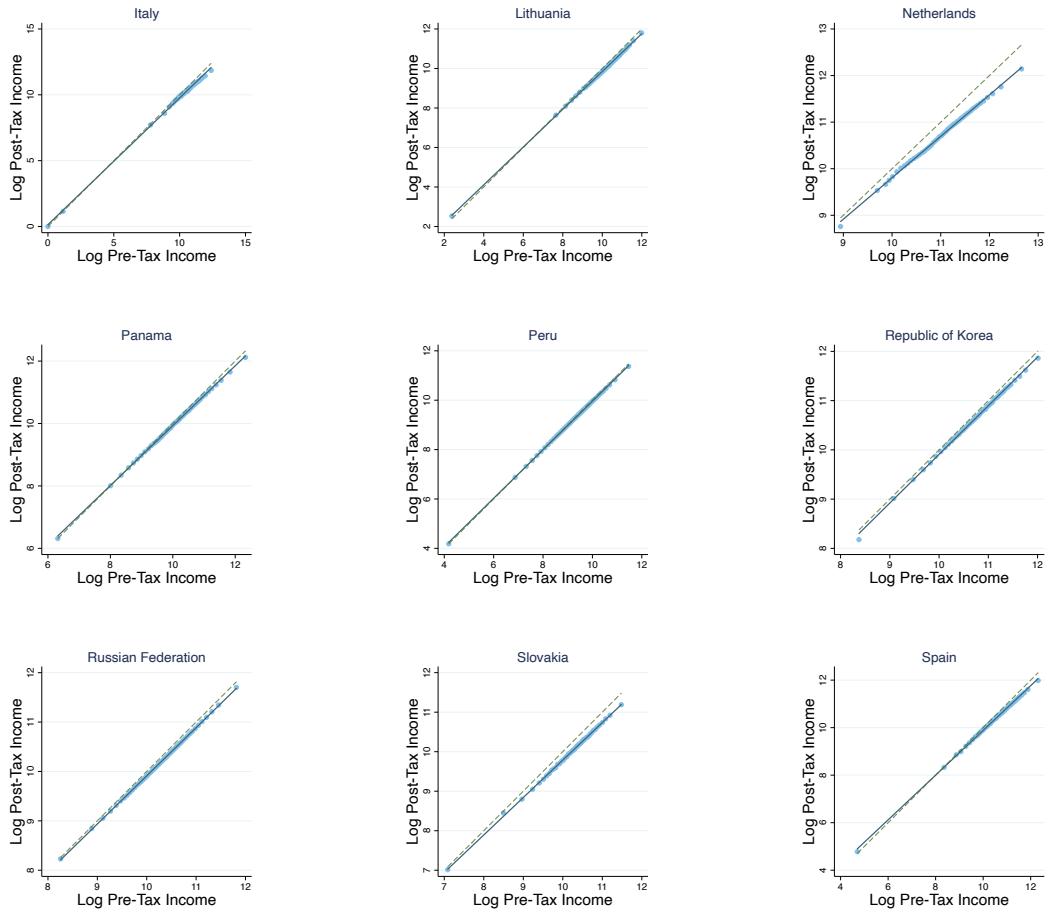


Figure A-3: Log post-tax income as a function of log pre-tax income, Wave 10. Post-tax income is defined as pre-tax income minus income taxes. Each dot is a percentile of the log pre-tax income distribution. The dashed line is the 45-degree line. The solid line is the OLS fitted line.

I.5 Details on Imputation

While for numerous countries, such as Canada, Norway, and the United Kingdom, information on income taxes and social contributions is directly observed, for several other countries, such as Australia, Israel, and the United States, income taxes and social contributions are either imputed or simulated based on available information. Table A-2 shows whether taxes and contributions are imputed in each country and wave. Unless the imputation procedures rely on a log-linear tax function similar to ours, our goodness-of-fit measures are not overestimated. To our knowledge, neither LIS nor any country-specific dataset uses a log-linear tax function to impute income taxes. Instead, they use more complex micro-simulations methods. For example, the data on income taxes for the United States come from the Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS). It uses the Census Bureau's tax model, a micro-simulation model comparable to NBER's TAXSIM, to compute federal income taxes based on information from the CPS, the Internal Revenue Service, the American Housing Service, and the State Tax Handbook.

Figure A-4 confirms that imputation does not affect our results. Here we plot the distribution of R^2 obtained when we exclude from our sample all countries and waves for which taxes and social contributions were imputed rather than observed directly. This graph shows that the mean and the median of the distribution of R^2 obtained when we exclude imputed values are the same as the ones for the overall sample.

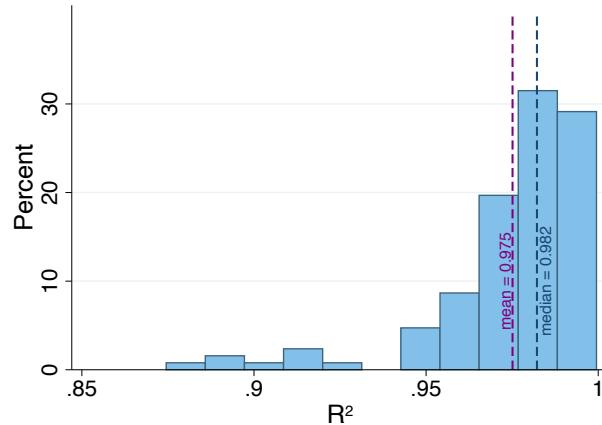


Figure A-4: Distribution of the R^2 from year-by-year and country-by-country regressions of log post-tax income on log pre-tax income when we exclude imputed values

Country	Wave 1 1980	Wave 2 1985	Wave 3 1990	Wave 4 1995	Wave 5 2000	Wave 6 2004	Wave 7 2007	Wave 8 2010	Wave 9 2013	Wave 10 2016	Wave 11 2018
Australia						yes	yes	yes	yes	yes	yes
Austria						no	no	no	no	no	no
Belgium		yes	yes			yes	yes	yes	yes	yes	yes
Brazil						yes	yes	yes	yes	yes	yes
Canada	no	no									
China				no							
Colombia					yes	yes	yes	yes	yes	yes	yes
Czechia		no	no	yes	no	no	no	no	yes	yes	yes
Denmark	no	no									
Dominican Republic						no					
Estonia					no	yes	yes	yes	yes	yes	yes
Finland	no	no									
France	no	no	yes	no	no						
Germany	no	no	yes	yes							
Greece						yes	yes	yes	yes	yes	yes
Guatemala						no	yes	yes	yes		
Iceland						no	no	no			
Ireland					no	no	no	no	no	no	no
Israel	yes	yes									
Italy					yes	yes	yes	yes	yes	yes	yes
Japan						yes	yes	yes	yes		
Lithuania							no	no	no	no	no
Luxembourg						no	no	no	no		
Netherlands		yes	no	no							
Norway	no	no									
Panama						yes	yes	yes	yes	yes	
Peru						no	no	no	no	no	
Poland				no							
Republic of Korea						no	no	no	no	no	
Romania					no						
Russian Federation							yes	yes	yes	yes	yes
Slovakia			no			no	no	no	yes	yes	yes
Spain						no	no	no	no	no	
Sweden	no	no	no	no	no	no					
United Kingdom	no	no									
United States	yes	yes									
Percent Imp.	20	20	43	27	35	35	40	45	53	52	47

Table A-2: This table shows which country-wave pair has an imputed measure of income taxes. “yes” means taxes are imputed, while “no” means taxes are directly observed. In the last row, we compute the percentage of countries with imputed income taxes in each wave.

II Effective Taxes Across Countries

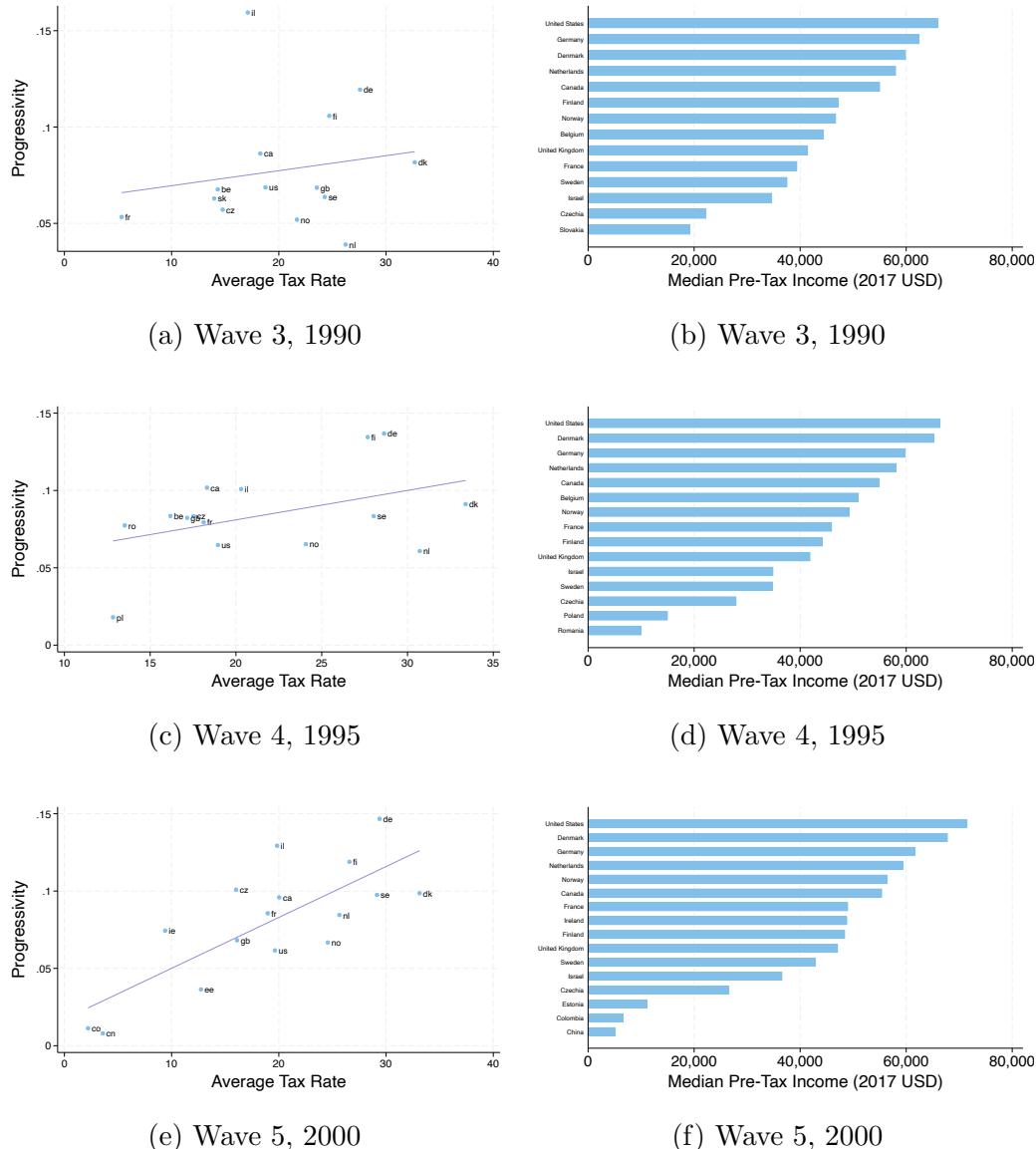


Figure A-5: Tax Parameters Across Countries. Panels on the left: progressivity as a function of the average tax rate in a given wave. The average tax rate is evaluated at the median income of each country. The solid lavender line is the OLS fitted line. Panels on the right: pre-tax median income measured in 2017 USD PPP.

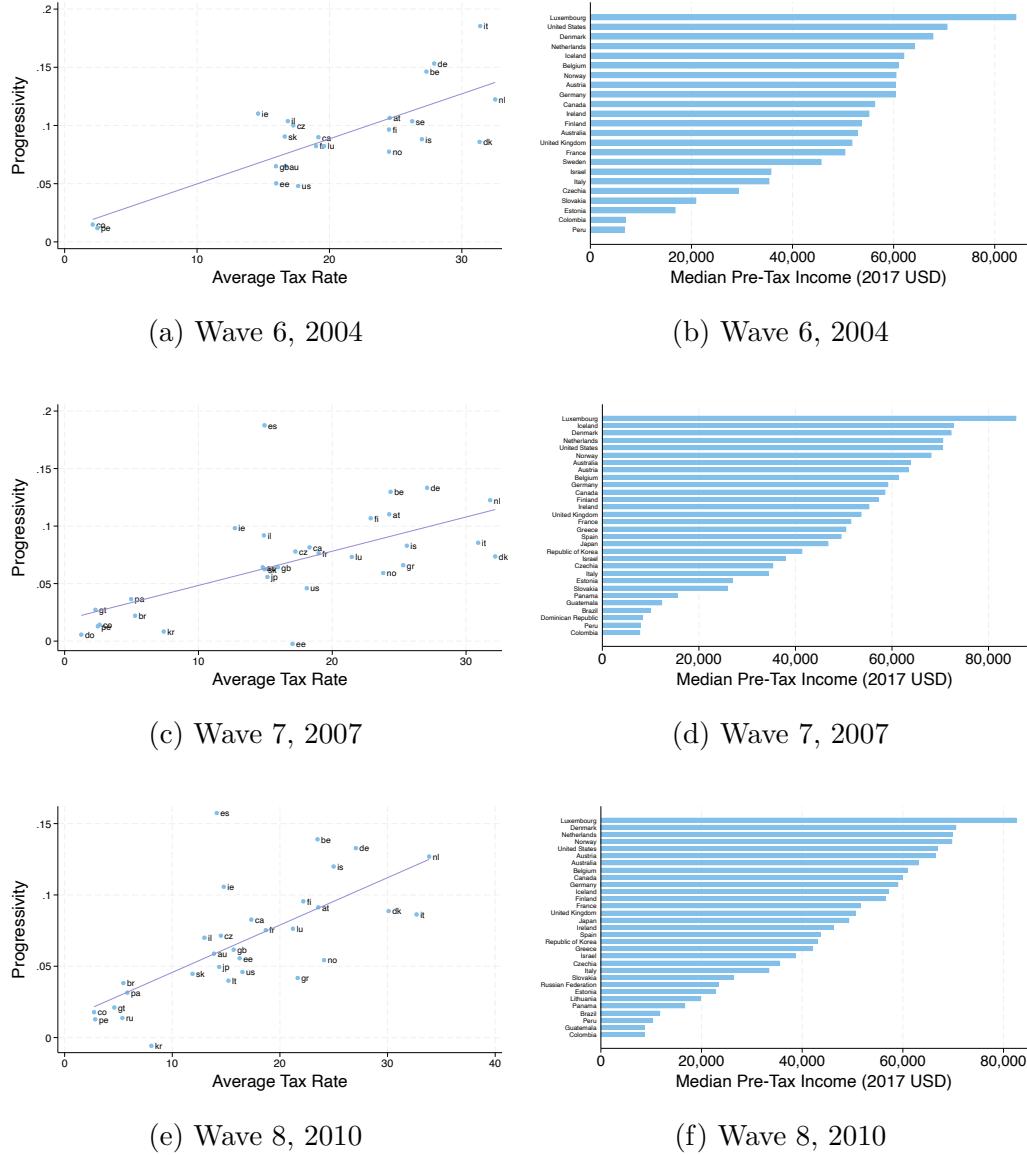


Figure A-6: Tax Parameters Across Countries. Panels on the left: progressivity as a function of the average tax rate in a given wave. The average tax rate is evaluated at the median income of each country. The solid lavender line is the OLS fitted line. Panels on the right: pre-tax median income measured in 2017 USD PPP.

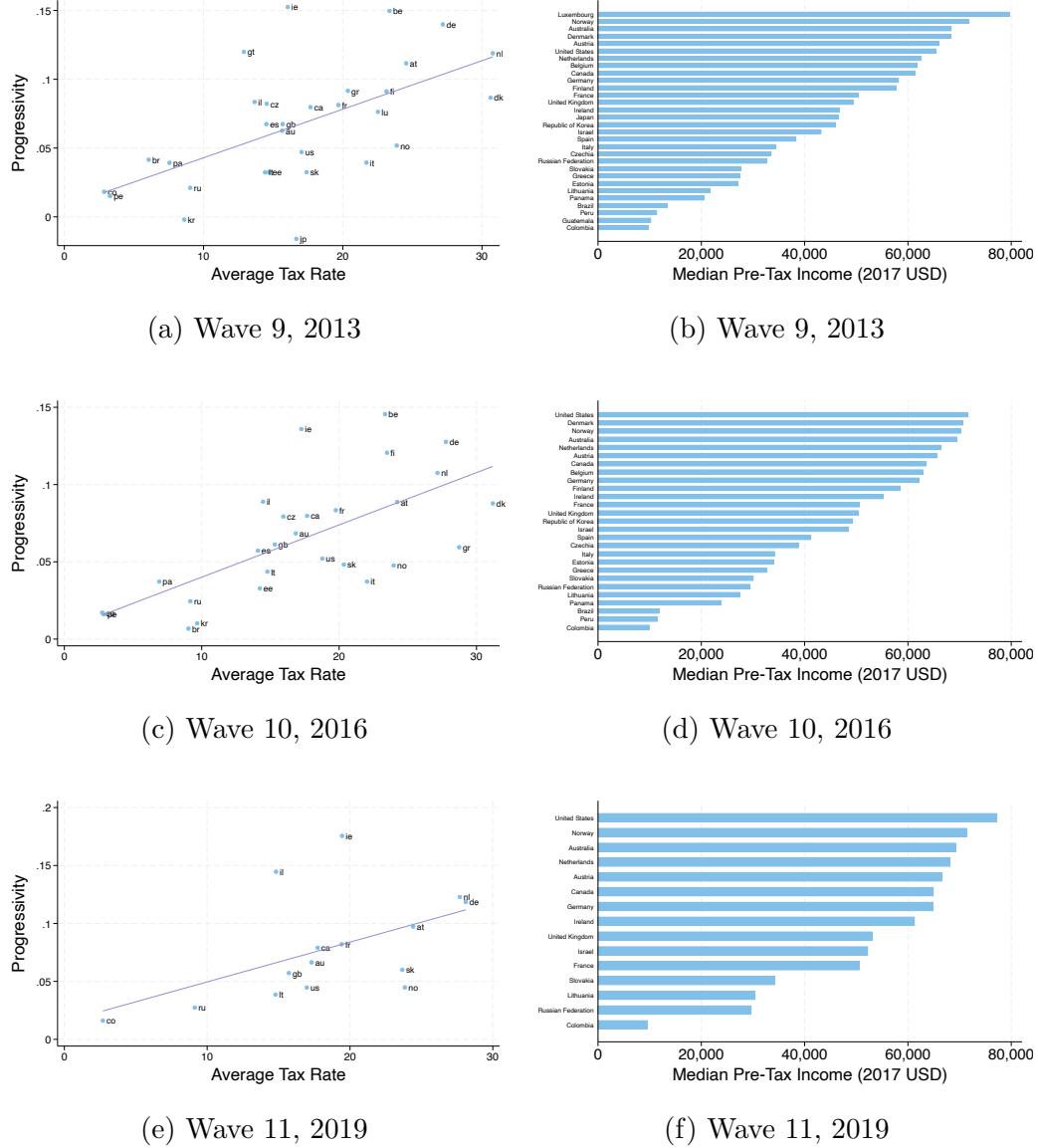


Figure A-7: Tax Parameters Across Countries. Panels on the left: progressivity as a function of the average tax rate in a given wave. The average tax rate is evaluated at the median income of each country. The solid lavender line is the OLS fitted line. Panels on the right: pre-tax median income measured in 2017 USD PPP.

Country	Wave										
	1 1980	2 1985	3 1990	4 1995	5 2000	6 2004	7 2007	8 2010	9 2013	10 2016	11 2019
Australia						16.70	14.81	13.87	15.65	16.85	17.31
Austria						24.55	24.26	23.56	24.56	24.23	24.43
Belgium		14.30	16.18			27.32	24.36	23.49	23.35	23.34	
Brazil						5.26	5.45	6.06	9.03		
Canada	17.99	18.27	18.31	20.04	19.17	18.30	17.34	17.68	17.67	17.74	
China				3.59							
Colombia				2.21	2.12	2.61	2.73	2.86	2.76	2.70	
Czechia		14.76	17.52	16.01	17.27	17.24	14.51	14.54	15.94		
Denmark	31.53	32.68	33.39	33.13	31.34	32.18	30.10	30.61	31.19		
Dominican Republic						1.25					
Estonia					12.74	15.98	17.03	16.26	14.69	14.23	
Finland	26.60	24.70	27.68	26.58	24.50	22.87	22.17	23.14	23.49		
France	5.98	6.04	5.34	18.12	18.96	18.99	18.98	18.69	19.69	19.76	19.42
Germany	21.30	26.20	27.58	28.63	29.39	27.91	27.08	27.05	27.18	27.77	28.11
Greece						25.30	21.65	20.37	28.74		
Guatemala						2.31	4.62	12.89			
Iceland						26.98	25.57	24.99			
Ireland				9.40	14.61	12.72	14.78	16.05	17.25	19.44	
Israel	19.48	17.11	20.30	19.84	16.86	14.89	12.99	13.66	14.46	14.83	
Italy					31.39	30.91	32.70	21.70	22.03		
Japan						15.15	14.36	16.67			
Lithuania							15.22	14.42	14.78	14.78	
Luxembourg						19.60	21.46	21.21	22.52		
Netherlands	26.22	30.72	25.65	32.52	31.80	33.86	30.78	27.16	27.69		
Norway	24.00	21.69	24.07	24.57	24.50	23.80	24.10	23.88	23.97	23.84	
Panama						4.97	5.82	7.56	6.90		
Peru						2.47	2.48	2.84	3.28	2.88	
Poland			12.84								
Republic of Korea						7.40	8.06	8.62	9.67		
Romania			13.52								
Russian Federation							5.36	9.04	9.17	9.13	
Slovakia	13.97				16.62	14.93	11.88	17.41	20.34	23.66	
Spain						14.93	14.14	14.51	14.09		
Sweden	30.45	32.48	24.28	28.03	29.16	26.25					
United Kingdom	20.12	22.57	23.54	17.16	16.10	15.96	15.93	15.70	15.68	15.32	15.72
United States	19.33	19.55	18.75	18.95	19.63	17.64	18.10	16.52	17.04	18.78	16.98

Table A-3: Average tax rate across countries and waves. The average tax rate is evaluated at the median income of each country in each wave.

Country	Wave										
	1 1980	2 1985	3 1990	4 1995	5 2000	6 2004	7 2007	8 2010	9 2013	10 2016	11 2019
Australia						0.07	0.06	0.06	0.06	0.07	0.07
Austria						0.11	0.11	0.09	0.11	0.09	0.10
Belgium		0.07	0.08			0.15	0.13	0.14	0.15	0.15	
Brazil						0.02	0.04	0.04	0.04	0.01	
Canada	0.07	0.09	0.10	0.10	0.09	0.08	0.08	0.08	0.08	0.08	0.08
China				0.01							
Colombia				0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Czechia		0.06	0.08	0.10	0.10	0.08	0.07	0.08	0.08	0.08	
Denmark	0.06	0.08	0.09	0.10	0.09	0.07	0.09	0.09	0.09	0.09	
Dominican Republic						0.01					
Estonia					0.04	0.05	0.00	0.06	0.03	0.03	
Finland	0.13	0.11	0.13	0.12	0.10	0.11	0.10	0.09	0.12		
France	0.04	0.03	0.05	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08
Germany	0.08	0.11	0.12	0.14	0.15	0.15	0.13	0.13	0.14	0.13	0.12
Greece						0.07	0.04	0.09	0.06		
Guatemala						0.03	0.02	0.12			
Iceland						0.09	0.08	0.12			
Ireland					0.07	0.11	0.10	0.11	0.15	0.14	0.18
Israel	0.14	0.16	0.10	0.13	0.10	0.09	0.07	0.08	0.09	0.14	
Italy						0.19	0.09	0.09	0.04	0.04	
Japan						0.06	0.05	-0.02			
Lithuania							0.04	0.03	0.04	0.04	
Luxembourg						0.08	0.07	0.08	0.08		
Netherlands		0.04	0.06	0.08	0.12	0.12	0.13	0.12	0.11	0.12	
Norway	0.08	0.05	0.07	0.07	0.08	0.06	0.05	0.05	0.05	0.04	
Panama						0.04	0.03	0.04	0.04		
Peru						0.01	0.01	0.01	0.02	0.02	
Poland			0.02								
Republic of Korea							0.01	-0.01	0.00	0.01	
Romania			0.08								
Russian Federation							0.01	0.02	0.02	0.03	
Slovakia		0.06			0.09	0.06	0.04	0.03	0.05	0.06	
Spain						0.19	0.16	0.07	0.06		
Sweden	0.07	0.10	0.06	0.08	0.10	0.10					
United Kingdom	0.06	0.07	0.07	0.08	0.07	0.07	0.06	0.06	0.07	0.06	0.06
United States	0.07	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.04

Table A-4: Progressivity across countries and waves. Progressivity is measured by the tax function parameter τ .

Country	Wave										
	1 1980	2 1985	3 1990	4 1995	5 2000	6 2004	7 2007	8 2010	9 2013	10 2016	11 2019
Australia						52833	63831	63139	68425	69480	69272
Austria						60440	63462	66436	65999	65605	66523
Belgium		44374	50970			60974	61359	60949	61815	62912	
Brazil						9969	11746	13448	11854		
Canada	58589	55039	54902	55426	56308	58583	59940	61359	63538	64952	
China					5109						
Colombia				6616	6959	7789	8629	9775	9922	9605	
Czechia		22270	27937	26609	29337	35355	35568	33554	38820		
Denmark	63405	59922	65271	67819	67826	72294	70573	68398	70679		
Dominican Republic						8306					
Estonia				11176	16813	26981	22813	27065	33955		
Finland	44338	47202	44161	48436	53686	57240	56579	57699	58501		
France	37972	38219	39411	45959	49001	50408	51524	51642	50463	50681	50574
Germany	66165	57331	62449	59856	61642	60379	59184	59042	58203	62162	64867
Greece						50483	41991	27502	32657		
Guatemala						12341	8688	10248			
Iceland						62056	72758	57102			
Ireland				48835	55166	55271	46189	46681	55166	61292	
Israel	30709	34669	34899	36593	35778	37934	38685	43192	48460	52240	
Italy					35380	34472	33416	34468	34166		
Japan						46789	49301	46602			
Lithuania							19730	21703	27463	30415	
Luxembourg						84238	85716	82504	79650		
Netherlands		58052	58081	59433	64196	70566	69892	62474	66463	68186	
Norway	51565	46728	49306	56444	60518	68145	69766	71783	70277	71361	
Panama						15592	16714	20548	23875		
Peru						6816	7928	10290	11406	11555	
Poland			15000								
Republic of Korea							41378	42980	45973	49326	
Romania			10061								
Russian Federation								23421	32611	29446	29679
Slovakia		19193			20915	25949	26334	27601	30098	34269	
Spain						49504	43639	38369	41130		
Sweden	33117	36228	37553	34829	42925	45702					
United Kingdom	35398	36468	41427	41894	47094	51803	53648	50650	49439	50443	53035
United States	68412	67225	65980	66430	71503	70622	70509	66836	65500	71532	77188

Table A-5: Pre-tax median income measured in 2017 USD PPP across countries and waves.

III Effective Taxes Over Time

Numerous factors affect effective taxation over time. First, tax laws determine the levels of statutory taxation, and thus tax reforms translate into changes in effective taxation. Second, taxpayers' behavior influences effective taxation, as people can change their labor choices based on the incentives or disincentives provided by the tax laws. Finally, the business cycle affects tax laws and labor choices and thus affects effective taxation. While disentangling the effect of each of these factors on effective income taxes goes beyond the scope of our paper, we can still observe some interesting patterns.

In Figures [A-8-A-11](#), we show the evolution of the average tax rate for the median household and progressivity for the countries in our sample. First, we observe interesting dynamics in the average tax rate for the median household. In Canada, Denmark, Finland, Norway, and the United States, the average tax rate has remained relatively stable over the past 40 years, despite a general increase in median income. For instance, the average tax rate in Canada is 17.79% in 1985 (corresponding to a median income of \$ 58,589) and 17.74% in 2019 (for a median income of \$ 64,952). Then, in the United States, the average tax rate has its largest reduction between 2000 and 2010, when it drops from 19.63% to 16.52%. This decline is due to the reduction in median income over those years and the 2001 and 2003 income tax reforms collectively known as the “Bush tax cuts” (see [Borella, De Nardi, Pak, Russo, and Yang \(2023\)](#) for a more in-depth description of these reforms and their effects on the effective tax burden.) In turn, the average tax rate for the median household has changed substantially in the United Kingdom. It increases between 1980 and 1990, despite the substantial reductions in income taxes carried out by Margaret Thatcher’s government (see [Daunton \(2017\)](#) for a description of the Thatcher tax reforms.) It then decreases markedly between 1990 and 1995 and remained stable ever since. Figure [A-8](#) shows that progressivity in Australia decreases between 2005 and 2010 and increases between 2010 and 2015. Our results are remarkably close, in both levels and trends, to those in [Tran and Zakariyya \(2021\)](#), which estimates progressivity for Australia using a log-linear tax function and the Household, Income and Labour Dynamics in Australia Survey (HILDA). They argue that the decrease in progressivity between 2005 and 2010 is due to an increase in the top income threshold in 2006, which results in a tax cut for high-income taxpayers. Then, Figure [A-11](#) shows that the average tax rate in Spain decreases between 2008 and 2010, increases between 2010 and 2013, and then drops again between 2013 and 2016. These movements are consistent with the reforms in the Spanish income tax described in [García-Miralles, Guner, and Ramos \(2019\)](#). In particular, the Spanish government cut taxes after the Great Recession in 2008, raised them between 2010 and 2012 to contrast a fall in GDP, and cut them again in 2015 after the economic recovery following the Great Recession.

Second, we observe significant changes in the level of income tax progressivity across countries. To fix the scale of these changes, recall that the elasticity of post-tax income to pre-tax income is $1 - \tau$. Thus, a change in 0.01 in τ implies a one percentage point change in the response of post-tax income to the pre-tax one. The United States sees a general decrease in progressivity over the last 40 years. In particular, progressivity in 2018 was about 40 percent lower than in 1980. The decrease in progressivity in the United States between 1980 and 2018 is consistent with the findings of [Wu \(2021\)](#) and [Borella, De Nardi, Pak, Russo, and Yang \(2023\)](#). The United Kingdom and Canada display a similar evolution of progressivity: it increases between 1985 and 1995 and then declines. Compared to its 1995 level, progressivity in 2018 is a third lower in the United Kingdom and a quarter lower in Canada. Progressivity increases in the Scandinavian countries between 1990 and 1995 but then shows different dynamics. In Denmark, progressivity grows until 2000, decreases markedly between 2000 and 2006, rebounds, and stabilizes after 2010. In Norway, in turn, it grows until 2004 but declines after then and, in 2018, is about half the size of 2004. Finally, progressivity declines between 1995 and 2013 but rebounded to its 2000 level in 2018. In Finland, finally, progressivity drops between 1995 and 2004, is relatively stable until 2013, and increases between 2013 and 2016.

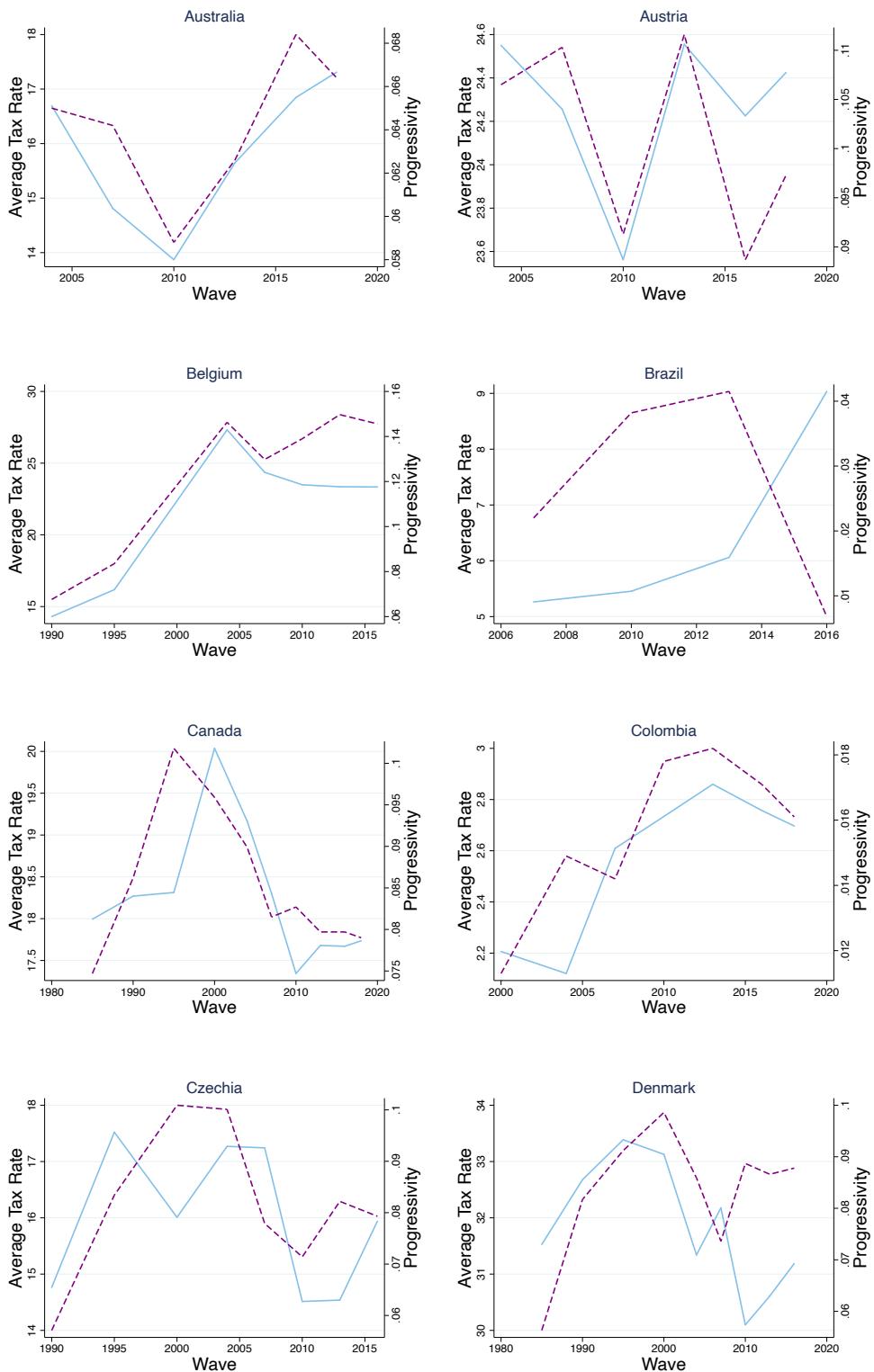


Figure A-8: Average tax rate and progressivity over time. The solid blue line is the average tax rate for the median household. The dashed purple line is the progressivity parameter τ .

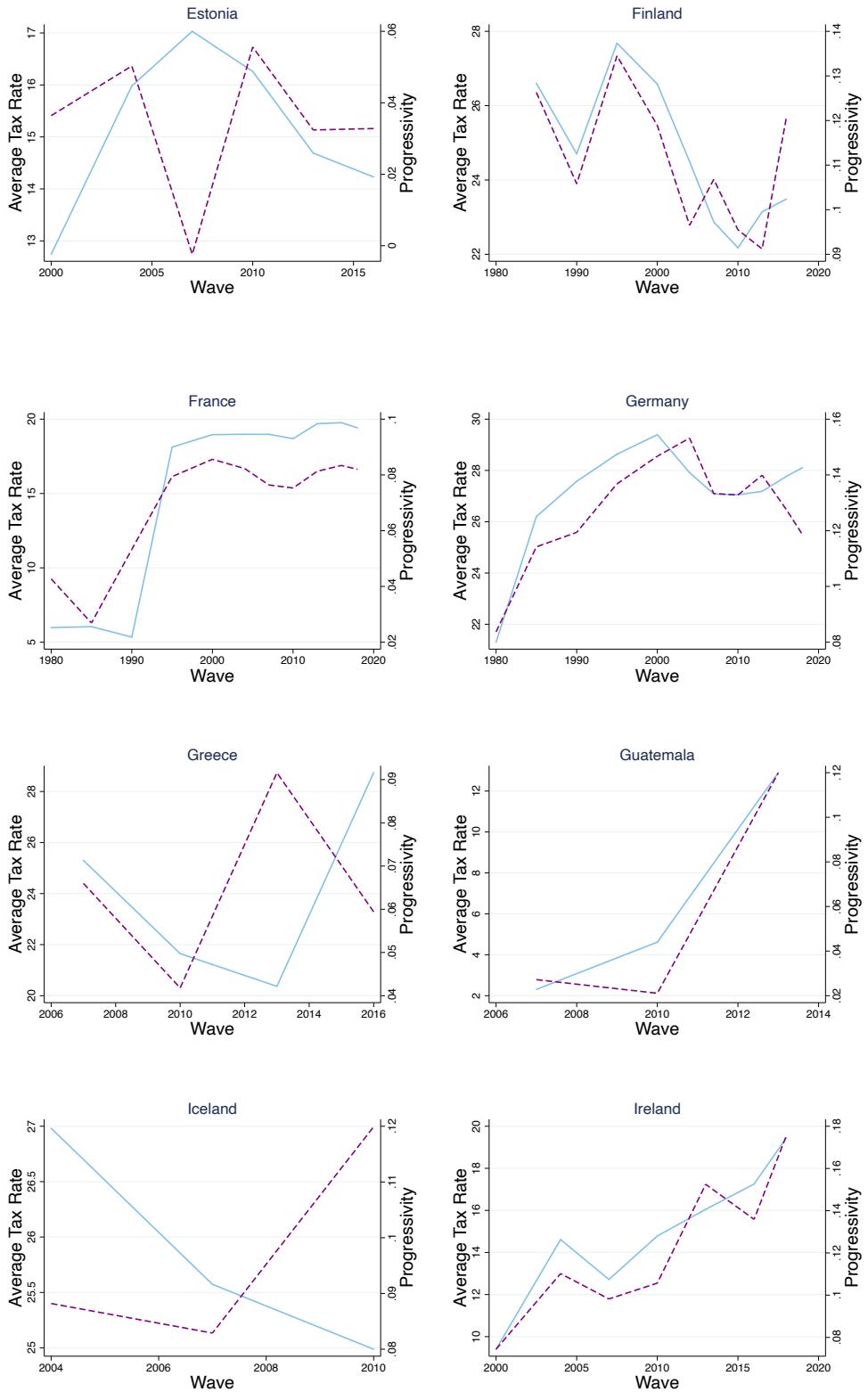


Figure A-9: Average tax rate and progressivity over time. The solid blue line is the average tax rate for the median household. The dashed purple line is the progressivity parameter τ .

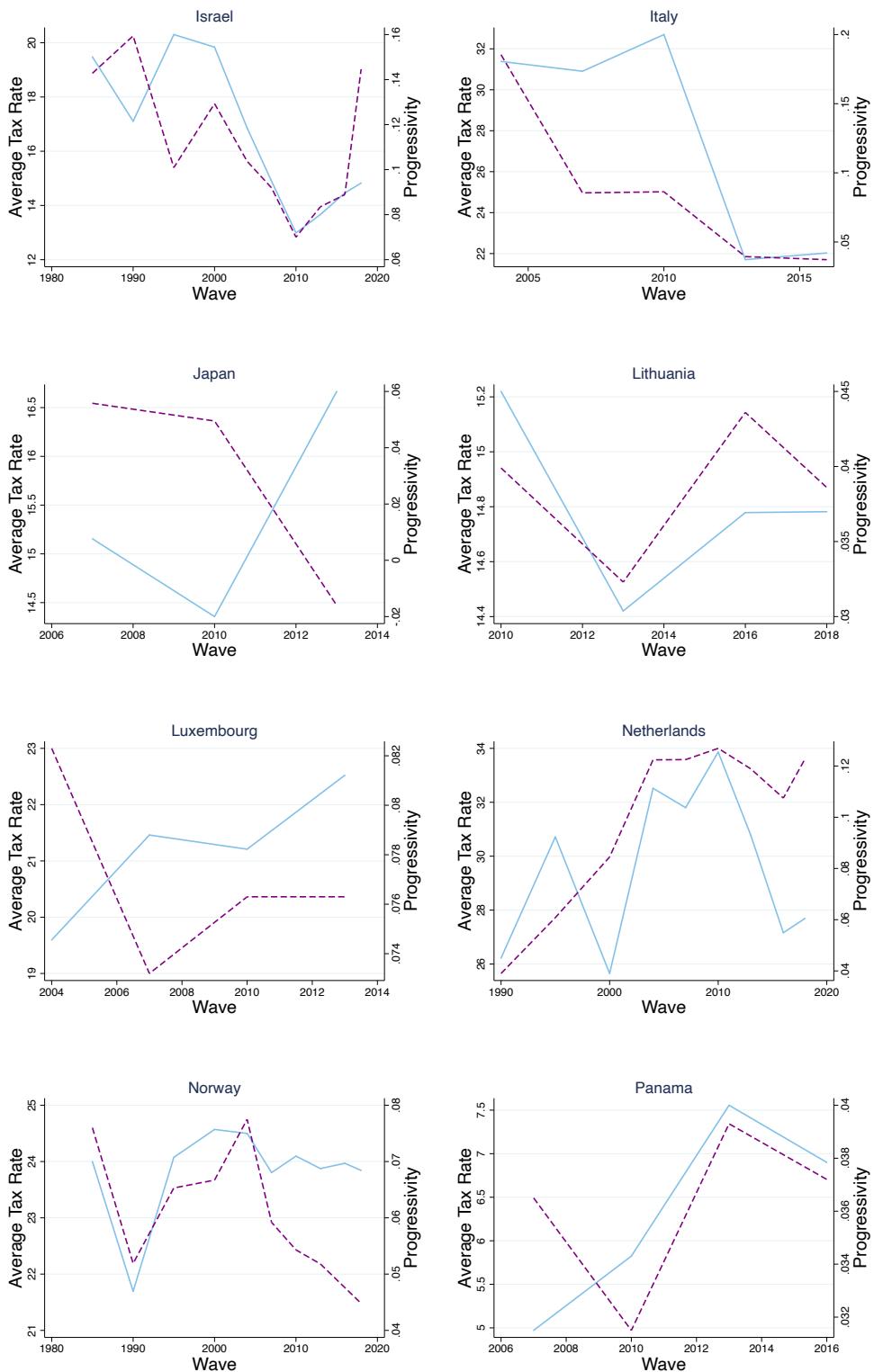


Figure A-10: Average tax rate and progressivity over time. The solid blue line is the average tax rate for the median household. The dashed purple line is the progressivity parameter τ .

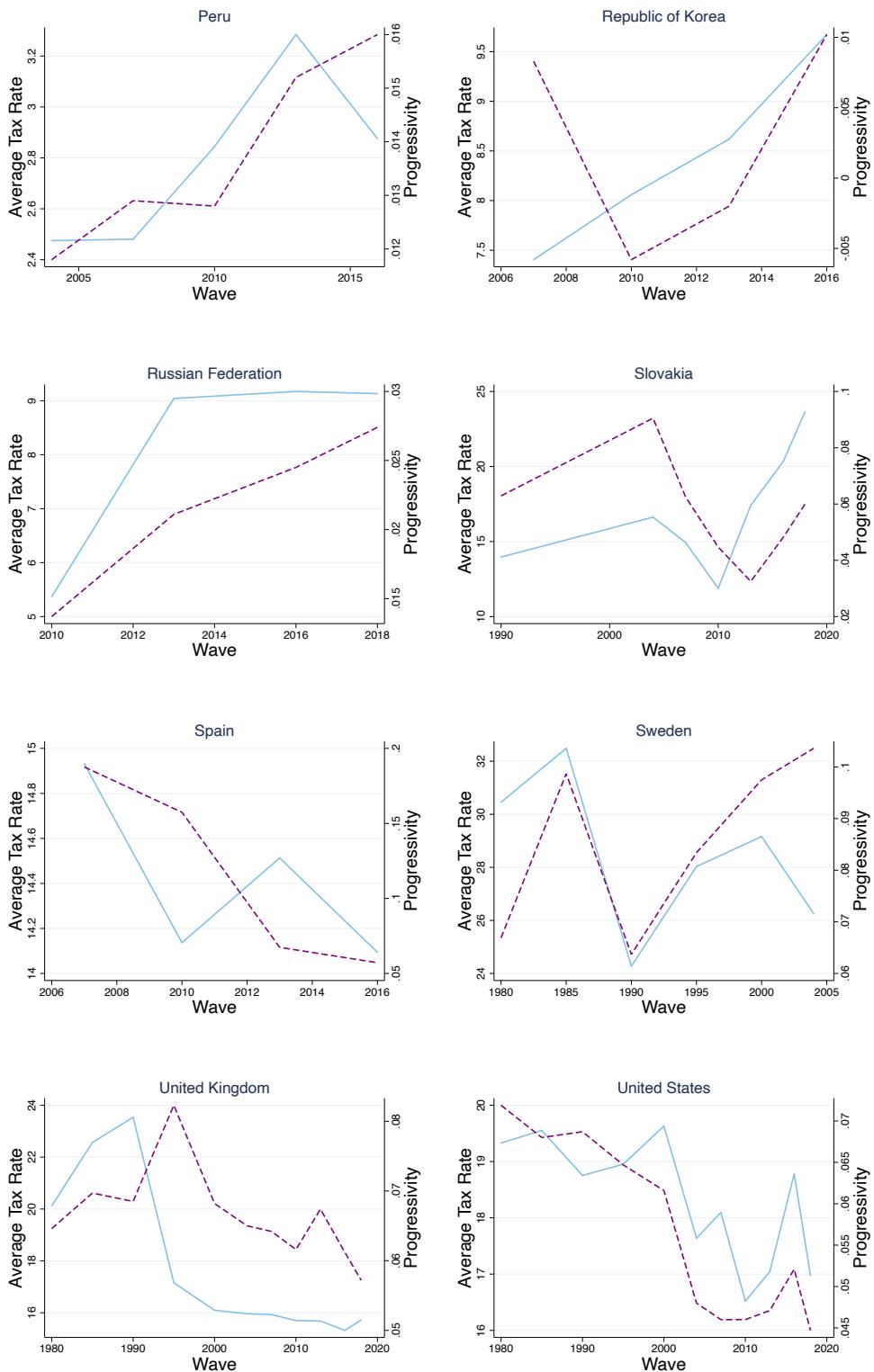


Figure A-11: Average tax rate and progressivity over time. The solid blue line is the average tax rate for the median household. The dashed purple line is the progressivity parameter τ .

IV Progressivity and Development

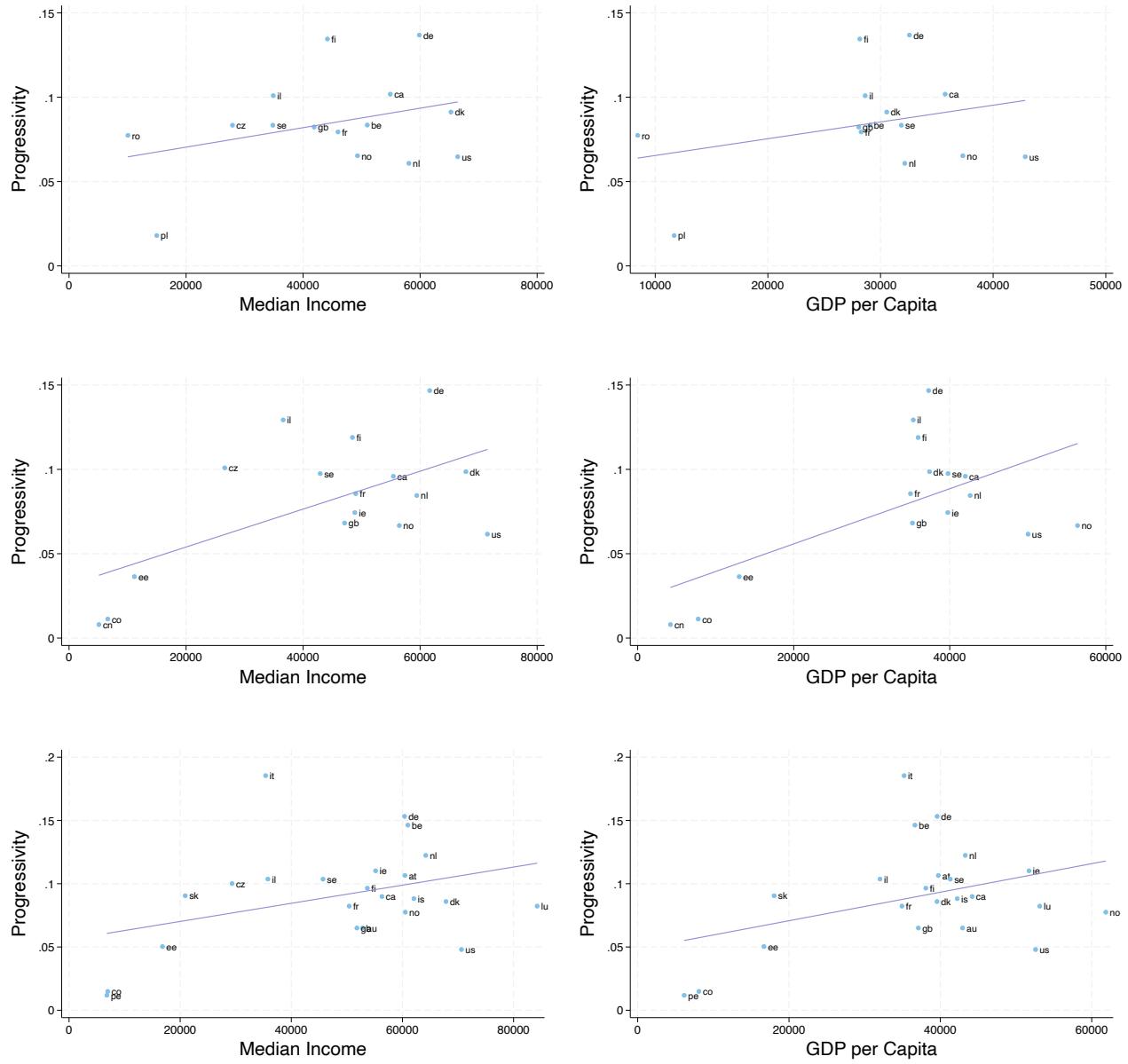


Figure A-12: Progressivity as a function of median income and GDP per capita. Left panels: progressivity as a function of median income. Right panels: progressivity as a function of GDP per capita. Progressivity is measured by the parameter τ . GDP per capita comes from the Penn World Tables and is measured at chained PPP and in 2017 US dollars.

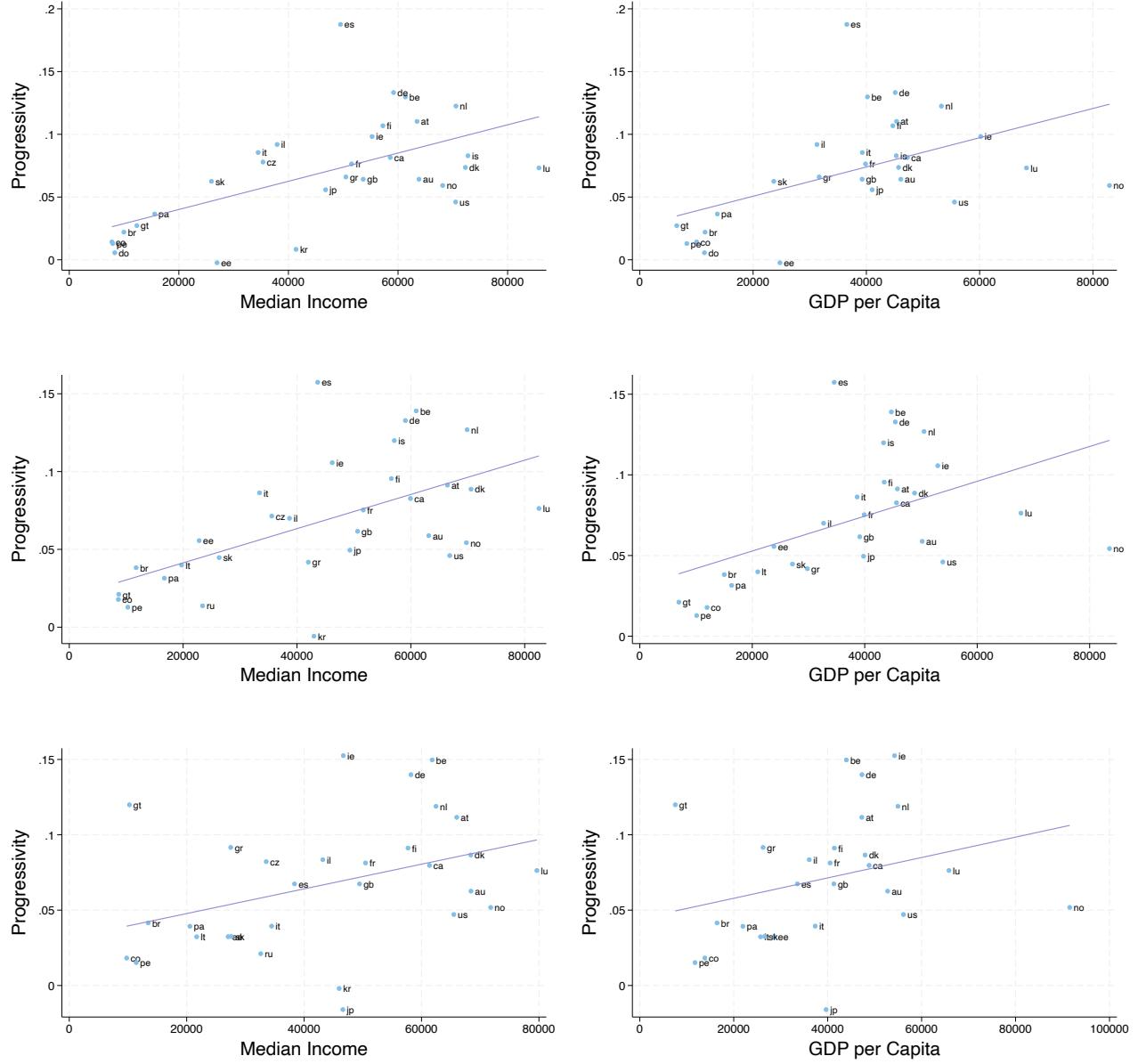


Figure A-13: Progressivity as a function of median income and GDP per capita. Left panels: progressivity as a function of median income. Right panels: progressivity as a function of GDP per capita. Progressivity is measured by the parameter τ . GDP per capita comes from the Penn World Tables and is measured at chained PPP and in 2017 US dollars.

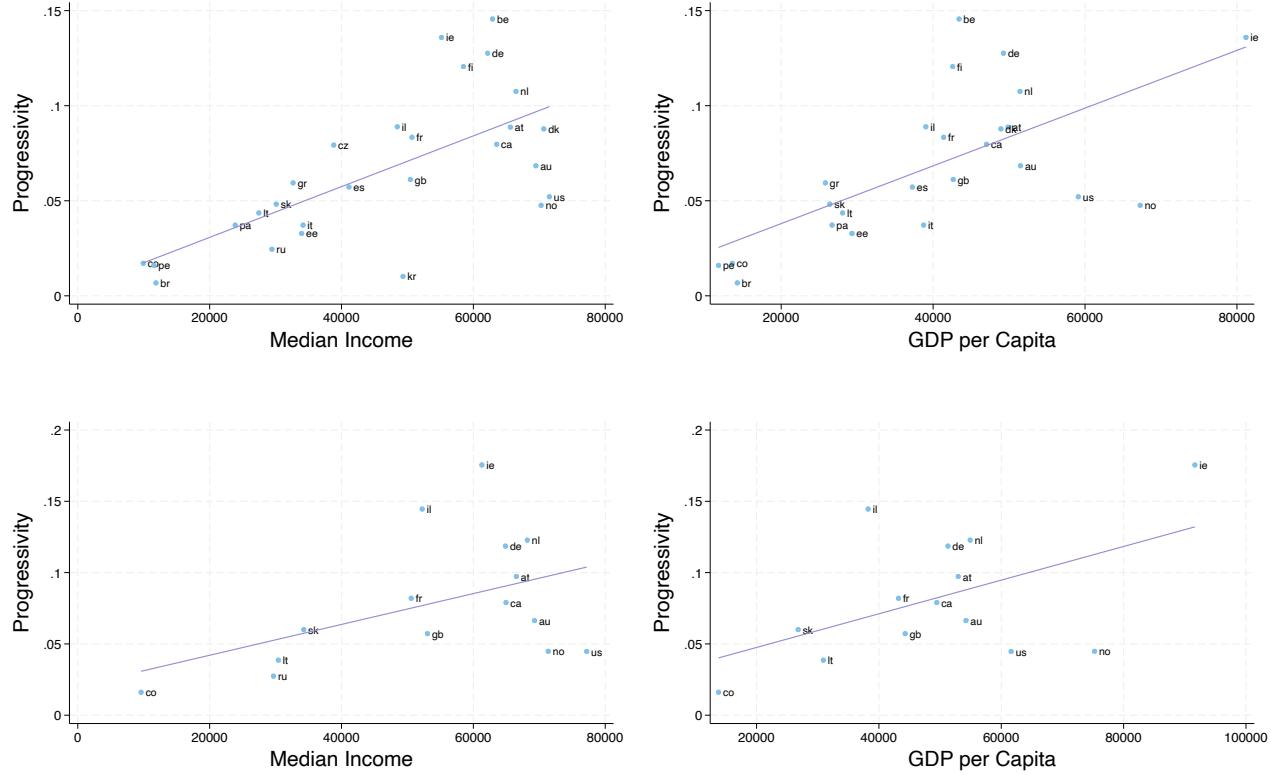


Figure A-14: Progressivity as a function of median income and GDP per capita. Left panels: progressivity as a function of median income. Right panels: progressivity as a function of GDP per capita. Progressivity is measured by the parameter τ . GDP per capita comes from the Penn World Tables and is measured at chained PPP and in 2017 US dollars.

V Evolution of Household Composition

In Figures A-15 and A-16, we display the dynamics of household composition for the countries in our sample. These figures highlight several interesting trends.

First, across all countries, the fraction of married couples with children decreases significantly over time, while the share of married couples without children is either stable or increasing. For instance, in 1985, half of the Norwegian households are married with children, while only 11 percent are married without children. By 2018, the fraction of couples with children declines to 35 percent, while the fraction of married couples without children increases to 15 percent. In Figure A-15 in Appendix V, we show a similar decline for Germany. In particular, while 57% of German households are married with children in 1980, only 35% are in 2018. In turn, the share of married couples without children rises from 19% in 1980 to 22% in 2018.

Second, the share of singles without children has increased in most countries, while the fraction of single parents is relatively stable. For instance, the share of singles in the United States goes from 15% in 1980 to 22% in 2018 while the fraction of single parents only rises from 12% to 13% between the same years. Figure A-15 shows that the rise in the share of singles is particularly pronounced for European countries such as France and Germany. In particular, the fraction of singles in France more than doubles between 1980 and 2018, going from 13% to 28%. This is accompanied by a similar increase in the share of single parents, which rises from 6% in 1980 to 14% in 2018. In Germany, these changes are even larger. Between 1980 and 2018, the shares of German singles and single parents rise from 14% and 4%, respectively, to 32% and 9%.

These results highlight the shift from being married and having children to either not having children or, in large part, not being married. These trends are consistent with the decline in marriage and fertility rates experienced by numerous countries worldwide and documented by numerous studies in the literature. For instance, [Boldrin, De Nardi, and Jones \(2015\)](#) shows that fertility rates decreased in Europe and the USA during the 20th century. [OECD \(2019\)](#) confirms this finding for OECD countries and shows that the number of children per woman declined from 2.8 in 1970 to 1.7 in 2016. It also shows that marriage rates have declined significantly in most OECD countries over the last twenty years. Finally, [Ahn and Sánchez-Marcos \(2020\)](#) document large decreases in the fertility rates of numerous European countries.

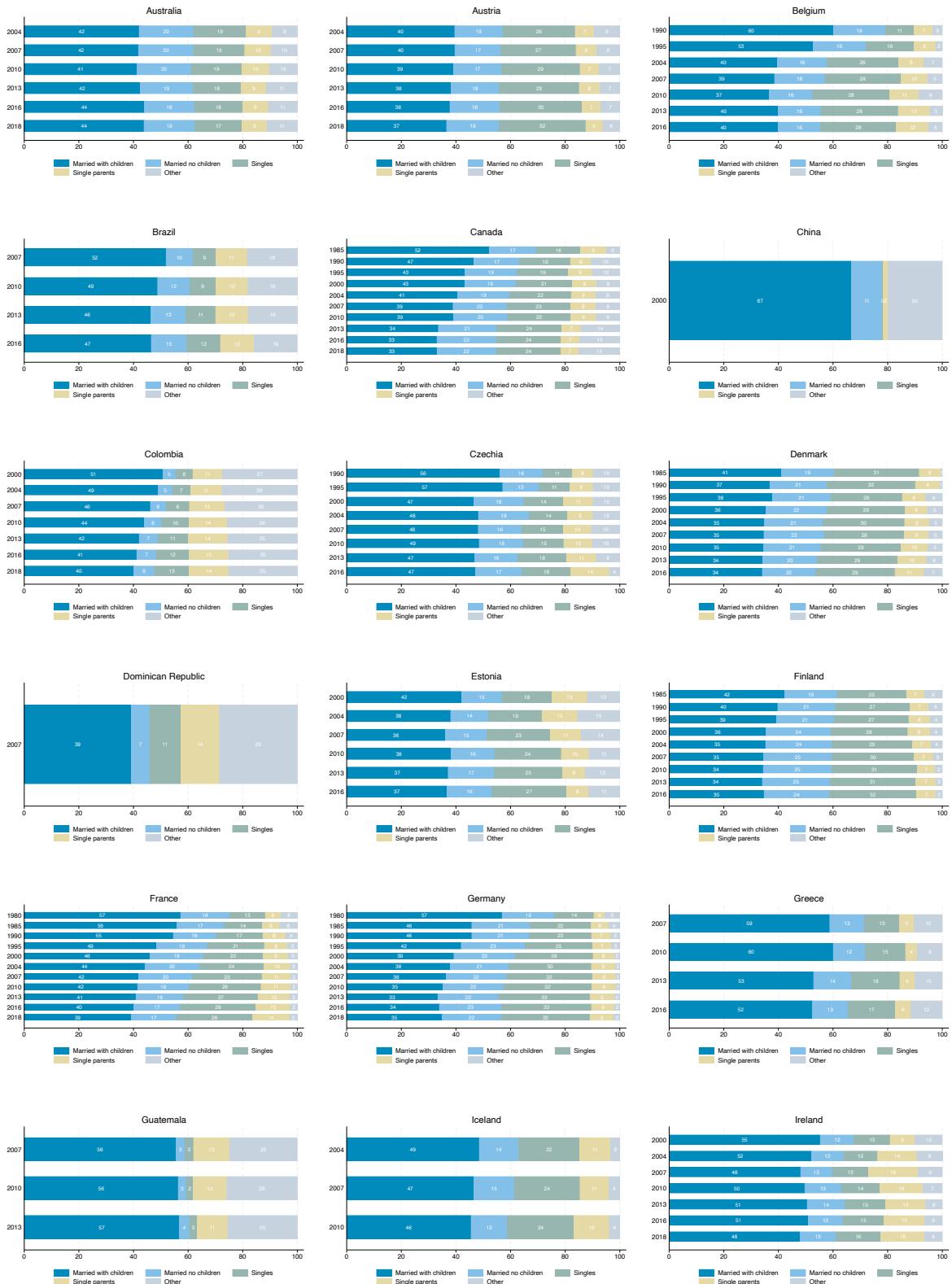


Figure A-15: Household composition by wave for selected countries in our sample. Each share is computed by dividing the number of households with the corresponding family structure by the number of total households in the given country and year.

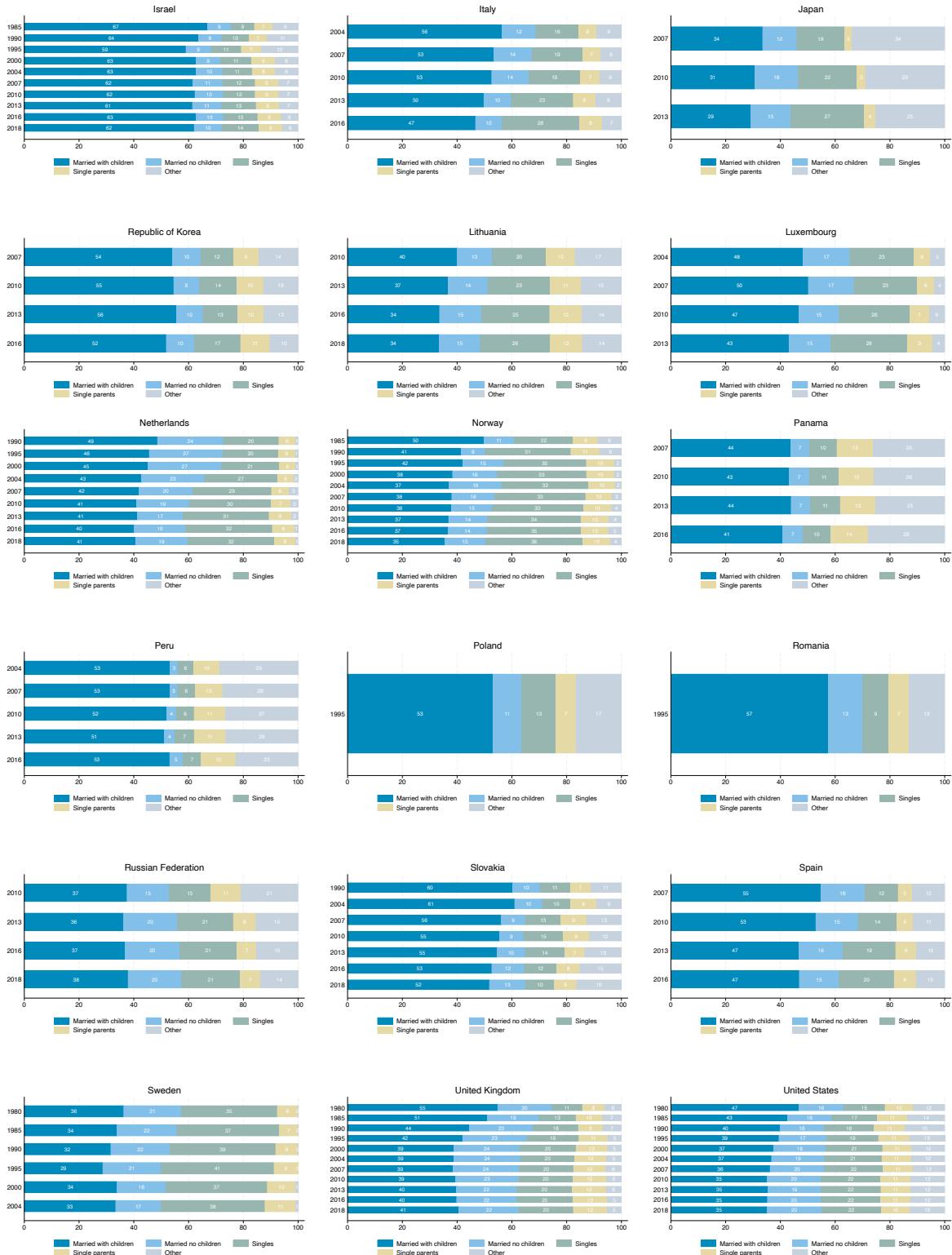


Figure A-16: Household composition by wave for selected countries in our sample. Each share is computed by dividing the number of households with the corresponding family structure by the number of total households in the given country and year.

VI Additional Results on Progressivity by Household Type

Country	Family Structure	Wave 1 1980	Wave 2 1985	Wave 3 1990	Wave 4 1995	Wave 5 2000	Wave 6 2004	Wave 7 2007	Wave 8 2010	Wave 9 2013	Wave 10 2016	Wave 11 2018
Australia	Married, no children	0.087	0.069	0.065	0.069	0.100	0.072
	Married with children	0.111	0.111	0.084	0.086	0.112	0.104
	Singles	0.053	0.053	0.047	0.047	0.046	0.048
	Single parents	0.064	0.073	0.064	0.063	0.090	0.072
Austria	Married, no children	0.097	0.122	0.120	0.131	0.161	0.150
	Married with children	0.124	0.138	0.119	0.143	0.115	0.130
	Singles	0.149	0.131	0.100	0.123	0.088	0.108
	Single parents	0.136	0.163	0.088	0.162	0.083	0.086
Belgium	Married, no children	.	.	0.049	0.093	.	0.163	0.179	0.139	0.172	0.151	.
	Married with children	.	.	0.152	0.220	.	0.192	0.162	0.209	0.221	0.215	.
	Singles	.	.	0.054	0.050	.	0.158	0.140	0.147	0.164	0.155	.
	Single parents	.	.	0.061	0.137	.	0.230	0.198	0.214	0.220	0.282	.
Brazil	Married, no children	0.024	0.041	0.046	0.007	.	.
	Married with children	0.027	0.041	0.047	0.004	.	.
	Singles	0.015	0.038	0.038	0.008	.	.
	Single parents	0.016	0.032	0.035	0.011	.	.
Canada	Married, no children	.	0.125	0.074	0.092	0.105	0.103	0.098	0.096	0.098	0.101	0.100
	Married with children	.	0.115	0.145	0.115	0.125	0.116	0.119	0.123	0.116	0.122	0.127
	Singles	.	0.054	0.076	0.135	0.100	0.096	0.083	0.089	0.087	0.086	0.085
	Single parents	.	0.083	0.117	0.119	0.134	0.125	0.122	0.114	0.121	0.109	0.108
China	Married, no children	0.005
	Married with children	0.009
	Singles	0.006
	Single parents	0.014
Colombia	Married, no children	0.014	0.018	0.017	0.023	0.023	0.021	0.019
	Married with children	0.013	0.017	0.016	0.021	0.023	0.021	0.021
	Singles	0.009	0.012	0.013	0.015	0.015	0.014	0.013
	Single parents	0.009	0.011	0.010	0.012	0.013	0.012	0.011
Czechia	Married, no children	.	.	0.132	0.137	0.132	0.131	0.140	0.105	0.120	0.113	.
	Married with children	.	.	0.077	0.112	0.122	0.114	0.121	0.101	0.103	0.098	.
	Singles	.	.	0.155	0.097	0.139	0.138	0.062	0.072	0.127	0.120	.
	Single parents	.	.	0.084	0.090	0.124	0.117	0.109	0.093	0.111	0.105	.
Denmark	Married, no children	.	0.071	0.106	0.178	0.182	0.163	0.136	0.133	0.122	0.122	.
	Married with children	.	0.146	0.153	0.193	0.205	0.177	0.174	0.152	0.147	0.150	.
	Singles	.	0.053	0.083	0.095	0.100	0.080	0.064	0.098	0.094	0.093	.
	Single parents	.	0.044	0.102	0.151	0.211	0.178	0.141	0.152	0.145	0.156	.
Dominican Republic	Married, no children	0.008
	Married with children	0.006
	Singles	0.003
	Single parents	0.005
Estonia	Married, no children	0.022	0.048	0.083	0.052	0.039	0.040	.
	Married with children	0.046	0.051	0.052	0.064	0.043	0.063	.
	Singles	0.040	0.064	-0.026	0.071	0.029	0.031	.
	Single parents	0.045	0.050	0.004	0.088	0.043	0.071	.
Finland	Married, no children	.	0.213	0.156	0.198	0.154	0.134	0.142	0.139	0.126	0.161	.
	Married with children	.	0.197	0.188	0.201	0.160	0.150	0.152	0.142	0.151	0.166	.
	Singles	.	0.210	0.161	0.198	0.170	0.110	0.144	0.106	0.094	0.161	.
	Single parents	.	0.196	0.211	0.218	0.187	0.173	0.134	0.156	0.170	0.180	.
France	Married, no children	0.053	0.050	0.081	0.089	0.098	0.099	0.093	0.091	0.098	0.107	0.097
	Married with children	0.072	0.060	0.088	0.099	0.105	0.094	0.088	0.084	0.100	0.109	0.101
	Singles	0.035	0.019	0.049	0.102	0.120	0.115	0.103	0.103	0.108	0.104	0.108
	Single parents	0.042	0.031	0.054	0.108	0.115	0.114	0.113	0.110	0.120	0.125	0.122
Germany	Married, no children	0.124	0.170	0.163	0.212	0.231	0.185	0.182	0.173	0.153	0.166	0.169
	Married with children	0.067	0.128	0.140	0.172	0.196	0.193	0.129	0.168	0.169	0.149	0.164
	Singles	0.148	0.138	0.155	0.153	0.169	0.193	0.168	0.162	0.188	0.152	0.133
	Single parents	0.116	0.144	0.149	0.175	0.196	0.210	0.209	0.202	0.192	0.178	0.179
Greece	Married, no children	0.097	0.041	0.089	0.056	.	.
	Married with children	0.066	0.033	0.094	0.063	.	.
	Singles	0.057	0.056	0.100	0.055	.	.
	Single parents	0.051	0.050	0.087	0.087	.	.
Guatemala	Married, no children	0.041	0.017	0.120	.	.	.
	Married with children	0.031	0.023	0.123	.	.	.
	Singles	0.016	0.019	0.138	.	.	.
	Single parents	0.016	0.017	0.111	.	.	.
Iceland	Married, no children	0.118	0.088	0.144
	Married with children	0.111	0.119	0.168
	Singles	0.156	0.121	0.136
	Single parents	0.160	0.131	0.192
Ireland	Married, no children	0.108	0.128	0.109	0.100	0.155	0.212	0.221
	Married with children	0.111	0.138	0.152	0.183	0.202	0.223	0.227
	Singles	0.054	0.107	0.079	0.073	0.169	0.098	0.241
	Single parents	0.058	0.105	0.073	0.105	0.091	0.113	0.157

Table A-6: Progressivity by household type.

Country	Family Structure	Wave 1 1980	Wave 2 1985	Wave 3 1990	Wave 4 1995	Wave 5 2000	Wave 6 2004	Wave 7 2007	Wave 8 2010	Wave 9 2013	Wave 10 2016	Wave 11 2018
Israel	Married, no children	.	0.177	0.163	-0.062	0.153	0.131	0.115	0.103	0.105	0.132	0.130
	Married with children	.	0.199	0.184	0.138	0.153	0.109	0.106	0.074	0.098	0.105	0.116
	Singles	.	0.091	0.154	0.161	0.095	0.097	0.077	0.071	0.079	0.077	0.343
	Single parents	.	-0.111	0.116	0.075	0.081	0.069	0.043	0.047	0.044	0.056	0.086
Italy	Married, no children	0.257	0.164	0.069	0.054	0.041	.
	Married with children	0.226	0.087	0.101	0.048	0.038	.
	Singles	0.214	0.097	0.088	0.038	0.039	.
	Single parents	0.107	0.052	0.072	0.025	0.029	.
Japan	Married, no children	0.074	0.064	0.081	.	.
	Married with children	0.058	0.075	0.061	.	.
	Singles	0.084	0.059	-0.092	.	.
	Single parents	0.060	0.087	0.057	.	.
Lithuania	Married, no children	0.048	0.052	0.055	0.064
	Married with children	0.048	0.046	0.042	0.041
	Singles	0.036	0.030	0.034	0.028
	Single parents	0.041	0.043	0.124	0.110
Luxembourg	Married, no children	0.097	0.121	0.137	0.116	.	.
	Married with children	0.107	0.120	0.106	0.121	.	.
	Singles	0.132	0.089	0.114	0.104	.	.
	Single parents	0.112	0.054	0.108	0.146	.	.
Netherlands	Married, no children	.	.	0.032	0.044	0.118	0.124	0.145	0.162	0.137	0.156	0.162
	Married with children	.	.	0.039	0.122	0.159	0.168	0.160	0.172	0.179	0.148	0.162
	Singles	.	.	0.041	0.062	0.067	0.155	0.187	0.187	0.148	0.142	0.180
	Single parents	.	.	0.077	0.046	0.124	0.123	0.183	0.136	0.099	0.166	0.192
Norway	Married, no children	.	0.147	0.155	0.069	0.123	0.093	0.121	0.099	0.099	0.089	0.078
	Married with children	.	0.137	0.154	0.144	0.147	0.126	0.133	0.125	0.123	0.100	0.097
	Singles	.	0.079	0.044	0.058	0.059	0.086	0.051	0.045	0.042	0.040	0.038
	Single parents	.	0.157	0.158	0.134	0.151	0.074	0.084	0.079	0.074	0.068	0.064
Panama	Married, no children	0.041	0.035	0.047	0.043	.
	Married with children	0.041	0.038	0.049	0.043	.
	Singles	0.032	0.022	0.029	0.025	.
	Single parents	0.030	0.030	0.035	0.036	.
Peru	Married, no children	0.017	0.011	0.017	0.019	0.022	.
	Married with children	0.013	0.016	0.016	0.019	0.019	.
	Singles	0.010	0.009	0.008	0.010	0.010	.
	Single parents	0.009	0.008	0.010	0.012	0.015	.
Poland	Married, no children	.	.	0.019
	Married with children	.	.	0.021
	Singles	.	.	0.030
	Single parents	.	.	0.023
Republic of Korea	Married, no children	0.001	-0.037	-0.013	0.004	.	.
	Married with children	0.009	0.004	0.005	0.015	.	.
	Singles	0.001	-0.022	-0.017	0.005	.	.
	Single parents	-0.006	0.000	-0.039	-0.039	.	.
Romania	Married, no children	.	.	0.091
	Married with children	.	.	0.074
	Singles	.	.	0.097
	Single parents	.	.	0.079
Russian Federation	Married, no children	0.017	0.027	0.034	0.034	.
	Married with children	0.017	0.017	0.021	0.026	.
	Singles	0.016	0.029	0.033	0.036	.
	Single parents	0.009	0.026	0.026	0.027	.
Slovakia	Married, no children	.	0.145	.	.	0.115	0.106	0.082	0.060	0.059	0.091	.
	Married with children	.	0.101	.	.	0.097	0.074	0.053	0.015	0.061	0.052	.
	Singles	.	0.112	.	.	0.158	0.102	0.051	0.036	0.051	0.086	.
	Single parents	.	0.075	.	.	0.084	0.061	0.057	0.058	0.079	0.075	.
Spain	Married, no children	0.177	0.092	0.045	0.064	.	.
	Married with children	0.234	0.226	0.068	0.079	.	.
	Singles	0.171	0.111	0.091	0.032	.	.
	Single parents	0.097	0.224	0.030	0.131	.	.
Sweden	Married, no children	0.110	0.111	0.104	0.116	0.102	0.137
	Married with children	0.140	0.157	0.144	0.163	0.135	0.153
	Singles	0.064	0.174	0.074	0.099	0.152	0.153
	Single parents	0.147	0.177	0.155	0.117	0.181	0.158
United Kingdom	Married, no children	0.084	0.091	0.049	0.085	0.069	0.070	0.065	0.064	0.070	0.074	0.069
	Married with children	0.032	0.018	0.041	0.091	0.083	0.087	0.077	0.092	0.110	0.098	0.083
	Singles	0.135	0.134	0.104	0.073	0.057	0.053	0.054	0.041	0.046	0.039	0.043
	Single parents	0.122	0.114	0.114	0.124	0.093	0.079	0.098	0.105	0.069	0.078	0.010
United States	Married, no children	0.113	0.085	0.083	0.072	0.069	0.052	0.058	0.054	0.052	0.054	0.055
	Married with children	0.100	0.103	0.095	0.098	0.103	0.082	0.073	0.082	0.083	0.092	0.077
	Singles	0.055	0.053	0.056	0.051	0.048	0.041	0.041	0.040	0.038	0.041	0.038
	Single parents	0.066	0.072	0.063	0.057	0.053	0.046	0.042	0.041	0.045	0.057	0.048

Table A-7: Progressivity by household type.

VII The Role of Transfers for Progressivity

So far, we have treated public social benefits in the same way as the income earned in private markets. However, public transfers play a crucial role in redistribution policies. To study the effect of transfers on income tax progressivity, we define a tax-and-transfer function in which we include public social benefits in the post-tax income (rather than in the pre-tax one) to highlight that they come from the government. Using the tax-and-transfer function, we compute the progressivity net of government transfers. We then compare it to the progressivity gross of government transfers which we have computed in Section 4.

Figure A-17 compares gross and net progressivity. In this figure, we plot the point estimates for each measure of progressivity and the 95% confidence intervals. The confidence intervals show that progressivity is tightly estimated and that there are significant differences between gross and net progressivity. This figure shows that net progressivity is much higher than its gross counterpart in every country and wave. In our sample, net progressivity is, on average, seven times larger than its gross counterpart. Therefore, public transfers have a large and significant effect on redistribution in every country we study. This Figure also shows that including transfers preserves the ranking of countries at the extremes of the progressivity distribution. Thus, countries with high gross progressivity tend to have high net progressivity.

The significant differences between gross and net progressivity highlight the importance of the choice of tax function when studying and modeling income tax systems. From an empirical point of view, using a gross or a net measure leads to significantly different assessments of the degree of progressivity in a specific country. As policymakers may want to act to increase (or decrease) income tax progressivity, its correct measurement is vital to guide income tax policy. From an economic modeling perspective, the choice of which tax function to use is critical for the magnitude of the after-tax income that enters the household's budget constraint.

In Figure A-18, we show net progressivity by household types. Studying net progressivity is particularly meaningful when we distinguish by household types, especially when looking at the role of children. Governments around the world use transfers to redistribute resources to families with children. For example, the Temporary Assistance for Needy Families (TANF) provides cash transfers to low-income families with children in the United States. In the United Kingdom, the Child Benefit provides financial support to parents with children younger than 16.

Several interesting facts emerge from Figure A-18. First, as we observed above, net progressivity is much higher than gross progressivity in each country and wave. For example, in wave 10, in the United States, net progressivity is more than five times as large as the gross one.

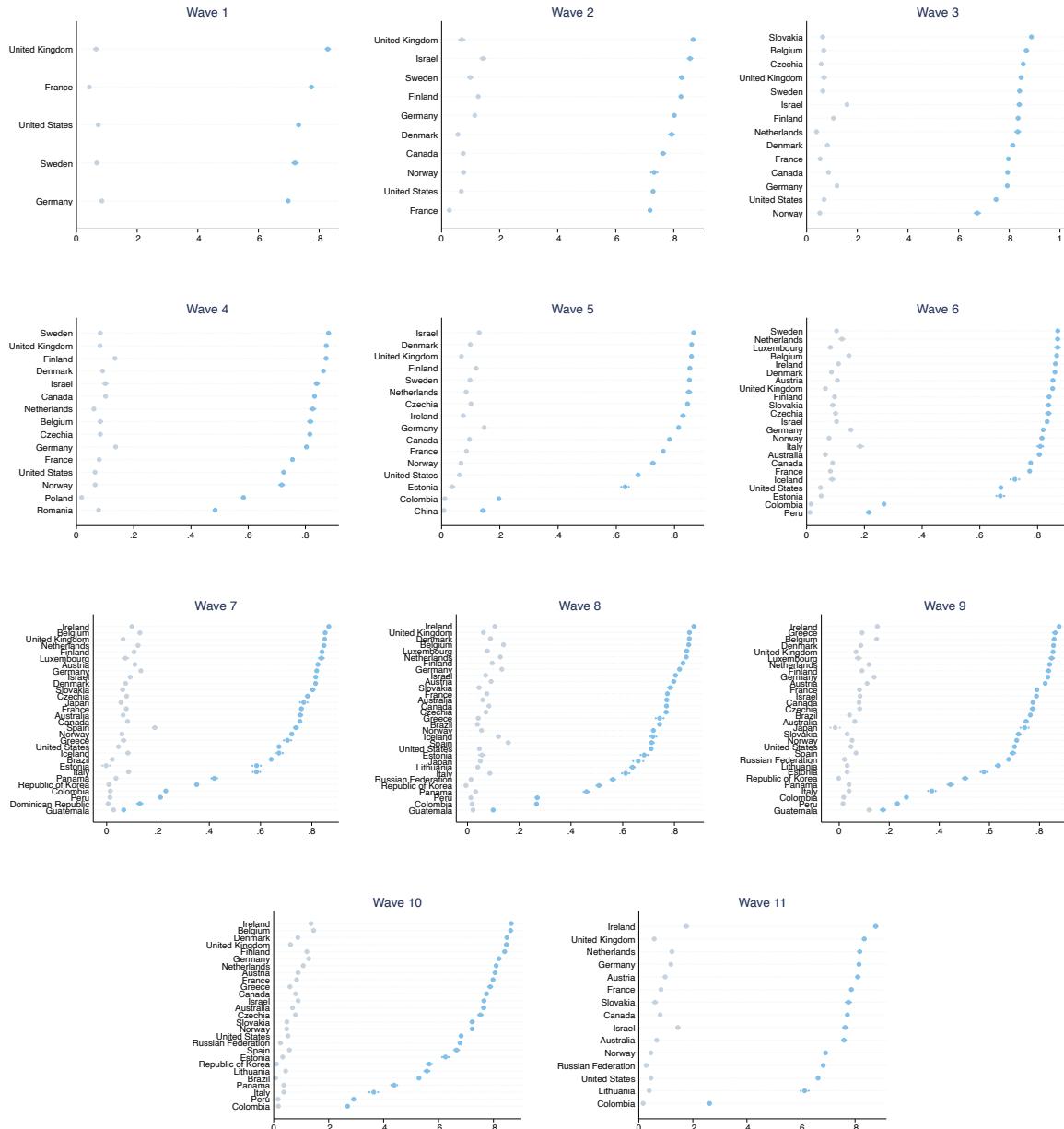


Figure A-17: Comparison of progressivity gross and net of government transfers. The gray dots mark gross progressivity. The blue ones denote net progressivity. Gray and blue diamonds mark the 95% confidence interval for the corresponding progressivity.

Second, marriage and the presence of children generate significant differences in net progressivity. For example, childless couples face lower net progressivity than singles in the United States in wave 10. In turn, married couples without children enjoy higher net progressivity than couples with children in Canada in wave 10.

Third, married couples with children face the lowest net progressivity in almost every country and wave. This is the opposite of what we observed for gross progressivity. Notably, in the United States, couples with children face the lowest net progressivity in every wave. At the same time, they enjoy the highest gross progressivity in each wave. In turn, single parents have the highest net progressivity in almost every country and wave. For example, in Canada and the United States, single parents face the highest net progressivity in each wave. These dynamics could be due to single parents having lower incomes and receiving more child-related government transfers than married couples with children.

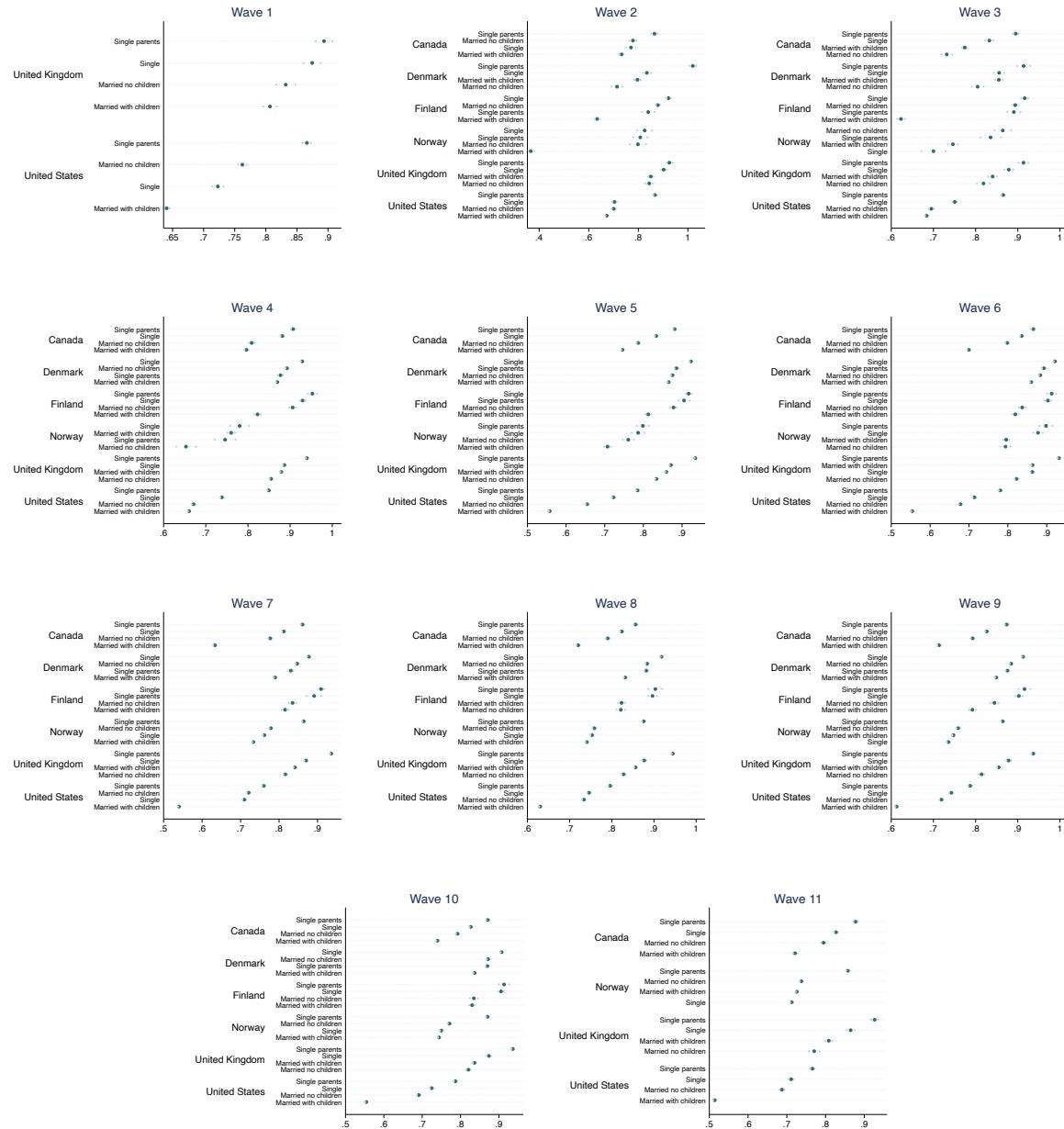


Figure A-18: Net income tax progressivity by household type. Green dots are the point estimate for the progressivity parameter τ , and gray diamonds mark the 95% confidence interval.

VIII Additional Results on Desired Tax Rates

Country	Group	Pre-tax income	Desired tax rate	Realized tax rate	Difference	% Difference
France	Top 1%	404,942	44.26	34.79	9.47	27.21
	Top 2-10%	147,674	29.56	26.81	2.75	10.25
	Top 11-50%	72,600	16.88	21.44	-4.56	-21.29
	Bottom 50%	30,815	8.52	14.80	-6.29	-42.48
Italy	Top 1%	305,900	38.05	43.03	-4.98	-11.58
	Top 2-10%	129,491	26.23	35.89	-9.65	-26.90
	Top 11-50%	55,956	15.89	24.54	-8.65	-35.24
	Bottom 50%	19,946	10.65	13.82	-3.17	-22.95
UK	Top 1%	372,930	36.53	32.21	4.32	13.40
	Top 2-10%	155,747	22.98	25.37	-2.39	-9.42
	Top 11-50%	75,455	12.82	18.14	-5.32	-29.33
	Bottom 50%	29,951	6.94	8.47	-1.53	-18.08
US	Top 1%	787,894	24.84	36.35	-11.51	-31.66
	Top 2-10%	260,842	14.82	28.37	-13.55	-47.76
	Top 11-50%	114,839	9.35	22.31	-12.96	-58.10
	Bottom 50%	38,318	8.39	11.37	-2.98	-26.18

Table A-8: Desired vs realized average tax rates by country

Country	Group	Pre-tax income	Desired tax rate	Realized tax rate	Difference	% Difference
France	Top 1%	404,942	55.21	38.16	17.05	44.67
	Top 2-10%	147,674	43.39	32.73	10.66	32.57
	Top 11-50%	72,600	33.20	28.63	4.58	15.98
	Bottom 50%	30,815	26.48	23.34	3.14	13.46
Italy	Top 1%	305,900	46.39	30.81	15.58	50.58
	Top 2-10%	129,491	36.16	28.56	7.60	26.63
	Top 11-50%	55,956	27.21	26.29	0.92	3.50
	Bottom 50%	19,946	22.68	23.41	-0.73	-3.13
UK	Top 1%	372,930	46.22	29.66	16.55	55.81
	Top 2-10%	155,747	34.74	25.80	8.94	34.64
	Top 11-50%	75,455	26.13	22.44	3.69	16.46
	Bottom 50%	29,951	21.15	17.93	3.22	17.98
USA	Top 1%	787,894	29.82	32.06	-2.23	-6.97
	Top 2-10%	260,842	20.46	28.03	-7.57	-27.00
	Top 11-50%	114,839	15.35	24.88	-9.53	-38.31
	Bottom 50%	38,318	14.46	20.46	-6.01	-29.35

Table A-9: Desired vs realized marginal tax rates by country

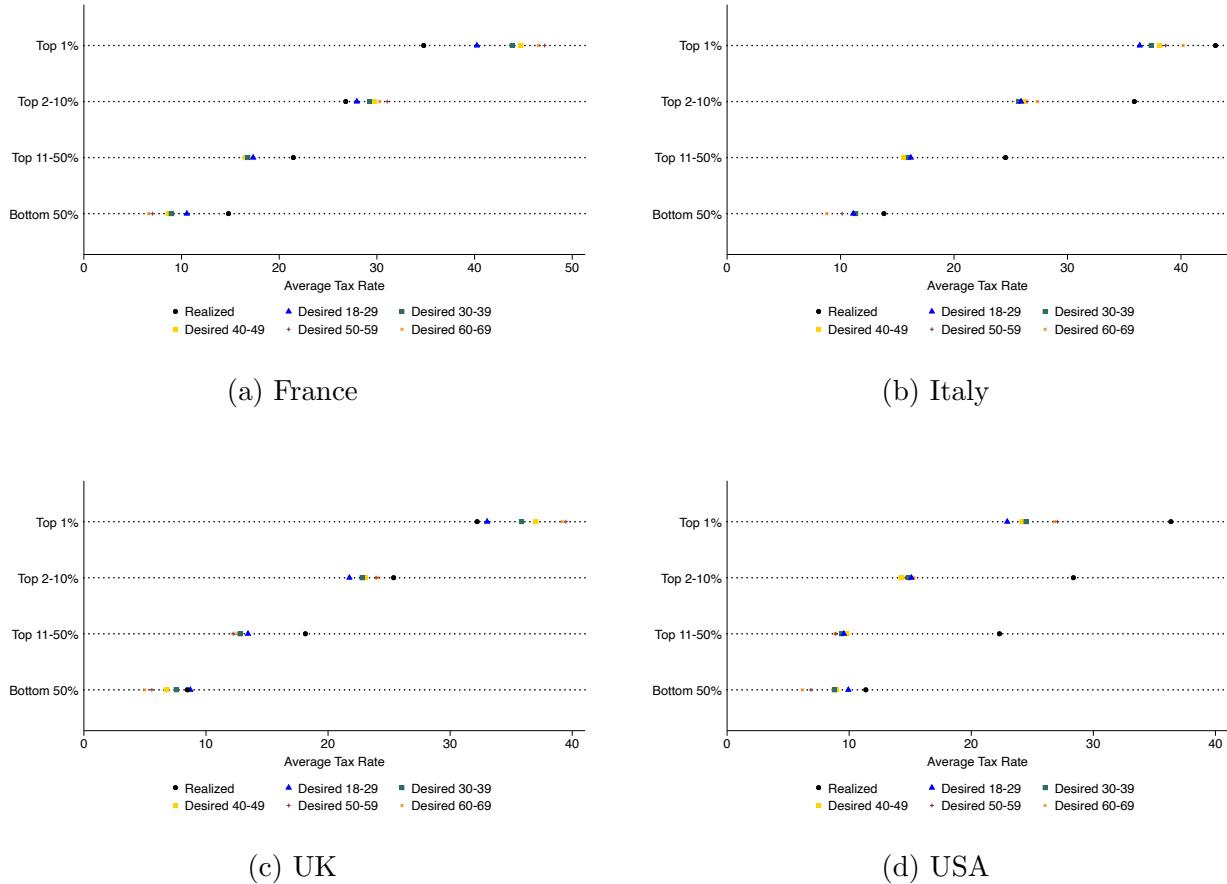
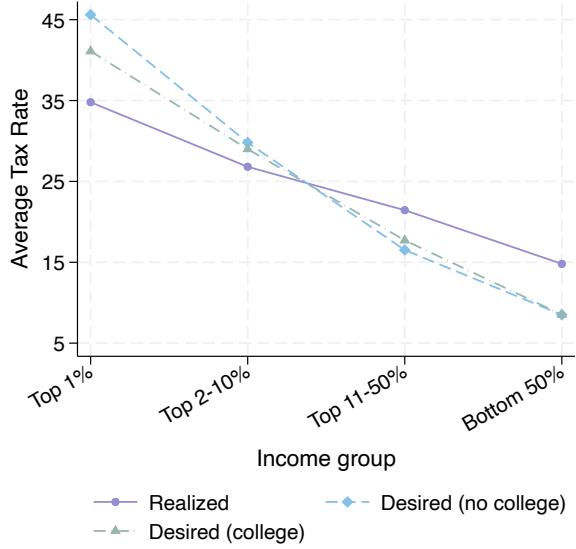
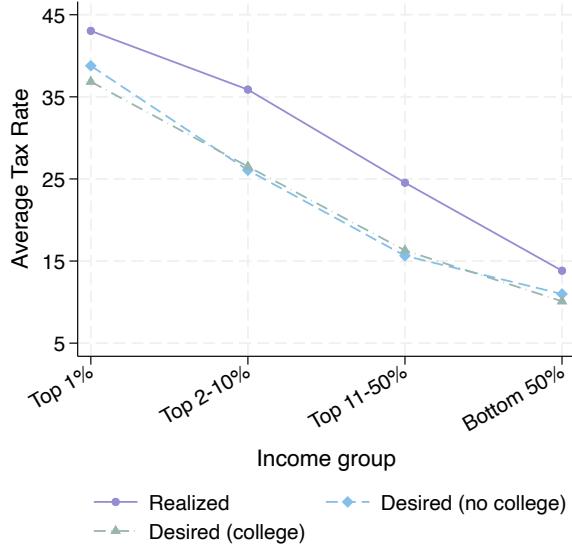


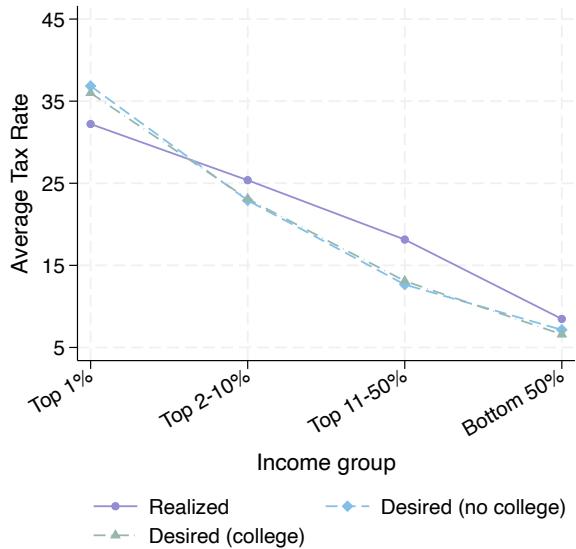
Figure A-19: Desired average tax rates by age groups (10-year bins)



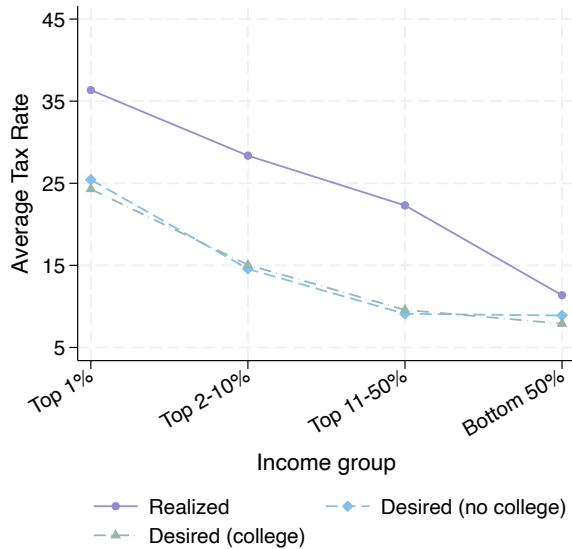
(a) France



(b) Italy

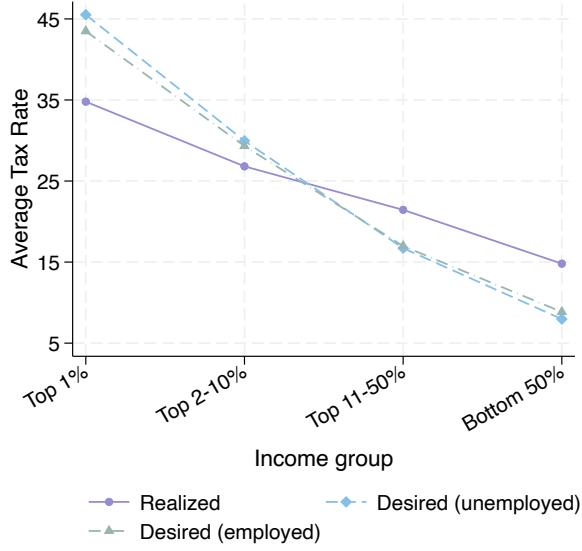


(c) UK

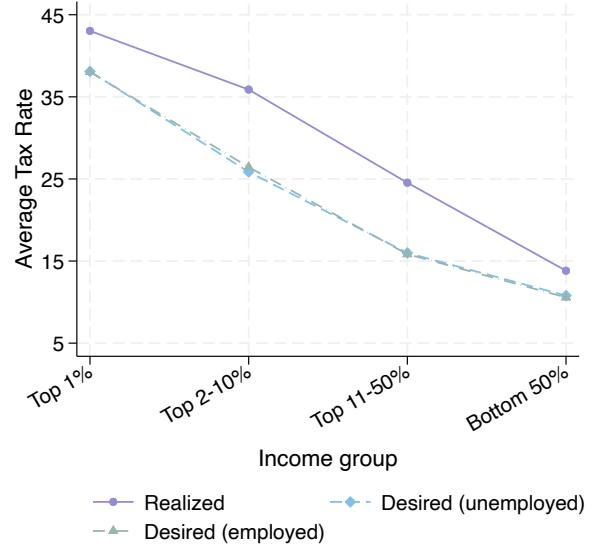


(d) USA

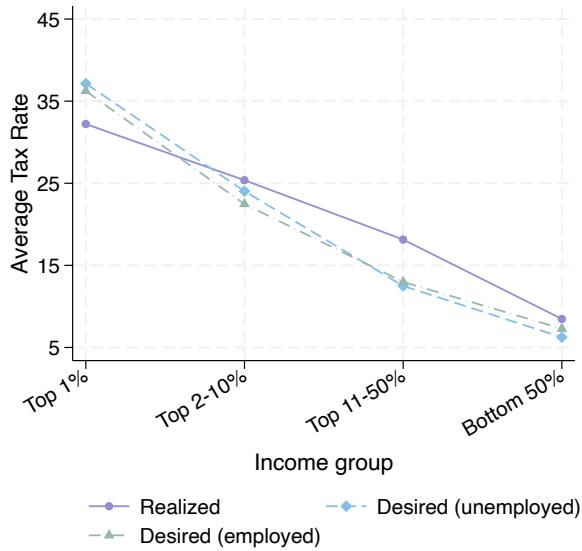
Figure A-20: Desired average tax rates by education (college vs non-college)



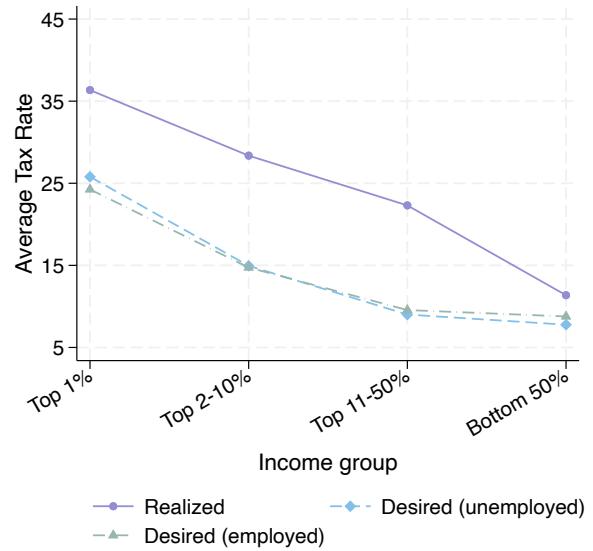
(a) France



(b) Italy



(c) UK



(d) USA

Figure A-21: Desired average tax rates by employment status (employed vs non-employed)

		Top 1		Top 2-10		Top 11-50		Bottom 50	
		Desired	Realized	Desired	Realized	Desired	Realized	Desired	Realized
France	left	54.36		32.60		14.08		7.08	
	centre-left	45.57		30.62		16.49		7.74	
	centre	42.42	34.79	28.97	26.81	17.53	21.44	8.55	14.80
	centre-right	41.67		28.47		17.27		9.57	
Italy	right	46.34		29.39		16.79		8.52	
	left	40.29		27.27		15.76		9.01	
	centre-left	39.01		27.22		15.91		9.36	
	centre	38.75	43.03	25.64	35.89	15.34	24.54	11.93	13.82
UK	centre-right	34.59		24.84		16.65		12.03	
	right	37.57		26.30		15.79		10.87	
	left	41.53		23.37		12.30		5.06	
	centre-left	38.19		23.65		12.60		6.01	
US	centre	35.47	32.21	22.67	25.37	12.77	18.14	7.82	8.47
	centre-right	34.30		23.05		13.61		6.52	
	right	35.60		22.28		12.70		8.10	
	left	29.09		14.65		7.68		7.98	
US	centre-left	26.61		15.11		8.80		7.10	
	centre	25.01	36.35	14.79	28.37	9.40	22.31	8.04	11.37
	centre-right	22.75		15.09		9.77		9.25	
	right	21.55		14.03		10.68		10.72	

Table A-10: Desired average tax rates by political leaning.

		Top 1		Top 2-10		Top 11-50		Bottom 50	
		Desired	Realized	Desired	Realized	Desired	Realized	Desired	Realized
France	left	67.30		51.71		38.44		33.43	
	centre-left	57.00		45.19		34.03		27.11	
	centre	52.94	38.16	41.95	32.73	32.60	28.63	25.25	23.34
	centre-right	51.80		40.89		31.63		25.27	
Italy	right	57.63		44.24		34.29		27.77	
	left	49.52		38.51		28.78		23.07	
	centre-left	47.92		37.86		28.20		22.60	
	centre	46.89	30.81	35.53	28.56	26.60	26.29	23.64	23.41
UK	centre-right	41.70		33.01		25.71		21.59	
	right	45.78		35.99		26.86		22.59	
	left	52.69		38.00		29.05		23.19	
	centre-left	48.52		36.42		27.21		21.73	
US	centre	44.69	29.66	33.71	25.80	25.23	22.44	20.99	17.93
	centre-right	43.57		33.90		25.80		19.71	
	right	44.74		33.32		25.10		21.15	
	left	35.25		22.07		15.70		15.98	
US	centre-left	32.38		21.79		15.98		14.41	
	centre	30.11	32.06	20.58	28.03	15.56	24.88	14.29	20.46
	centre-right	26.98		19.73		14.71		14.22	
	right	24.93		17.73		14.53		14.57	

Table A-11: Desired marginal tax rates by political leaning.