Income Tax Progressivity: A Cross-Country Comparison*

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Abstract

This paper studies income taxes across the world using detailed micro-data from the Luxembourg Income Study. We first show that income tax systems worldwide are approximated remarkably well by a two-parameter effective tax function. Then, we estimate country-and-year specific tax functions to compare the level of average taxation and income tax progressivity across countries and over time and examine the effects of government transfers and family structure. We find that a higher level of taxation is associated with a higher degree of progressivity. In particular, countries with a high degree of social insurance display the highest progressivity and average taxation levels. We also find that, for all countries we consider, government transfers play a crucial role for redistribution. When taken into account, government transfers increase the progressivity of the income tax system up to seven-fold. Finally, we find that the effect of family structure on income tax progressivity varies extensively by country. The presence of children in the family has the largest effect on progressivity in countries like Canada and Denmark. In turn, marriage has the biggest impact on progressivity in countries like the United States and France.

Keywords:

JEL Codes:

*We would like to thank Mariacristina De Nardi and Margherita Borella.

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1 Introduction

2 Related Literature

First, our paper connects to the rich literature on **approximating the income tax and transfer system with a log-linear function** of post-tax income on pre-tax income.

The “log-linear approach" was pioneered by Feldstein (1969) and Benabou (2000) and made popular by Heathcote, Storesletten, and Violante (2017). While there are various approaches to modeling the income tax and transfer system, these papers argue in favor of the log-linear specification due to both its simplicity, as it requires only two parameters which 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. Guner, Kaygusuz, and Ventura (2014) use IRS data for the year 2000 and investigate how effective taxes change with family status and composition. They estimate several effective tax functions, including a log-linear one, and conclude that the log-linear tax function fits the data well. Heathcote, Storesletten, and Violante (2020) use data from the Congressional Budget Office to study tax progressivity between the end of the 1970s and 2016. They find that the level of progressivity is the same in 2012-2016 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 (2020) use PSID data to study the evolution of effective tax rates between the end of the 1960s and 2016. They compile a history of income tax reforms over that period and compare the evolution of progressivity and average tax rates with the desired outcomes of the reforms.

A few recent papers have used the log-linear tax function for 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 quite well. Kaas, Kocharkov, Preugschat, and Siassi (2020) study homeownership in Germany and use the log-linear tax function in the context of a rich structural model. They show that it approximates the income tax and transfer system quite well. Finally, De Magalhaes, Martorell, and Santaeulalia-Llopis (2019) plan to use microdata to estimate and compare tax progressivity across over 20 countries. To our knowledge, they have not yet provided estimated tax functions.

Second, our paper connects to the literature on **cross-country comparisons of tax progres-**

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

sivity.

Holter, Krueger, and Stepanchuk (2019) study the role of tax progressivity to assess how much additional tax revenue governments can generate by increasing labor income taxes. They use a log-linear tax function and compare progressivity measured by the progressivity wedge across OECD countries between 2000 and 2007.[2] They find substantial heterogeneity in tax progressivity, with the most progressive taxes being in Denmark and the least progressive ones in Japan. 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, for all countries, income taxes should be less progressive as a response to an increase in fiscal pressure.

3 The Tax Function

We use a two-parameter log-linear effective tax function, which can be estimated by ordinary least squares (OLS).

3.1 Log-Linear Tax Function

Following Feldstein (1969), Benabou (2000), Heathcote, Storesletten, and Violante (2017), and Borella, De Nardi, Pak, Russo, and Yang (2020), we model taxes T on total income Y as:

$$T(Y) = Y - (1-\lambda)Y^{1-\tau}, \tag{1}$$

The associated average and marginal tax rates are given by:

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

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

Equation 2 shows that the parameter λ corresponds to the average tax rate when income is equal to 1 unit of income and thus captures the notion of the level of taxation in the economy. Instead, the parameter τ captures the degree of progressivity of the income tax system. In particular, the tax system is progressive when $\tau > 0$, regressive when $\tau < 0$, and flat with marginal and average tax rates set at λ when $\tau = 0$.[3]

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

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

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

[3] The parameter τ is a measure of progressivity because the the elasticity of post-tax income with respect to pre-tax income, $\partial \log(Y - T(Y))/\partial \log(Y)$, is equal to $1 - \tau$.

3.2 Estimation Strategy

We take logs of Equation 1 to obtain:

$$\log(Y - T(Y)) = \log(1 - \lambda) + (1 - \tau)\log(Y). \tag{4}$$

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 year. We run weighted regressions using the LIS-provided household-level cross-sectional weight to obtain results representative of the whole population of each country in each year. We compute the parameter λ from the estimated constant and the parameter τ from the estimated coefficient on the log of pre-tax income. Section 5.1 shows that this tax function fits our data remarkably well.

König (2021) argues that estimating log-linear tax functions by OLS results in biased estimates of the progressivity parameter τ and proposes an estimation strategy based on Pseudo-Poisson Maximum Likelihood (PPML). We check the robustness of our results to this estimation strategy in Appendix ...

4 Data

This section describes our data, sample selection, and income definitions.

4.1 Luxembourg Income Study (LIS)

We use microdata from the Luxembourg Income Study (LIS) Database. LIS harmonizes microdata from about 50 countries for over 50 years. 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.

4.2 Sample Selection

There are 11 available LIS waves spanning from the early 1970s to 2020. We use all waves and countries for which we have data on gross income, income taxes, and government transfers. We operate at the wave level to ensure a consistent and comparable time unit across countries. Thus, 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. Table 1 in Appendix A.1 shows the countries in our sample and the years we observe them for. Our final sample consists of 37 countries, observed over different waves.

We conduct household-level analysis and focus on working-age households whose head is between 25 and 60 years old. We restrict our analysis to working-age households to facilitate the comparison across countries. Here we should probably say why working-age households are the most comparable across countries. RED (2010) does it and so does HSV (2020) but none of them explicitly say why.

First, we restrict our attention to "standard" households, defined as the following four types of households: (1) one-person household; (2) couple without children; (3) couple with children; or (4) one parent with children. 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. Our household selection is similar to the one of Heathcote, Storesletten, and Violante (2020), who, given their focus on the working age, only select households with children and non-elderly childless households. Figure 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 89.3 percent, and the median is 91.9 percent. Sections 5 and 6 presents results for standard households.

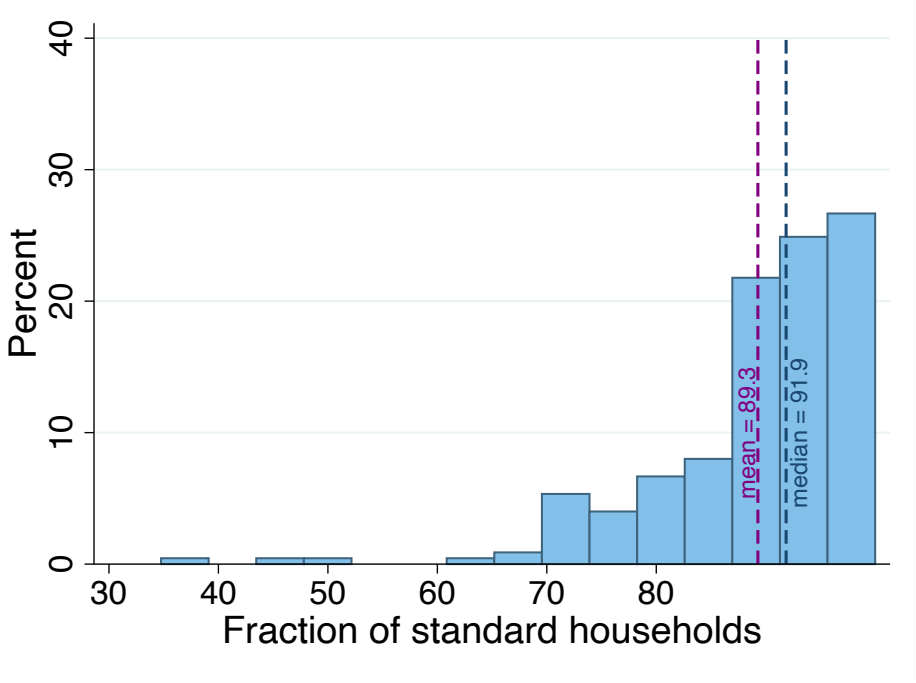

Figure 1: Share of households with heads between 25 and 60 that qualify as "Standard" Households. Results for all countries and all waves in our sample.

Second, to study the role of family composition for progressivity, we estimate effective tax functions separately for each of the four household types that make up our notion of a standard household. We present descriptive statistics on household composition and the estimated tax functions in Section 7.2.

4.3 Income Definitions and Adjustments

Our results on effective taxes depend crucially on the definitions of pre-and-post-tax income. We start by defining a *tax function*, in which household pre-tax income is given by the sum (for the head and the spouse, if present) of labor income, capital income, pensions, public social benefits, and private transfers, while post-tax income is defined as pre-tax income minus income taxes and social security contributions. Public social benefits capture transfers from government insurance and assistance programs. Appendix A.2 describes the income components in detail. Using the tax function allows us to interpret the parameter λ from Equation (1) as the average tax rate and τ as a measure of progressivity of the income tax system. A tax function defined this way can be used in structural models which model government transfers explicitly, as it only captures income taxes. Section 5 reports the results for our tax function.

Then, to study the role of transfers and the government for progressivity, we define a *tax and transfer function,* in which we modify the income definitions so that public social benefits are included in post-tax income rather than in the pre-tax one. With this function, τ now captures a wider notion of redistribution in the economy. The tax and transfer function can be used in structural models which do not model government transfers explicitly, as it captures both income taxes and government transfers. Section 6 compares the results of the tax and the tax and transfer function.

The monetary quantities that make up our income definitions need to be adjusted to be comparable across country and time. 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. LIS directly provides adjustment factors that allow us to convert nominal monetary amounts into 2017 USD PPP. 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.

5 Effective Income Taxes

In this section, we first show that our tax function is a good approximation of the income tax systems of all countries in our sample. Then, we describe the average level of taxation and progressivity in the cross-section and over time.

5.1 Fit of the Tax Function

As Heathcote, Storesletten, and Violante (2017) show, the log-linear tax function in Equation 1 is a good approximation of the US federal income tax system. In this section, we show that the log-linear tax function is a good approximation of the income tax systems in all the countries in our sample.

First, in Figure 2 we show that our log-linear tax function is a remarkably accurate approximation of the income tax system in all the countries in our sample. We plot the logarithm of post-tax income as a function of the logarithm of pre-tax income for six countries in wave 10, corresponding to 2015-2017. Online Appendix xxx shows the results for the remaining countries in wave 10. To draw these graphs, we first select our sample of standard households with heads aged between 25 and 60, and then we construct weighed 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.

Second, in Figure 3 we show that the R^2 from the regressions we use to estimate our tax functions is very high. We run the regression in Equation 4 wave-by-wave and country-by-country and we and report the distribution of the R^2 from these regressions in Figure 3. The distribution is significantly skewed to the right and has a mean of 0.975 and a median of 0.983. 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 well approximates the income tax systems of the countries in our sample.

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. While for numerous countries, such as Canada, Norway, and the United Kingdom, information on income taxes and social contributions is directly observed, for many 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 2 in Appendix A.1 shows whether taxes and contributions are imputed or not in each country and in each wave. If the imputation procedures rely on a log-linear tax function similar to ours, our goodness-of-fit measures could be grossly overestimated. However, 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 Current Population Survey (CPS) - Annual Social and Economic Supplement (ASEC.) This survey 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 13 in Appendix B confirms that our results are not affected by imputation. Here we

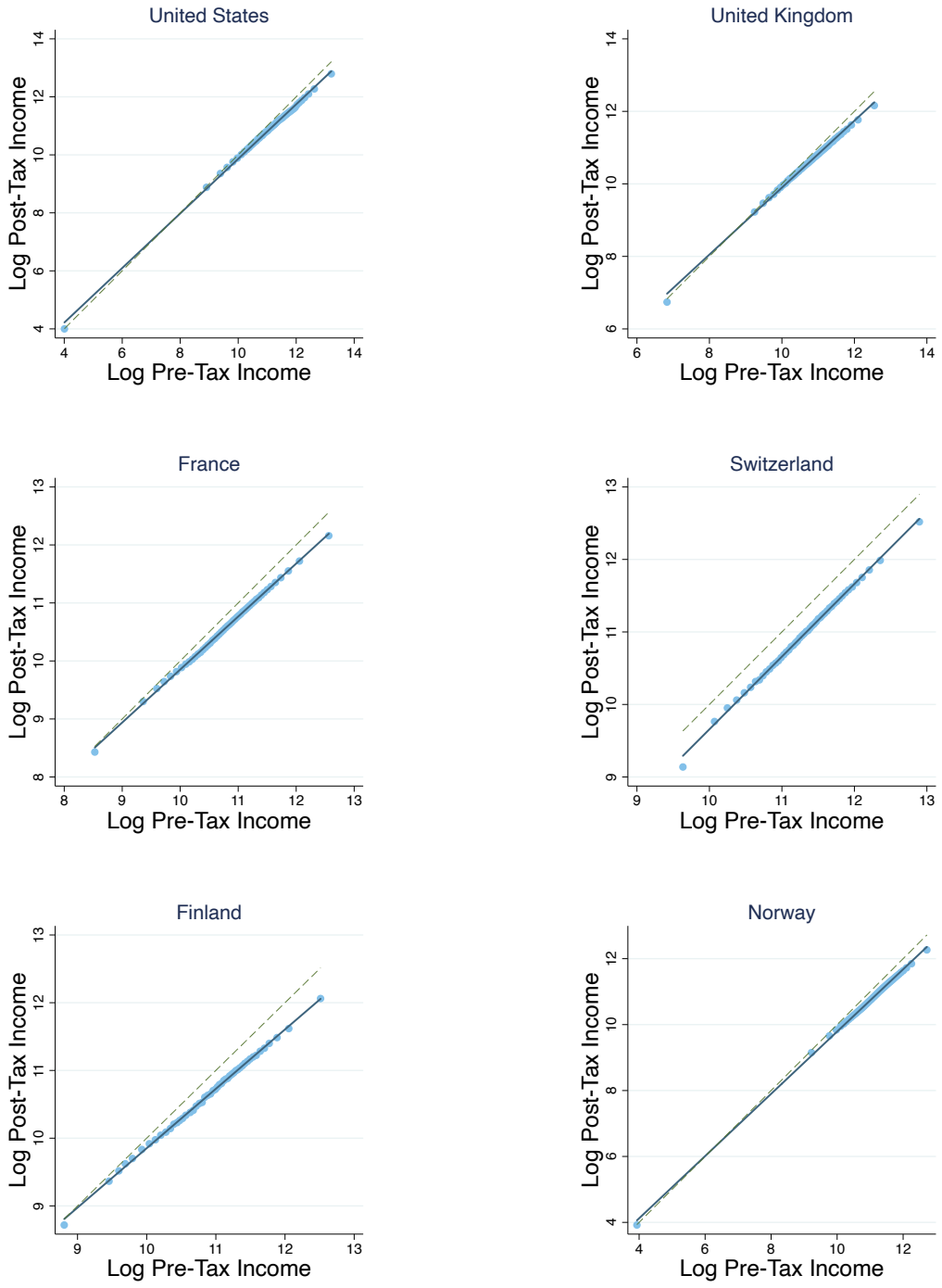

Figure 2: Log post-tax income as a function of log pre-tax income, Wave 10. Post-tax income is defined as pre-tax income minus income taxes. Each dot is a percentile of the log pre-tax income distribution. The dashed line is the 45 degree line. The solid line is the OLS fitted line.

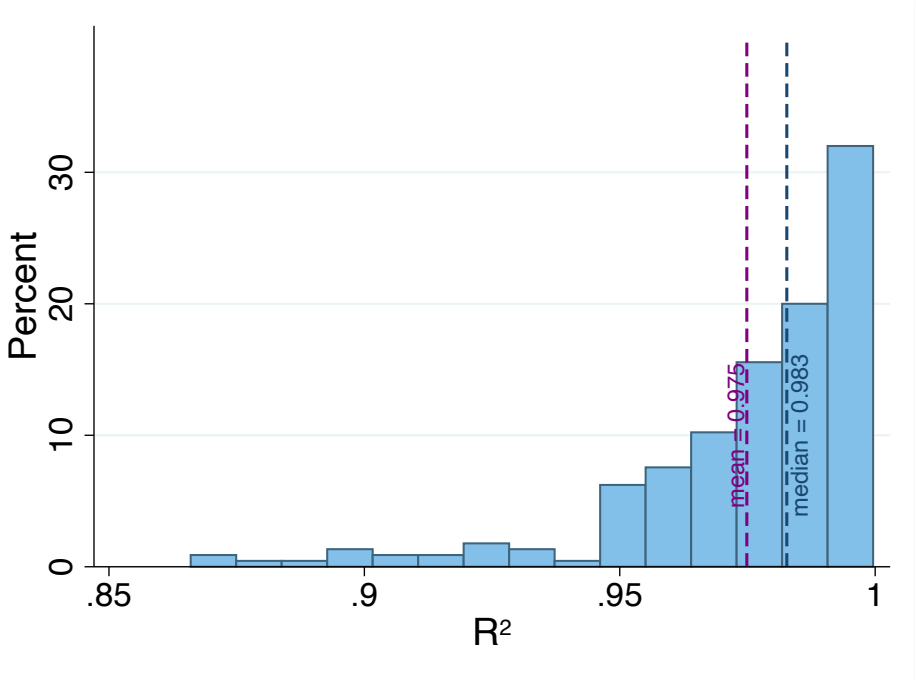

Figure 3: Distribution of the R^2 from year-by-year and country-by-country regressions of log post-tax income on log pre-tax income.

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 both the mean and the median of the distribution of R^2 are untouched when we exclude imputed values.

5.2 Effective Income Taxes Across Countries

After establishing that the log-linear tax function is a good approximation of the income tax systems of the countries in our sample, we turn to discuss our estimated effective tax functions.

We start by comparing the average level of taxation and progressivity across countries. Figure 4 shows our results in wave 10. Here 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. Figure 5 shows pre-tax median income in each country available in wave 10. Financial quantities are reported in 2017 dollars, as described in Section 4.3. Looking at these two figures together, we see that, for example, the average tax rate in the USA is about 19%, corresponding to a median pre-tax income of about $ 72,000. Online appendix ... shows the estimated tax parameters and the median pre-tax income for all waves other than wave 10.

Figure 4 shows that a higher level of progressivity is generally associated with a higher average tax rate for the median household. This is confirmed by the positive-sloped fitted line. We observe

several interesting facts. First, numerous countries, such as Spain (ES,) the United Kingdom (GB,) and the United States (US,) are concentrated around an average tax rate between 15 and 20 percent and progressivity between 0.04 and 0.08. Second, Northern-European countries, such as Germany (DE), Belgium (BE), Finland (FI), and the Netherlands (NL,) are characterized by the highest degree of progressivity and high average tax rates. This is consistent with the high degree of social protection present in this countries.[4] Third, at the opposite extreme, we observe countries with a low level of average income taxation and low progressivity of the income tax system. These are South-American countries such as Colombia (CO) and Peru (PE.) Despite having progressive statutory income taxes, these countries exhibit very low effective tax progressivity. Finally, Switzerland (CH) is characterized by one of the highest average tax rates but the lowest progressivity, despite having progressive federal income taxes. Switzerland's income taxes are complicated because they are levied at the federal, cantonal, and municipal levels. Do we know what LIS measures? Federal income taxes are very low and vary between 0.5 and 11 percent and that could explain why we find an essentially flat rate.

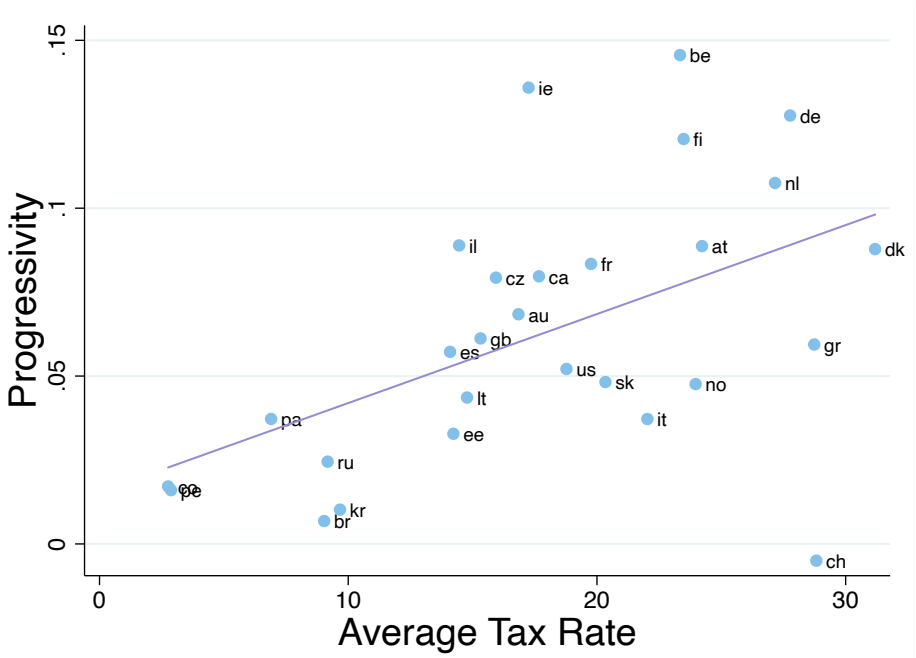

Figure 4: Average Tax Rate and Progressivity in Wave 10 (2015-2017). The average tax rate is evaluated at the median income of each country. Progressivity is measured by the parameter τ. The solid lavender line is the OLS fitted line.

[4]See Alesina and Glaeser (2006) for a discussion of the differences between the American and the European welfare state and for a classification of the European approaches to social insurance.

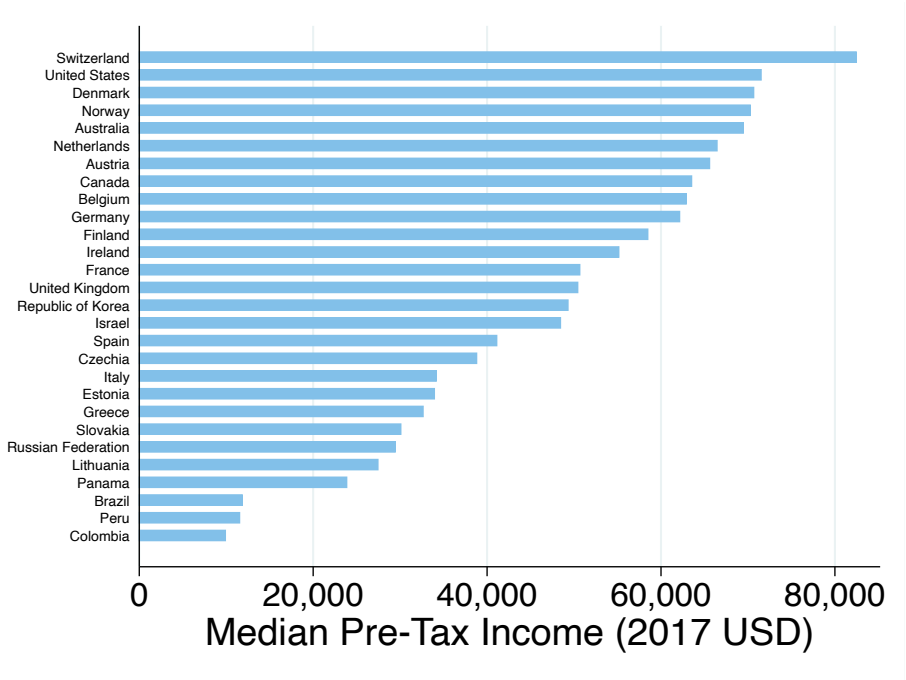

Figure 5: Median Pre-Tax Income in Wave 10. Income is measured in 2017 USD PPP.

5.3 Effective Income Taxes Over Time

To complete our description of the world's income tax systems, we present the evolution over time of the average tax rate for the median household and progressivity. We compute the average tax rate for the median household by applying Equation (2) to the median pre-tax income of each country in each wave. Figure 14 in Appendix B shows the evolution of median pre-tax income for the countries in Figure 6. We measure progressivity by the parameter τ in our tax function.

Figure 6 displays the evolution of λ and τ for the USA, Norway, Germany, the United Kingdom, Canada, and France. Explaining all the changes in the tax parameters requires investigating the history of tax legislation for each country, which goes beyond the scope of our paper.[5] However, we can still observe interesting patterns in Figure 6.

We need to decide what graphs to use and how to show the results, then we can frame the discussion.

[5] Borella, De Nardi, Pak, Russo, and Yang (2020) do it for the United States.

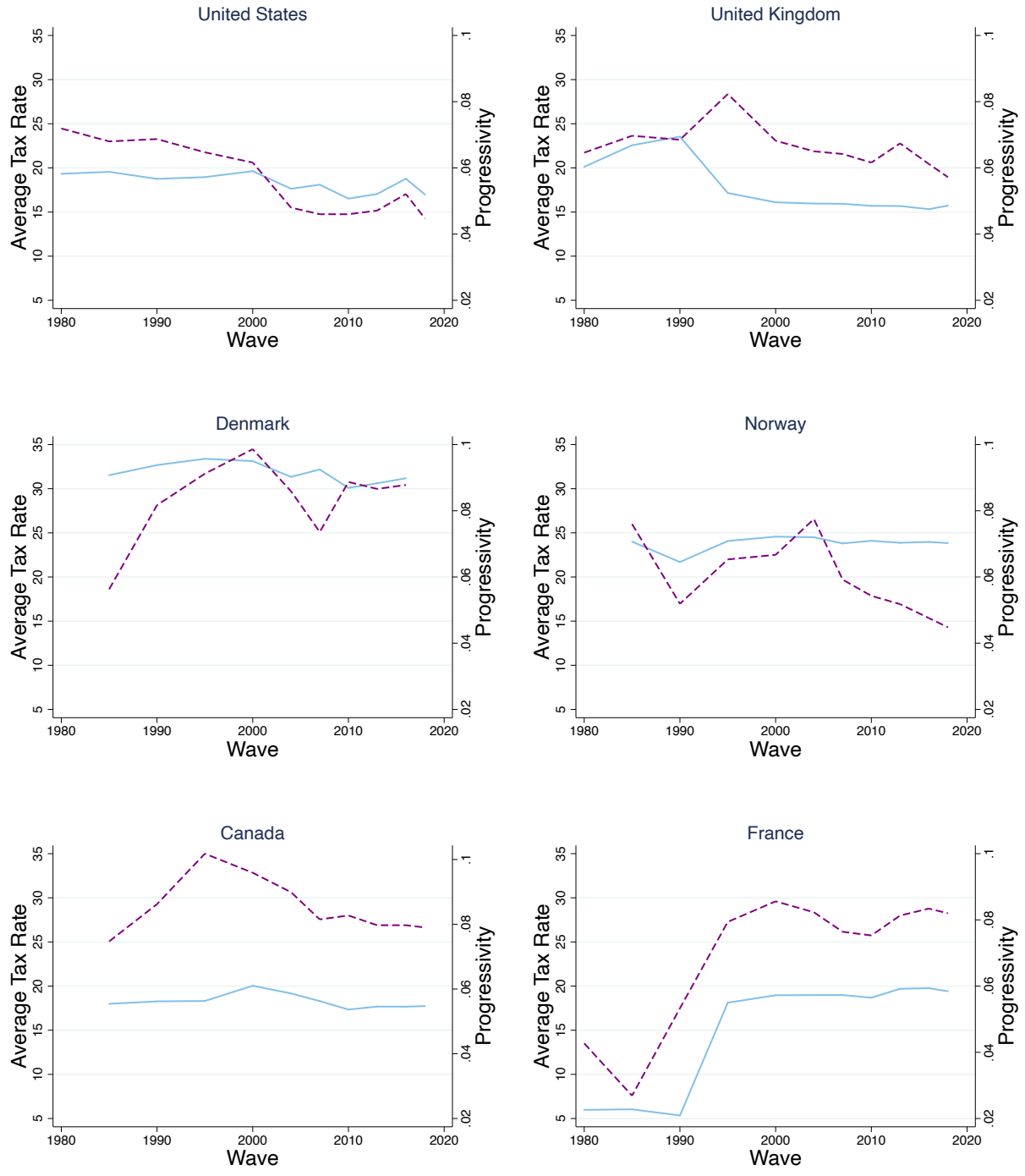

Figure 6: Average tax rate and progressivity over time for selected countries. The solid blue line is the average tax rate for the median household in each year, the dashed purple line is progressivity, measured by the parameter τ.

6 The Role of Transfers for Progressivity

This section analyzes the effects of government transfers on the progressivity of the income tax system. We do so by estimating a tax and transfer function, in which public social benefits enter the post-tax income and not the pre-tax one.

6.1 Progressivity gross and net of transfers

So far, we have ignored the role of transfers for redistribution, as we have treated public social benefits in the same way as the income earned in private markets. Now, we exclude all public social benefits from pre-tax income and include them in the post-tax income to study their effects on the estimated progressivity of the income tax system. We call gross progressivity the progressivity estimated using the tax function and net progressivity the one estimated using the tax and transfer function.

Figure 7 compares gross and net progressivity in six waves of LIS. Net progressivity is much higher than its gross counterpart in every country and wave. Thus, transfers have a sizable effect on progressivity and redistribution worldwide. Moreover, the large differences between gross and net progressivity highlight the importance of the functional form of the tax function when studying - and modeling - income tax systems. For example, using the tax function for Switzerland in Wave 5 would conclude that the income tax system is regressive, as the parameter τ is negative. However, using the tax and transfer function would lead to the opposite conclusion, as net progressivity is largely positive. The tax function specification is also crucial when modeling the income tax system. The functional form has significantly different implications on the magnitude of the post-tax income entering the household budget constraint and, consequently, on the optimal choices of consumption and savings.

We can also study the evolution over time of the role of transfers by analyzing the differences in gross and net progressivity. For example, in the United States, net progressivity was ten times larger than the gross one in 1980 (i.e., in the first wave of LIS) and became even bigger in 2019, when it was 15 times larger than the net one. Therefore, transfers have become more important for redistribution in the United States over the last 40 years.

I would like to say more

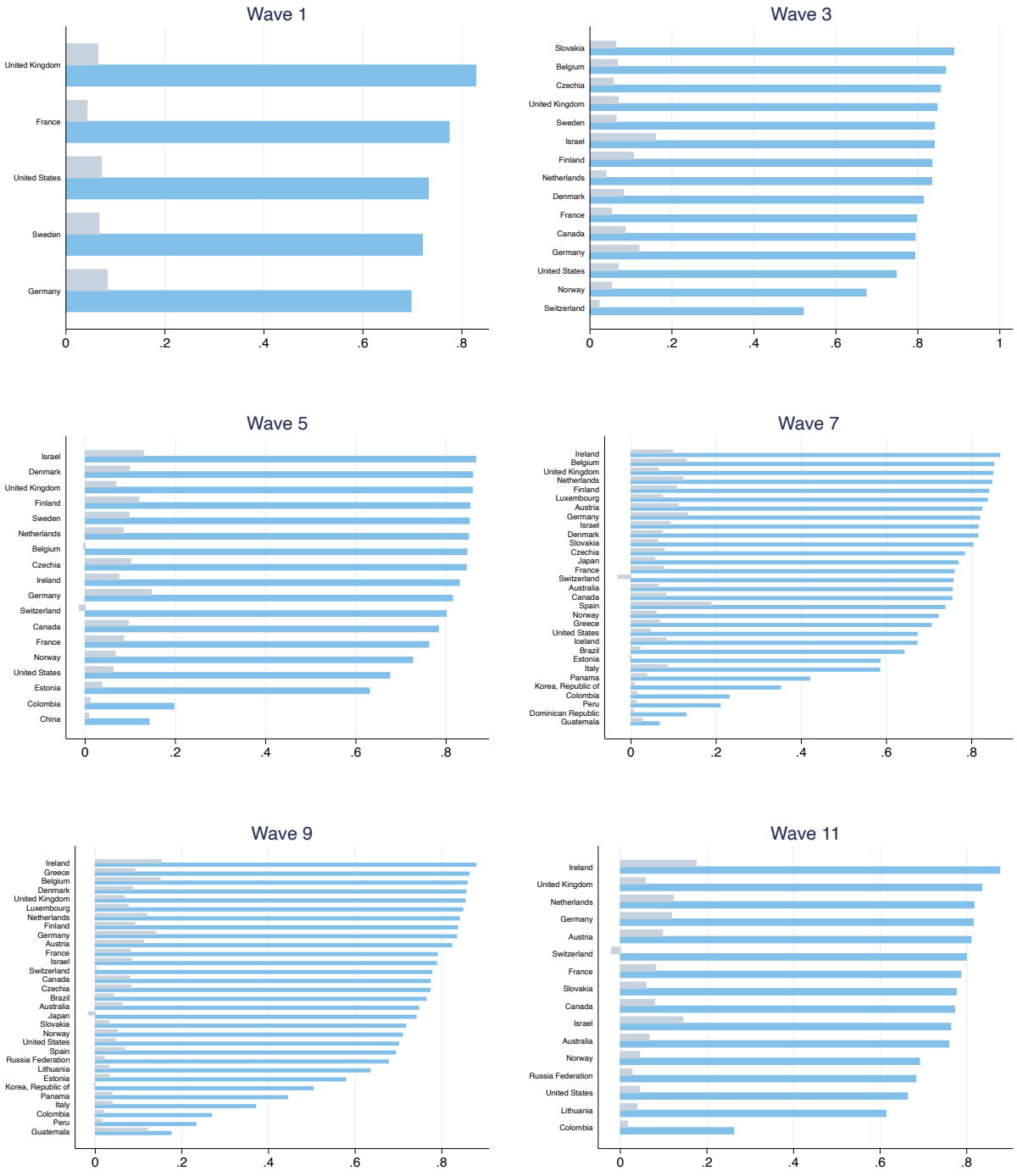

Figure 7: Comparison of progressivity gross and net of government transfers. The gray bars denote gross progressivity, the blue ones show net progressivity.

7 Estimation by Household Types

In this section we estimate tax functions separately by household type, which is interesting because ...

7.1 Household Composition in our sample

Here we want to describe the household structure in our sample to see where things stand and how they have changed over time

In Figure 8 we pool all available years together and study household structure by country. We may want to redo this graphs and figure out whether a bar chart can include categories with zero occurrences.

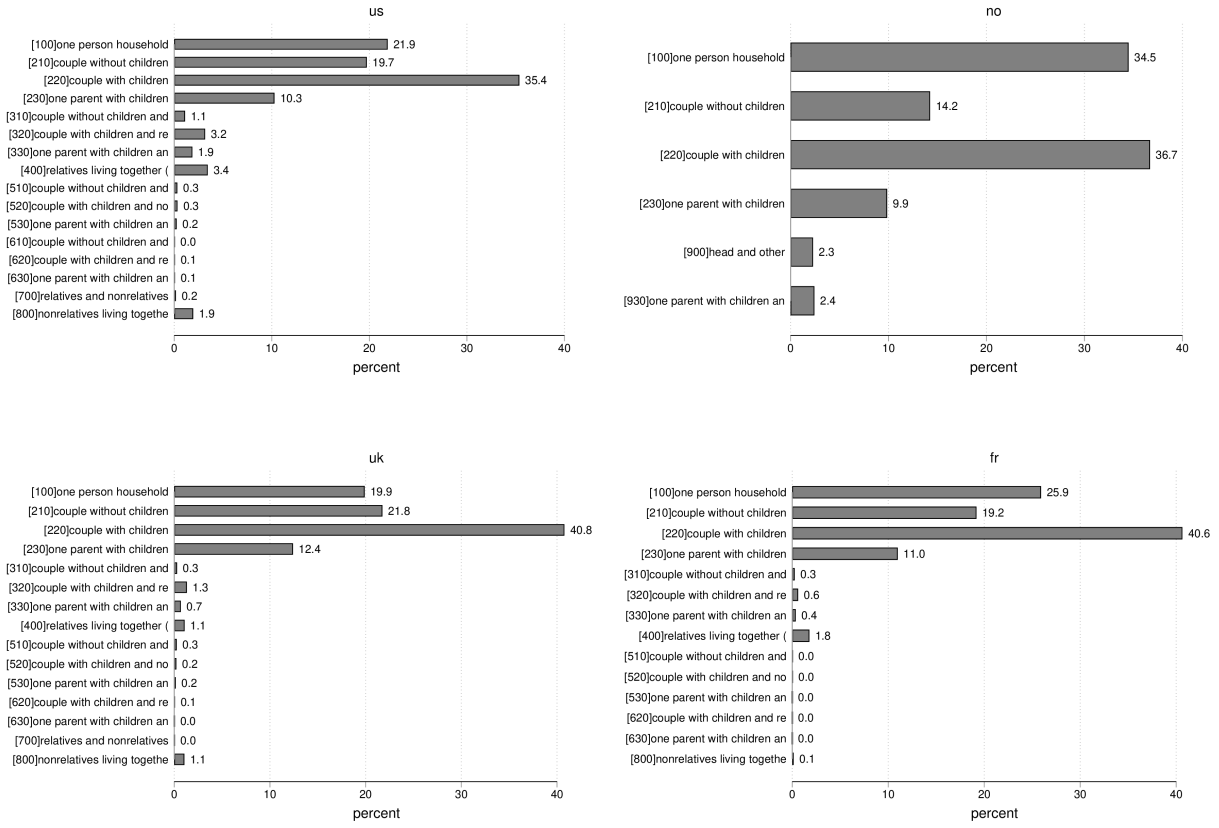

Figure 8: Household Composition in our sample

In Figure ... we focus on the 4 types that make up our definition of standard households and study the dynamics of these groups over time for different countries. Here we select the same countries as above and each graph has 4 lines, one for every type

7.2 Tax Parameters by Household Type

Here we show our estimated tax parameters by household type.

In Figure 9 we fix a wave and look at the progressivity level for all countries for which we have data in that wave.

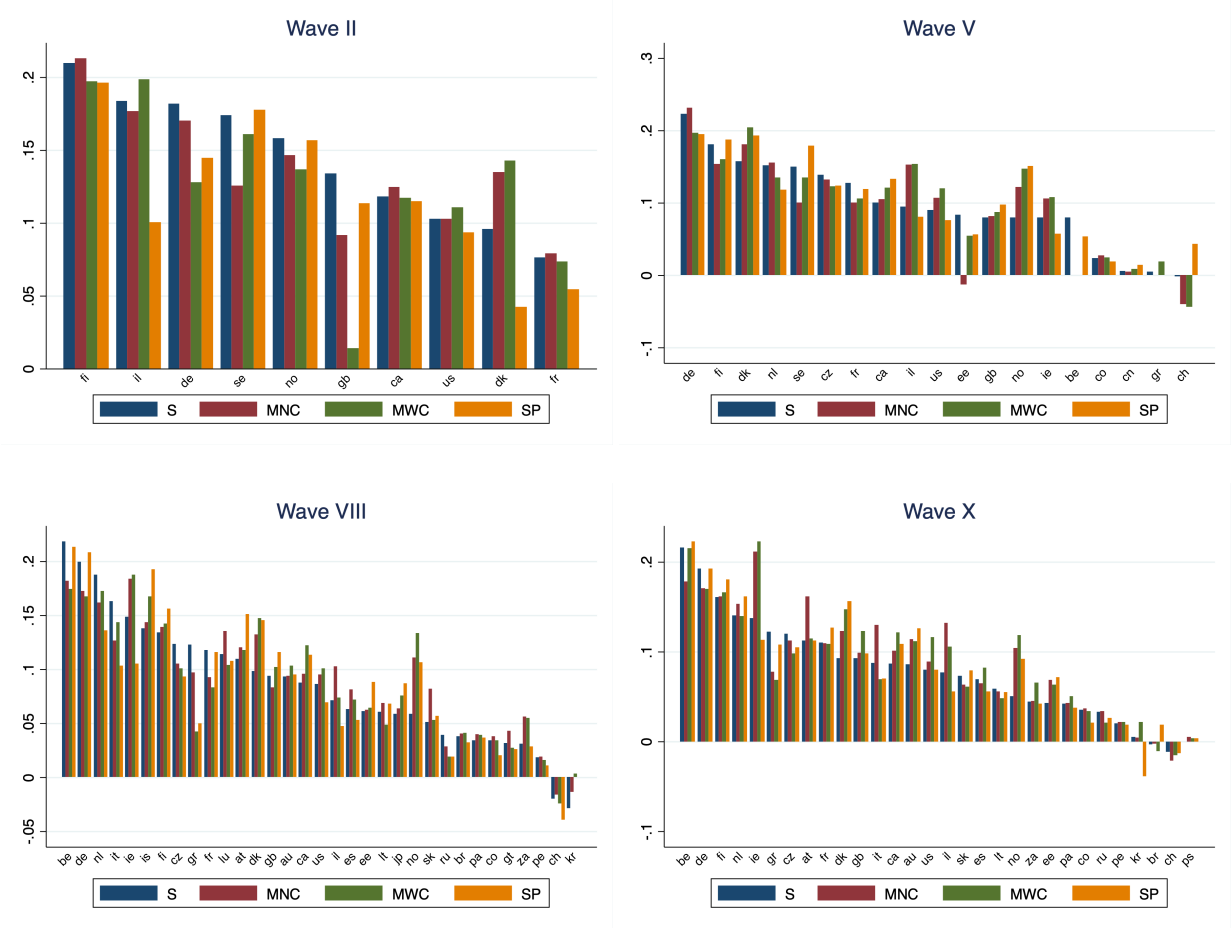

Figure 9: Progressivity by household type. Fix the wave, look at all countries.

In Figure 10 we fix a country and look at the evolution of progressivity across time.

In Figure 11 we fix a wave and look at the average tax rate for all countries for which we have data in that wave. The average tax rate is evaluated at the median income for each country in each wave. I don't know if we want to show this for sure. We may end up deciding it's too confusing, because median income is moving around, but I put it here for now.

In Figure 12 we fix a country and look at the evolution of the average tax rate across time. I am even less sure about including these, because median income varies across time and across country, so comparisons are very complicated

In Figure ... we show the comparison between the tax and the tax and transfer function across household types. This is interesting because it allows us to study the role of transfers for different groups.

Figure 10: Progressivity by household type. Fix country, look at all waves

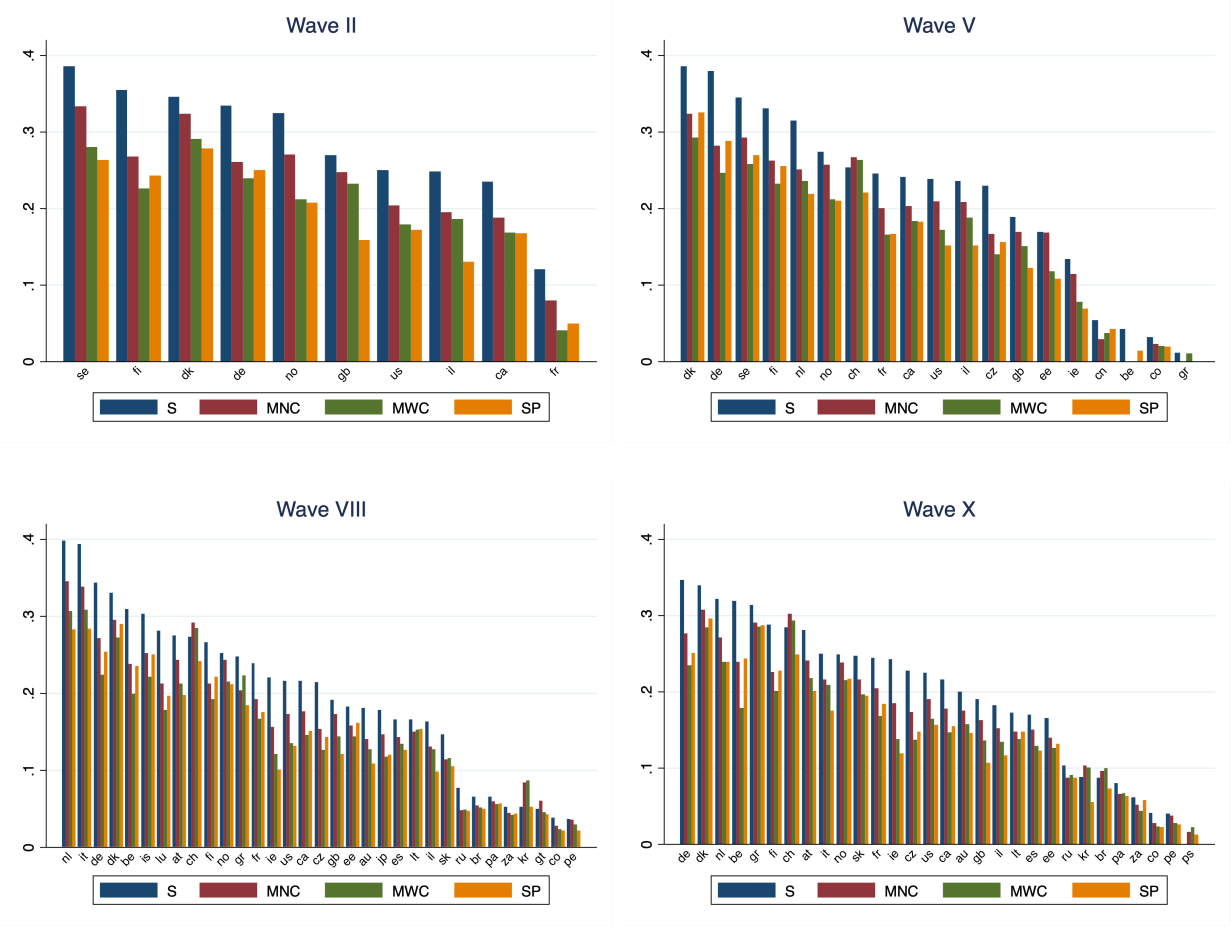

Figure 11: Average tax rate by household type. Fix the wave, look at all countries.

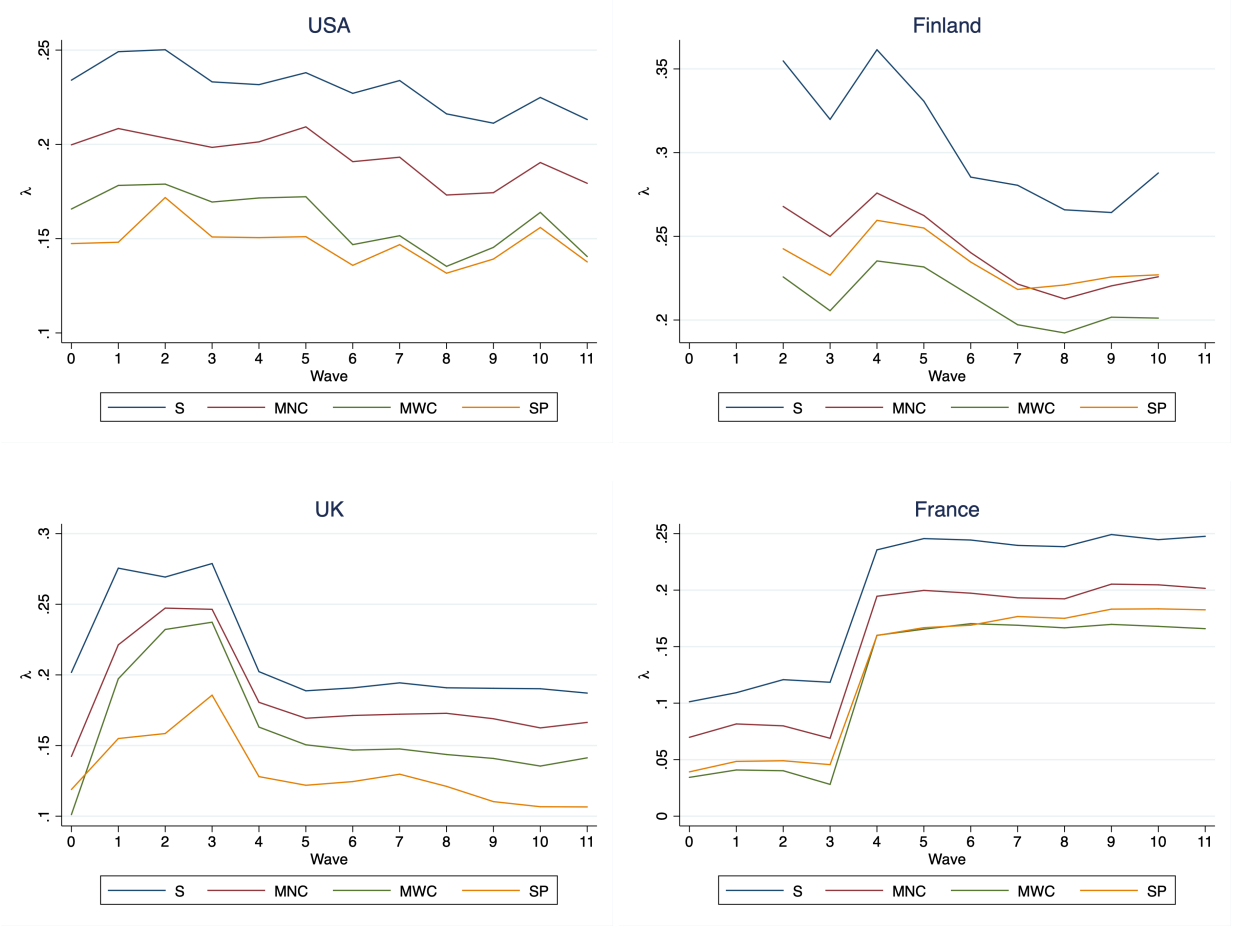

Figure 12: Average tax rate by household type. Fix country, look at all waves

8 Conclusion

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A LIS data

A.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
Austria	at						9,355	11,046	11,491	10,653	10,670	6,865
Australia	au						7,375	5,844	10,121	8,381	9,812	8,149
Belgium	be			4,789	4,636	1,355	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
Switzerland	ch			2,972		5,331	2,337	13,172	13,413	12,433	13,260	4,088
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	
Germany	de	29,367	38,192	18,651	23,690	37,109	22,242	20,196	32,372	33,706	33,336	12,368
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	
Spain	es							6,923	6,797	6,186	6,805	
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
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
Greece	gr							3,054	2,659	3,854	9,577	
Guatemala	gt							7,737	7,483	6,505		
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
Iceland	is						1,981	1,960	2,002			
Italy	it						4,120	3,927	3,880	3,404	2,997	
Japan	jp							1,399	1,172	942		
Republic of Korea	kr							17,540	7,709	7,189	5,495	
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							
Romania	ro				34,508							
Russian Federation	ru								8,567	50,219	150,981	62,965
Sweden	se	7,302	6,570	8,645	9,522	8,699	9,839					
Slovakia	sk			9,920			3,187	3,061	2,877	5,593	7,545	2,386
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	186,216	454,938	795,498	718,222	1,002,199	1,186,052	1,137,751	1,277,705	629,101
Total countries		5	10	15	15	18	24	31	32	31	28	16

Table 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.

A.2 Income Components

We take the components which define our measures of pre-tax and post-tax income directly from LIS.[6]

Labor income. Total income from 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. 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), all functions (old-age, disability, survivors). Includes voluntary individual pensions, mandatory individual pensions, occupational pensions, employment related public pensions, universal pensions and assistance pensions.

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.

[6]The definitions can be found in the codebook at: https://www.lisdatacenter.org/wp-content/uploads/files/data-lis_codebook.pdf

A.3 Details on Imputation

Country	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9	Wave 10	Wave 11
Austria						no	no	no	no	no	no
Australia						yes	yes	yes	yes	yes	yes
Belgium			yes	yes	yes	yes	yes	yes	yes	yes	
Brazil							yes	yes	yes	yes	
Canada		no	no	no	no	no	no	no	no	no	no
Switzerland			no		no	no	no	no	no	no	no
China					no						
Colombia					yes	yes	yes	yes	yes	yes	yes
Czechia			no	no	yes	no	no	no	yes	yes	
Germany	no	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
Denmark		no	no	no	no	no	no	no	no	no	
Dominican Republic							no				
Estonia					no	yes	yes	yes	yes	yes	
Spain							no	no	no	no	
Finland		no	no	no	no	no	no	no	no	no	
France	no	no	yes	no	no	no	no	no	no	no	no
United Kingdom	no	no	no	no	no	no	no	no	no	no	no
Greece							yes	yes	yes	yes	
Guatemala							no	yes	yes		
Ireland					no	no	no	no	no	no	no
Israel		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Iceland						no	no	no			
Italy						yes	yes	yes	yes	yes	
Japan							yes	yes	yes		
Republic of Korea							no	no	no	no	
Lithuania								no	no	no	no
Luxembourg						no	no	no	no		
Netherlands			yes	no	no	no	no	no	no	no	no
Norway		no	no	no	no	no	no	no	no	no	no
Panama							yes	yes	yes	yes	
Peru						no	no	no	no	no	
Poland				no							
Romania				no							
Russian Federation								yes	yes	yes	yes
Sweden	no	no	no	no	no	no					
Slovakia			no			no	no	no	yes	yes	yes
United States	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Percent Imp.	20	20	40	27	33	33	39	44	52	50	44

Table 2: ciao

B Effective Income Taxes

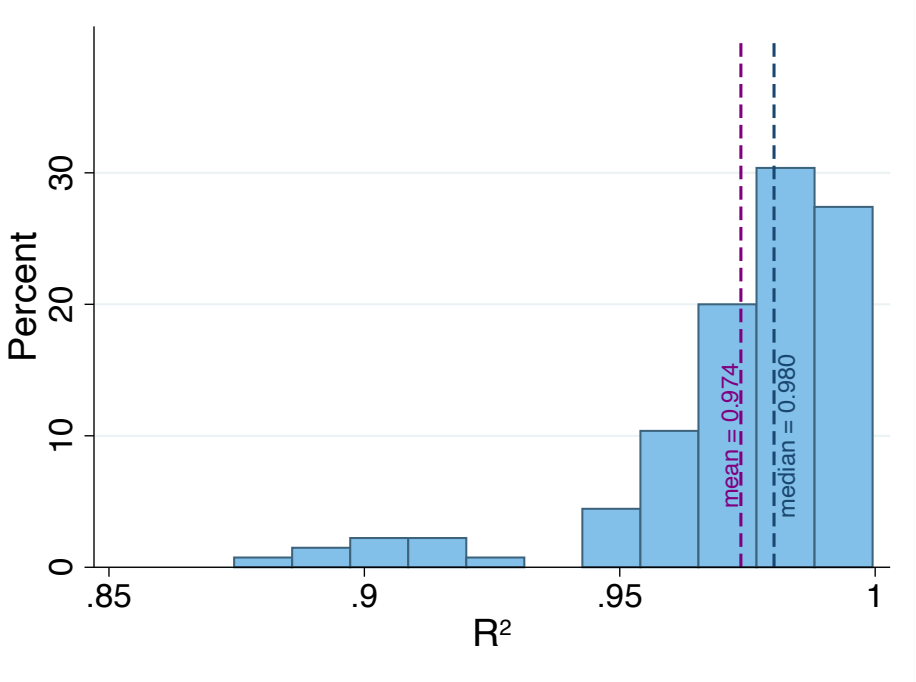

Figure 13: Distribution of the R^2 from year-by-year and country-by-country regressions of log post-tax income on log pre-tax income when we exclude imputed values

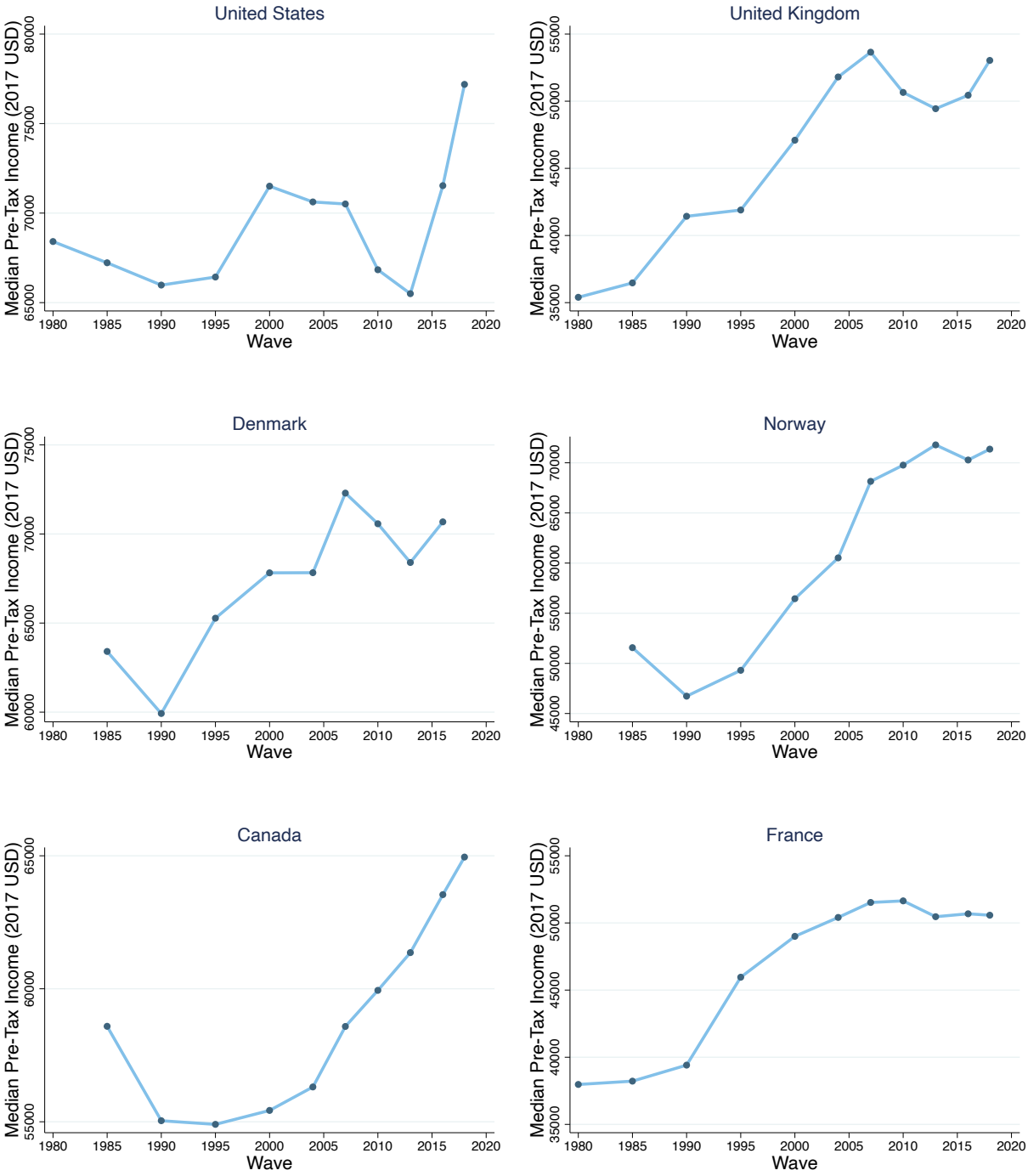

Figure 14: Median pre-tax household income for selected countries in 2017 USD PPP.

Here we put:

1. Graph for distribution of R^2 once we exclude countries and waves for which taxes and/or social contributions were imputed.
2. Scatter plots of estimated tax parameters for waves different than wave 10
3. Bar charts of median pre-tax income for waves different than wave 10