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### **Four levers of redistribution: The impact of tax and transfer systems on inequality reduction**

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# Four levers of redistribution: The impact of tax and transfer systems on inequality reduction

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## Abstract

Using observational micro data from the Luxembourg Income Study (LIS) we assess the redistributive impact of tax and transfer configurations across 22 OECD countries for the period 1999-2013. After imputing missing tax data (employer social security contributions), we measure the reduction of income inequality due to four key levers of tax and transfer systems: the average tax rate, tax progressivity, the average transfer rate, and transfer targeting. Our methodological improvements provide the following results: First, tax redistribution dominates transfer redistribution (excluding pensions) in most countries. Second, targeting explains very little of the cross-country variation in inequality reduction. In contrast, both progressivity of taxes and the average tax rate have large impacts on redistribution. Third, we observe the trace of political trade-offs. High average tax rates do not appear in conjunction with highly progressive tax systems.

*Keywords:* tax-benefit policies; social security contributions; inequality reduction

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# 1 Introduction

Four key policy levers contribute to redistribution: the average rate and progressivity of taxation, and the average rate and targeting of social transfers. *Ceteris paribus*, stronger targeting and progressivity reduces inequality. Beyond the *ceteris paribus* assumption, theory is inconclusive. Changes in targeting and progressivity may cause simultaneous changes in the average rate of transfers and taxes through political bargaining, labour market responses, or other mechanisms. It is unclear if such connections are present. Since there is no intuitive way forward, new theories need a base of accurate empirical evidence to reveal how the four levers of redistribution are connected.

This paper provides a base of empirical evidence by analysing the impact of taxes and transfers on redistribution in a unified framework.<sup>1</sup> Using Luxembourg Income Study (LIS) micro data, augmented by imputations of missing taxes, we decompose redistribution into the four policy levers. Our analysis provides an international comparison of 22 countries over the period 1999-2013 for a total of 67 country-years.

We provide a significantly improved measure of tax redistribution by imputing missing taxes. Employer social security contributions are not measured in the underlying household surveys, which causes a bias since the balance between employee and employer contributions varies significantly across countries. The imputations are accurate: the average share of social security contributions in household income has a correlation of 95 percent with the share of social security contributions in gross domestic product from national accounts. And the improvement is significant: our tax data covers 52 percent of the national tax revenue in contrast to 35 percent in the initial LIS data.<sup>2</sup> The imputations are essential to compare tax systems across countries.

The cross-country comparisons reveal patterns of policy configurations. Different countries lie at the extreme of each policy lever and there is a broad variety of configurations that provide the same magnitude of redistribution. No country strains all four levers simultaneously so redistribution is delivered by either taxes or transfers but not both. Categorising pensions as income rather than transfers, we find that most countries redistribute primarily through taxes. Our results hint at political trade-offs. Strongly progressive taxation appears incompatible with a high rate of tax.

Even though countries may trade-off progressivity against the average rate of taxes, both levers reduce inequality. Different countries obtain the same magnitude of inequality reduction through high rates of taxation and through strongly progressive tax schedules.

In contrast to taxes, within transfers, one lever is dominant. Most of the impact is

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<sup>1</sup>We focus on monetary redistribution. Non-monetary forms of redistribution, such as in-kind redistribution and occupational welfare, fell outside the scope of this analysis.

<sup>2</sup>The remaining portion of the tax revenue is mostly due to consumption tax and corporate taxation. We study consumption tax in a companion paper.

due to the rate of transfers while targeting plays only a minor role. Although it would be theoretically possible, no country pairs a low transfer rate with sufficient targeting to match the magnitude of redistribution reached by a high transfer rate.

We contribute to the literature in three ways. First, while the empirical literature provides an accurate assessment of transfers, the measurement and comparison of taxation remains either partial or biased (Marx, Salanauskaite, and Verbist, 2013; Nieuwenhuis, Munzi, and Gornick, 2016). As mentioned above, we reduce the bias by recovering missing tax data.

Second, we provide a unified framework to decompose redistribution into the four policy levers. With the exception of Immervoll and Richardson (2011) and Avram, Levy, and Sutherland (2014), existing literature does not isolate the specific effect of targeting and progressivity.<sup>3</sup> This study is the first to assess the redistributive impact of all four levers of redistribution using household survey data on a sample that includes the whole population.

Third, the methodological improvements lead to original findings. While few studies compare the redistributive impact of taxes and transfers simultaneously, their conclusions all point in the same direction: the redistributive effect of transfers is much more important than the tax system—the opposite to our finding (Immervoll and Richardson, 2011; Kenworthy, 2011; Joumard, Pisu, and Bloch, 2012; Avram, Levy, and Sutherland, 2014). The discrepancy is primarily due to state provided pensions, which inflate transfers (Immervoll et al., 2006; Mahler and Jesuit, 2006). If public pensions are categorised as income rather than transfers, the redistributive effect of transfers is dramatically reduced and falls below the redistributive effect of taxes. The imputation of missing taxes also challenges the usual ordering of countries in terms of efficiency in inequality reduction. For instance, France and Sweden redistribute primarily through taxes in our data.

The literature suggests that countries in which transfers are most targeted are less effective in reducing inequality (Korpi and Palme, 1998; Moene and Wallerstein, 2001), which is referred to as the ‘paradox of redistribution’. The importance of the transfer rate is well supported, but the existence of a negative relationship between targeting and redistribution is contested (Brady and Bostic, 2015; Marx, Salanauskaite, and Verbist, 2013). We find a positive yet weak relationship between targeting and redistribution. The impact of targeting is constrained by the size of the transfer budget as measured by the average transfer rate.

Many scholars have observed a negative correlation between the progressivity of the tax system and the extent of social spending (Kato, 2003; Lindert, 2004; Prasad and Deng, 2009; Beramendi and Rueda, 2007). While we confirm this stylised fact, we highlight the trade-off existing between progressivity and the average rate of taxes.

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<sup>3</sup>Immervoll and Richardson (2011) restrict their analysis to the non-elderly and exclude employer social security contributions. Avram, Levy, and Sutherland (2014) exploit EUROMOD, the tax-benefit microsimulation model for the European Union, while we compute actual redistribution using observational data.

The following section describes our framework for decomposing redistribution into the four policy tools. Section 3 describes the data and details the imputations of social security contributions. Section 4 provides the results of the international comparisons, which have been summarised with a range of graphs. We conclude, in Section 5, with a discussion of the results and recommendations for future research. Analysis of the redistributive impact of pensions and further details on the tax imputations are available in the appendix.

## 2 Four levers of monetary redistribution

Our analysis of monetary redistribution is sequential (see Figure 1). Our starting concept is *market income*, which is the sum of labour, capital and pension income before any transfers or taxes. We then add transfers, which converts market income to *gross income*. Finally, we subtract taxes to obtain *disposable income*. This sequential approach allows us to compare redistribution through taxes with redistribution through transfers for each country-year observation.<sup>4</sup>

[Place Figure 1 here.]

The work of Reynolds and Smolensky (1977) and Kakwani (1984) identifies the links between redistribution, progressivity (or targeting), and the average rate of taxes (or transfers). We rewrite these results in a form that contains the four levers of redistribution in a single formula:

$$\text{Redistribution} = \text{Transfer rate} * \text{Targeting} + \text{Tax rate} * \text{Progressivity} - \epsilon$$

The greater the average transfer rate and the more intensely these transfers are targeted to the poor, the greater the redistribution. Similarly, the greater the average tax rate and more progressive the tax system, the greater the redistribution. Algebraically, the impact of the four policy levers on redistribution is given by:

$$\text{Gini}_{\text{market}} - \text{Gini}_{\text{disposable}} = \frac{s}{1-s} \text{Kakwani}_{\text{transfer}} + \frac{t}{1-t} \text{Kakwani}_{\text{tax}} - \epsilon$$

Redistribution is measured by the difference between the Gini index on market income and the Gini index on disposable income—the Reynolds-Smolensky index. The impact of

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<sup>4</sup>Since we are interested in the general structure of redistribution at the country level, we consider the tax system and the transfer system as aggregates and do not analyse the specific contribution of different schemes.

the transfer rate is measured by  $\frac{s}{1-s}$ , where  $s$  is the average transfer rate.<sup>5</sup> This form is due to algebraic relationship between Reynolds-Smolensky index and the Kakwani index. Similarly, the tax rate is measured by  $\frac{t}{1-t}$ , where  $t$  is average tax rate.  $Kakwani_{transfer}$  and  $Kakwani_{tax}$  are the Kakwani indexes to measure transfer targeting and tax progressivity. The Kakwani index is the difference between the concentration index and the Gini index. Concentration indexes are calculated on pre-tax income and pre-transfer income. If transfers decrease with income and taxes increase with income, the  $Kakwani_{transfer}$  is negative and  $Kakwani_{tax}$  is positive.<sup>6</sup> As shown by Kakwani (1984),  $\epsilon$ , also known as the Atkinson-Plotnick index of re-ranking, captures the change of household ranking in the income distribution.<sup>7</sup> The poorest household according to market income may not be the poorest household according to disposable income.

In theory, redistribution from taxes (or transfers) depends on the interaction between the average rate and progressivity (or targeting). The marginal effect of progressivity is not constant. For example, an increase in progressivity will have a larger impact on redistribution when coupled with a higher average tax rate. The converse also applies. The marginal effect of the average tax rate varies according to the level of progressivity observed.

We are interested in the connections that go beyond the *ceteris paribus* assumption of marginal effects. A change in progressivity or targeting may come together with changes in the average tax and transfer rates, for example. Ultimately, revealing these connections requires accurate data on income, taxes, and transfers at the household level.

## 3 Data

### 3.1 Luxembourg Income Study (LIS) dataset

We use the micro data provided by the Luxembourg Income Study (LIS), a harmonisation of national household surveys. The data includes different types of household income comprised of individual earnings, monetary transfers, direct taxes, employee contributions, and household consumption behaviour. LIS data has become the benchmark for the analysis of the redistributive impact of tax and transfer systems (Ferreira, Lustig, and Teles, 2015). The data is comprehensive, comparable, and measures the behavioural effect of the transfer system—since the recipient reports the amount of transfers actually received rather than the amount the government intends to provide.

A common alternative to LIS data is EU-SILC data in combination with the EURO-

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<sup>5</sup>Notice that  $s$  is negative. Transfers may be thought of as negative taxes.

<sup>6</sup>In our sample, transfers are always targeted to the poor, i.e. the interaction term  $Kakwani_{transfer}$  is always negative. This results in only positive terms in the equation.

<sup>7</sup>See Urban (2009) for details on inequality decomposition and re-ranking.

MOD microsimulation model.<sup>8</sup> We chose to use LIS data for two reasons. First, LIS data has broader coverage of taxes and transfers. LIS includes EU-SILC data, supplemented with administrative tax data for some countries. EU-SILC has a lower time and geographical coverage as it is restricted to European Union countries from year 2004. Second, we focus on the ex-post impact of different tax and transfer configurations, but the micro-simulation method of EUROMOD only allows the researcher to calculate the ex-ante effects of legislation. Micro-simulation is an accurate method to evaluate the static effect (same population with unchanged behaviour) of a specific policy change but the behavioural and political response is central to our analysis.

### 3.2 Details on income measures

Taxes and transfers may be separated from labour, capital, and pension income to define three stages of income. *Market income* measures the sum of labour, capital, and pension income before any taxes. *Gross income* results from adding transfers. Subtracting income tax and social security contributions provides *disposable income*. The detail of LIS variables used at each income stage can be found in Table 1. We focus on the changes in the income distribution from market, to gross, to disposable income—the impact of transfers and taxes.

All income, tax, and transfer variables are standardised at the household level using the square root equivalence scale. We always compare transfers to market income and taxes to gross income. This is consistent with most legislation since eligibility criteria to transfers refer to market income while the tax base often includes part of transfer income.

Since transfers and taxes are benchmarked to different income concepts, we cannot compare the magnitude of targeting versus progressivity or the magnitude of the average rate of transfers versus the average rate of taxes (Urban, 2014). However, we can compare the magnitude of changes in inequality – the outcome variable – due to taxes and due to transfers.

We extract the Gini inequality index for each income concept, the Kakwani index of tax progressivity and transfer targeting, and average rates of taxes and transfers over household income. The choice of income concept can influence the Kakwani index. In previous studies the reference income is pre-tax income. We maintain this convention by using market income for the Kakwani index of transfer targeting and gross income for the Kakwani index of tax progressivity.

Two measurement choices are particular to our analysis. Firstly, we choose to include retirement pensions (including occupational and universal pensions but excluding assistance pensions) in market income. We acknowledge that public pensions contribute to the reduction of inequality but their role must be studied separately. The difference between public

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<sup>8</sup>On the comparison of LIS with SILC/EUROMOD inequality measures, see Marx, Salanauskaite, and Verbist (2013).

and private pensions poses problems of comparability. If public pensions are excluded from market income, most pensioners have zero income before transfers. Pensioners would be shown as being poor, like any working age household with zero market income, yet this measurement would not reflect pensioners true purchasing power.

Previous studies have used one of two possible adjustments (Jesuit and Mahler, 2010): restrict the analysis to the working age population or integrate public pensions into market income. We chose to integrate public pensions into market income, following recent literature (Marx, Salanauskaite, and Verbist, 2016).<sup>9</sup> Doing so the market income of pensioners is comparable between countries with funded pensions and countries with pay-as-you-go systems.<sup>10</sup> Pensioners make up a large share of most national populations and this share varies across countries. Including pensions within market income is the only adjustment which can provide insights for the entire national population.

Our sample frame thus includes the whole population in contrast to the majority of studies which reduce their sample to the working age population. To investigate the importance of excluding pensions from transfers, we run a specific analysis of the redistributive impact of pensions (see Appendix A). Our analysis confirms that public pensions are a major determinant of inequality reduction.

The second measurement choice particular to this study is we measure market income before deducting employer social security contributions. Previous studies only consider employee contributions and income tax. There are important reasons for including employer contributions in the analysis. The majority of the incidence (between two thirds and 90 percent) falls on the employee, even though the contributions are labeled for the employer (for a review, see Fullerton and Metcalf, 2002; Melguizo and González-Páramo, 2013). The incidence of social contributions is similar to personal income tax so there is no economic reason to treat personal income tax, employee contributions, and employer contributions differently. This choice eases comparability as the split between employer and employee contributions varies from one country to another. Notice in Figure 2 that many countries, such as Sweden, rely mostly on employer contributions while other countries, such as the Netherlands, rely on employee contributions. The following section details how we imputed employer contributions and other missing taxes.

[Place Figure 2 here]

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<sup>9</sup>Note that pension contributions are included into social security contributions in our data, while their counterpart, pension benefits, are excluded from social transfers. Ideally, one would like to withdraw the specific part of social security contributions that refers to pensions, but this is not possible with LIS data.

<sup>10</sup>A different rationale for including pensions into market income is suggested by Smeeding and Weinberg (2001): pensions might be considered equivalent to deferred compensation, which is not the case for other benefits covering social risks such as unemployment or sickness.

### 3.3 Imputation of social contributions

LIS data provides only partial coverage of the taxation of households (Nieuwenhuis, Munzi, and Gornick, 2016). Employee social security contributions and personal income tax are missing for some country-years, and employer social security contributions and taxes on consumption are missing for all country-years.

A large part of transfers is financed through indirect taxes such as social contributions from employers and tax on consumption (Kato, 2003; Beramendi and Rueda, 2007). Measuring the effects of transfers without measuring the effects of taxes which fund these transfers strongly distorts the measure of redistribution. In addition, exemptions from social security contributions, especially on low wages, has become one of the strongest elements of progressivity in the tax system in countries such as France and Belgium (Zemmour, 2015; Bozio, Breda, and Guillot, 2016).

We impute employer social contributions at the individual level using OECD data on statutory rules. Our imputation greatly improves the tax coverage of the dataset. We cover 52 percent of the national tax revenue—in contrast to 35 percent in the initial LIS data.<sup>11</sup> The remaining portion of the tax revenue is mostly due to consumption tax and corporate taxation, which fell outside the scope of household survey data used in LIS. Figure 3 shows the effect of imputing social security contributions on the distribution of tax coverage. For some countries, we also impute employee contributions.<sup>12</sup>

[Place Figure 3 here.]

Our method of imputation is to apply the statutory rates provided by the OECD Taxing Wages series to individual wages. To the extent that the wages are accurately measured, the application of statutory rates allows for correct imputation and serves to simulate the amount of employer social contributions. When employee social security contributions is also missing, we impute by the same method. Our imputations allow us to reconstruct the pre-tax labour income of each individual. Finally, imputed measures are aggregated to the household level.

### 3.4 Measuring the four levers of redistribution

Our variables of interest are the four levers of income redistribution described in Section 2: average tax rate, tax progressivity, average transfer rate, and transfer targeting.

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<sup>11</sup>This is the theoretical LIS coverage. The actual LIS data has even a lower coverage since employee contributions are missing in France and Italy.

<sup>12</sup>Since most studies tend to mix the different types of datasets (net, gross, and mixed) without further analysis, the recovery of employer and employee contributions is an important improvement in welfare state research. We plan to make this data available online. For this paper, we exclude the net datasets (ie. country-years for which even personal income tax is missing).

Tax and transfer rates are calculated by dividing the mean of taxes and transfers by the mean of household gross income and market income, respectively. Note that tax and transfer rates are not directly comparable because the denominator differs.<sup>13</sup> We select the denominator so that we can decompose redistribution using the formula described in Section 2.

Following recent studies, we use the Kakwani index (Kakwani, 1977, 1984) rather than the concentration index to measure tax progressivity and transfer targeting.<sup>14</sup> The concentration index summarises the distribution of a variable over households, ordered according to household income. This measure is sensitive to the initial level of inequality so the Kakwani index provides a correction by subtracting the Gini index from the concentration index. Intuitively, the Kakwani index measures the deviation from proportionality. The index ranges from  $-1 - Gini$  to  $1 - Gini$ . For transfers, the lower the Kakwani index the greater the intensity in which transfers decrease as income increases. The transfer system redistributes from rich to poor when the index is negative. For taxes, the higher the Kakwani index the greater the intensity in which tax increases as income increases. The tax system redistributes from rich to poor when the index is positive.

## 4 Results

### 4.1 Comparing the impact of transfers and taxes on inequality reduction

By computing the Gini index at different income stages, we assess the reduction in inequality due to transfers and due to taxes for each country-year in our dataset. The comparative impact of taxes and transfers is shown in Figure 4, where the step from market to gross income is due to transfers and the step from gross to disposable income is due to taxes. In most countries, taxation makes a stronger contribution to inequality reduction than transfers (excluding public pensions). There are notable exceptions, such as the United Kingdom, Ireland, or Denmark, for which there is a large reduction in inequality due to transfers relative to the reduction due to taxes.

[Place Figure 4 here.]

Our data confirm a stylised fact that the main predictor of disposable income inequality is market income inequality. The impact of taxes and transfers is not strong enough to remove the correlation between market income inequality and disposable income inequality,

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<sup>13</sup> We analysed the robustness of the results to the modification of this convention by calculating all rates on the same reference income (i.e. on the disposable income). The results are preserved.

<sup>14</sup>The Kakwani index is also used, for instance, in Verbist and Figari (2014), Avram, Levy, and Sutherland (2014), or Joumard, Pisu, and Bloch (2012).

which is 0.80 in our sample. Taxes and transfers do reduce inequality but countries with high market income inequality also, generally, have high disposable income inequality.<sup>15</sup>

Figure 5 provides more detail on the different combinations of taxes and transfers. It shows the relative contribution of taxes and transfers to inequality reduction, from market income to disposable income. One can identify two clusters of countries based on the magnitude of inequality reduction: low and high reduction clusters.

In the low reduction cluster of countries the Gini coefficient decreases by approximately 0.07 between market income and disposable income. This cluster includes Canada, Israel, Luxembourg, Spain, Austria, United States, Estonia, and Greece. In this group, tax redistribution always exceeds transfer redistribution. The tax reduction is centred around 0.05 points and the transfer reduction is centred around 0.02 points of the Gini index.

In the high reduction cluster of countries the Gini coefficient decreases by about 0.11 between market income and disposable income. This cluster includes United Kingdom, Denmark, Norway, Netherlands, Australia, France, Germany, Italy, Sweden, Finland, Czech Republic, and Slovakia. In this group a broad range of arrangements lead to the same magnitude of inequality reduction. A small number of countries (United Kingdom, Denmark, and Norway) displays a dominant role for transfers. In other countries the role of taxes is more dominant than transfers. At the extreme, in the Czech Republic, Slovakia, and Italy the tax system contributes to more than 75 percent of the inequality reduction. Iceland and Ireland are outliers in this breakdown, with a remarkably low and high magnitude of inequality reduction, respectively.

[Place Figure 5 here.]

These results differ from the results based on the original LIS data, i.e. before the imputation of employer contributions. (Appendix B displays the comparison.) The inclusion of employer social security contributions raises the average contribution of the tax system to inequality reduction and slightly diminishes the role of the transfer system. Czech Republic, France, Slovakia, and Sweden are sensitive to the imputations. In contrast, the position of certain countries, such as Israel, Iceland, or Denmark, remains unchanged.<sup>16</sup> The inclusion of employer social security contributions not only changes the redistribution measure but also reveals a bias in the analysis of the national structure of redistribution. The original data will overemphasise the role of the transfer system for a subset of countries.

Existing studies have considered the overall tax and transfer redistribution using LIS data, as we do. In some respects we repeat existing analysis (see Mahler and Jesuit, 2006; Wang, Caminada, and Goudswaard, 2014, for example). However, these studies exclude employer contributions and mix together countries where employee contributions is measured and countries where it is not. Due to these biases, they find that the tax

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<sup>15</sup>Ireland appears as an outlier in all dimensions of the present study. This is not specific to our data. See Nolan and Smeeding (2005) for explanations of the high market income inequality and the size of transfers.

<sup>16</sup>Denmark has no employer contributions (see Figure 2).

system is on average far less redistributive than the transfer system—even if we recalculate the results after the exclusion of pensions. These studies also find that certain countries (France, Sweden, Finland, Netherlands, United Kingdom, Czech Republic, and Slovakia) rely less on tax redistribution than others. Our results challenge the existing literature by measuring the role of taxation far more accurately. The minor role of taxation suggested by previous research is an artefact due to missing employee contributions (France) or due to the bias induced by excluding employer contributions (Sweden, Finland, Czech Republic, and Slovakia).

## 4.2 Inequality reduction due to transfers

Our data allows us to analyse the contribution of both the average rate of transfers and the intensity of targeting to inequality reduction. Figure 6 provides the decomposition. The downward sloping curves represent different magnitudes of vertical redistribution, which shows the inequality reduction without corrections for changes in the income ranking. The inequality reduction is greater as you move to the top right of the graph. Notice that transfers decrease with income because the targeting index is negative for all country-years. There is broad variation of the intensity of targeting across the sample. The Kakwani index varies from -1.05 to -0.35, with a mean at -0.77 and a standard deviation of 0.14. Ireland and the United Kingdom lie at the extreme by combining intensely targeted transfers with a relatively high average rate of transfers.

[Place Figure 6 here.]

The impact of targeting is constrained by the average rate of transfers. United States targets far more intensely than Iceland but both have a low average rate of transfers (around 2.5 percent of market income) which results in little difference in redistribution. Said simply, targeting has little impact when there is little money to distribute. Conversely, at a much higher rate of transfers (around 10 percent of market income) the difference in targeting between the strong targeting in United Kingdom and the weak targeting in Sweden results in a significantly greater inequality reduction for United Kingdom. We can interpret this relationship with the equation detailed in Section 2. Targeting is multiplied by the transfer rate to determine vertical redistribution, therefore the redistributive effect of targeting is conditional on the transfer rate.

Our results contribute to the existing literature on the ‘paradox of redistribution’ (Korpi and Palme, 1998). The paradox states that universal transfers (weak targeting) have a larger impact on redistribution. We show that the size of transfer redistribution is led by the rate of transfers. Our insight is that the rate of transfers is too low for targeting to have a strong impact. One standard deviation change of the transfer rate brings about much larger (2.5 times more) redistribution than one standard deviation change in targeting. In the full sample, one standard deviation increase in the intensity of targeting increases

redistribution by 0.008 points (20 percent of average redistribution due to transfers) while one standard deviation of the transfer rate increases redistribution by 0.020 points (50 percent of average redistribution due to transfers).<sup>17</sup>

### 4.3 Inequality reduction due to taxes

Figure 7 shows the decomposition of inequality reduction due to the average tax rate and due to the progressivity of taxes. The redistribution ranges from 0.03 to 0.10 points of the Gini index. One can read, for instance, that United States and Australia have similar average tax rates (24 percent and 23 percent respectively) but Australia displays a much more progressive tax system. Therefore, United States reduces inequalities by 0.05 points while Australia achieves a reduction of 0.06 points. The strictly positive range of the Kakwani index indicates that all countries have globally progressive tax systems, though individual tax features may still be regressive.

In contrast to redistribution through transfers, neither the average tax rate nor the progressivity of the tax system is dominant.<sup>18</sup> For instance, Sweden reaches a slightly stronger reduction than Ireland, in spite of a clearly less progressive tax design, but thanks to a much higher average tax rate. In the full sample, one standard deviation increase in tax progressivity increases redistribution by 0.017 (26 percent of average tax redistribution), while one standard deviation increase in the tax rate increases redistribution by 0.019 (29 percent of average tax redistribution).<sup>19</sup> The theoretical setting is not different for taxes than for transfers but due to range of average tax rates we observe, both variation in the tax rate and variation in progressivity impacts redistribution.

[Place Figure 7 here.]

### 4.4 Typical patterns and incompatible policy choices

Given that tax and transfers systems are the result of political bargaining, we are interested in highlighting typical patterns in the data. These patterns will inform new theories of

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<sup>17</sup>Marginal effects are calculated leaving other parameters at their sample mean. Calculation performed on 67 observations and robust to various sub-samples (such as excluding year 2010 or using cross-section sub-samples). The average vertical redistribution due to transfers is 0.042, one standard deviation of targeting is 0.14 and one standard deviation of transfer rate is 0.03. See Appendix C for a comment on the redistributive impact of extreme values of transfer targeting and tax progressivity.

<sup>18</sup>The change in the Gini coefficient from gross to disposable income has a correlation measure of 0.50 with the tax rate and 0.50 with tax progressivity.

<sup>19</sup>Marginal effects are calculated leaving other parameters centred at their sample mean. The calculation is performed on 67 observations and robust to various sub-samples (such as excluding year 2010 or using cross-section sub-samples). The average vertical redistribution due to taxes is 0.065, one standard deviation of progressivity is 0.04, and one standard deviation of the tax rate is 0.06.

redistribution that integrate both the marginal effects as well as the political connections between each lever of redistribution.

We find an incompatibility between strong tax progressivity and a high average rate of taxation (see Figure 8), which confirms an existing finding (Verbist and Figari, 2014), although with a different methodology and data.<sup>20</sup> Among the 22 country-years (one third of the sample, 8 different countries) for which the Kakwani index is higher than 0.17, none has a tax rate higher than 0.34. Symmetrically, among the 15 country-years (one fifth of the sample, 8 different countries) for which the tax rate is higher than 0.34, none has a Kakwani index higher than 0.17. In contrast, there is no clear relationship between targeting and the average transfer rate, in line with the results of recent studies (Brady and Bostic, 2015).

The incompatibility between strong progressivity and high taxes is not a statistical artefact. In the range of progressivity and average tax rates we observe, a country could apply the maximum average tax rate and the maximum progressivity without exceeding marginal tax rates of 100 percent. Consider the following thought experiment: Say Israel, with an average tax rate close to 20 percent, wanted to increase taxes to Sweden’s level of 40 percent but retain it’s highly progressive tax schedule. Assuming there is no behavioural or political response, i.e. pre-tax income is unchanged, Israel could simply double the average tax rate on each household to reach Sweden’s level. By definition, the Kakwani index would be left unchanged.<sup>21</sup> It follows that all marginal tax rates would also double. Since Israel’s marginal tax rates are below 50 percent, the new marginal rates would not exceed 100 percent. Since there is no statistical or mathematical reason to prevent a country from pairing Israel’s progressivity with Sweden’s average tax rate, we conclude that the pattern we observe is driven by political or behavioural constraints. We leave further analysis of these constraints to future work.

[Place Figure 8 here.]

The second pattern we observe is a positive correlation between market income inequality and the intensity of both tax progressivity and transfer targeting. While the focus is generally on whether targeting and progressivity reduce inequality, it appears that the relationship is stronger in the reverse direction. The countries with high market income inequality tend to use intensely progressive taxation and intensely targeted transfers. The correlation against market income inequality is -0.64 for targeting and 0.5 for progressivity. Remember that the targeting index is negative because the poor receive a greater share of the transfers, whereas the progressivity index is positive because the rich pay a greater share of taxes.

<sup>20</sup>Verbist and Figari (2014) use the EUROMOD micro-simulation model on a European sample of 15 countries.

<sup>21</sup> $Kakwani_{tax} = 2 \sum_{k=1}^n \frac{1}{n} (\frac{k}{n} - \sum_{i=1}^k \gamma_i) - G_{beforetax}$  where  $n$  is the number of households in the population and  $\gamma_i$  is the share of taxes paid by household  $i$ . Progressivity depends only on the pre-tax distribution of income and the share of taxes paid by each household, ordered according to their income. If  $\gamma_i \forall i$  and  $G_{beforetax}$  remain constant,  $Kakwani_{tax}$  is unchanged.

The positive correlation between market income inequality and targeting or progressivity is not deterministic. Consider the case of taxes. The Kakwani index corrects the concentration index for the pre-tax level of inequality. As we increase the pre-tax Gini, starting from a point of progressive taxation, there is no mathematical reason (in the Kakwani formula) that the Kakwani index should also increase.<sup>22</sup> A positive correlation shows that in countries with greater market income inequality the deviation of taxes or transfers from proportionality is greater.

We hypothesise that progressivity and targeting may be a substitute for labour market regulation. The negative relationship between minimum wage legislation or active labour market policies and labour income inequality is well documented (Salverda and Checchi, 2015). Our results suggest a political trade-off where the country either compresses the market income distribution with restrictions on the labour market, such as a minimum wage, or inequality is reduced ex-post by taxing the rich and giving to the poor. However, intense targeting and progressivity do not allow for an extremely unequal country to reduce inequality to a level comparable to a country starting at a lower base (as shown in Figure 4 above).

## 5 Discussion

We decomposed redistribution into four key levers: the progressivity and average rate of taxes, and the targeting and average rate of transfers. This approach provided three main findings. First, when excluding pensions, tax redistribution dominates transfer redistribution in most countries. Second, cross-country heterogeneity in the intensity of targeting explains very little of the observed variation in inequality reduction. For transfers, most of the redistributive effect is due to the rate of transfers. In contrast, both progressivity of taxes and the average tax rate have large impacts on tax redistribution. Third, we observe the trace of political trade-offs. High average tax rates do not appear in conjunction with highly progressive tax systems.

Our findings resulted from an encompassing approach. We studied the impact of taxes and transfers simultaneously, rather than in isolation. We strongly recommend that future comparative studies take a similar approach since the balance between tax and transfer redistribution varies significantly across countries. The usual framework that considers only one side of monetary redistribution, be it through taxes or through transfers, leads to a biased perspective for international comparisons.

We also highlighted the bias that arises from restricting analysis to the taxes that are

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<sup>22</sup>The Kakwani index for taxes can also be written as  $K_t = \frac{2}{n} \sum_{k=1}^n (\sum_{i=1}^k \alpha_i - \gamma_i)$ , where  $n$  is the number of households,  $\alpha_i$  is the share of pre-tax income received, and  $\gamma_i$  is the share of taxes paid by household  $i$ . Since the share of taxes is compared to the share of income, there is no deterministic relationship that would cause the pre-tax level of inequality to be positively correlated with the progressivity index.

paid by households (and appear in household surveys). The tax incidence often falls on households despite being paid by employers. In the context of inequality reduction, income tax, employee, and employer contributions are economically equivalent. This study is a step forward since it provides far more comparable data on the tax side – thanks to the imputation of employer contributions. Further improvements could be attained by making use of administrative data (Meyer and Mittag, 2015). Recent works on a country-by-country basis allow the distribution over households to match national accounts (Piketty, Saez, and Zucman, 2016; Garbinti, Goupille-Lebret, and Piketty, 2017). Further research is also needed to include consumption tax and transfers in kind (Figari and Paulus, 2015) into the analysis. We acknowledge that these improvements could alter our findings, as consumption tax is suspected to be regressive (Warren, 2008), while transfers in kind are likely to have strong redistributive effects (Sutherland and Tsakglou, 2012).

Lastly, we call for more careful consideration of the paradox of redistribution. Analyses that focus on one or two specific levers of redistribution among the four we identified could not only lead to flawed results but also deliver misleading policy recommendations. As shown in our decomposition, the relative importance of each lever depends on its combination with other levers. For example, the marginal contribution of targeting on redistribution strongly depends on the average rate of transfers. As already emphasised by scholars studying the paradox of redistribution, redistributive policies are the outcome of a political balance of these four levers. In this study, we observe an incompatibility between strong progressivity and high rates of taxation. This result indicates that governments cannot change redistributive policies in isolation. New theories of redistribution should recognise that pulling down one lever moves another.

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# 6 Figures

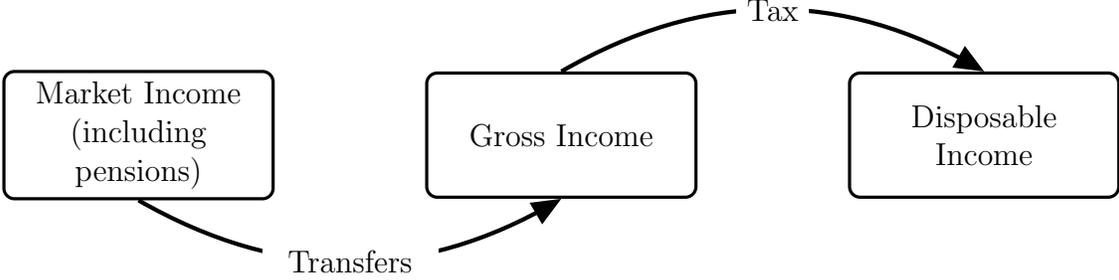


Figure 1: Sequential contribution of the tax and transfer system to inequality reduction.

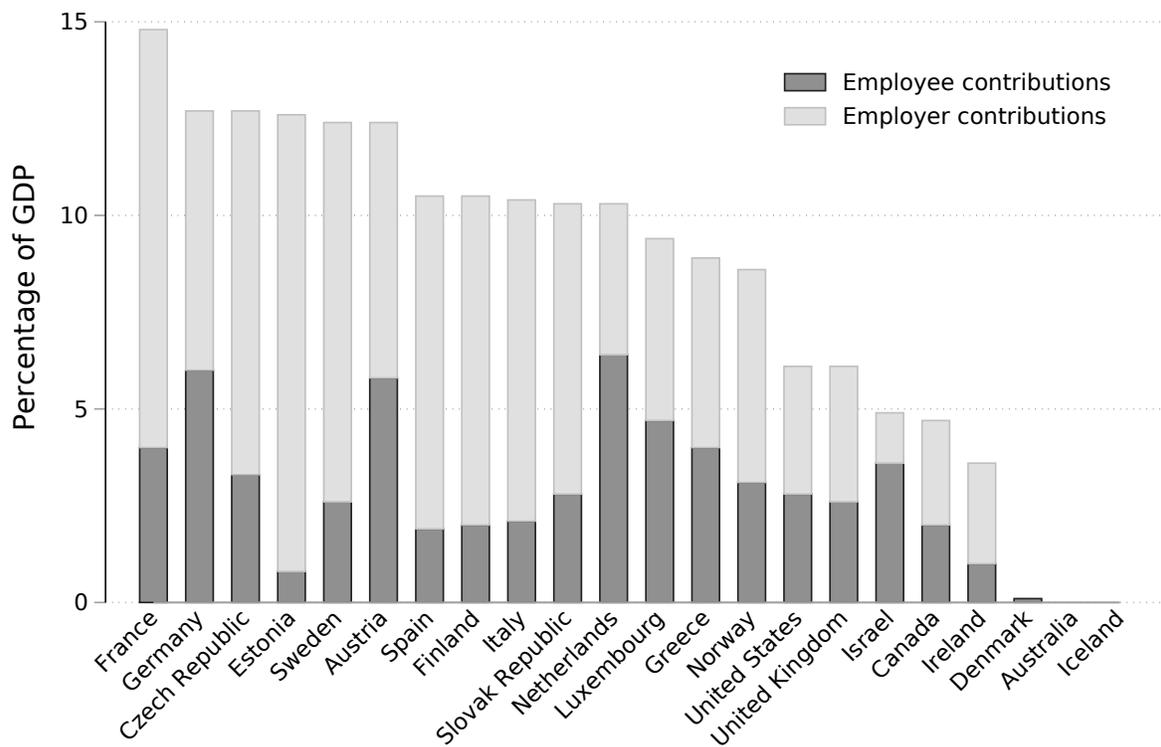


Figure 2: Split between employer and employee social security contributions.

Source: Revenue Statistics, OECD.

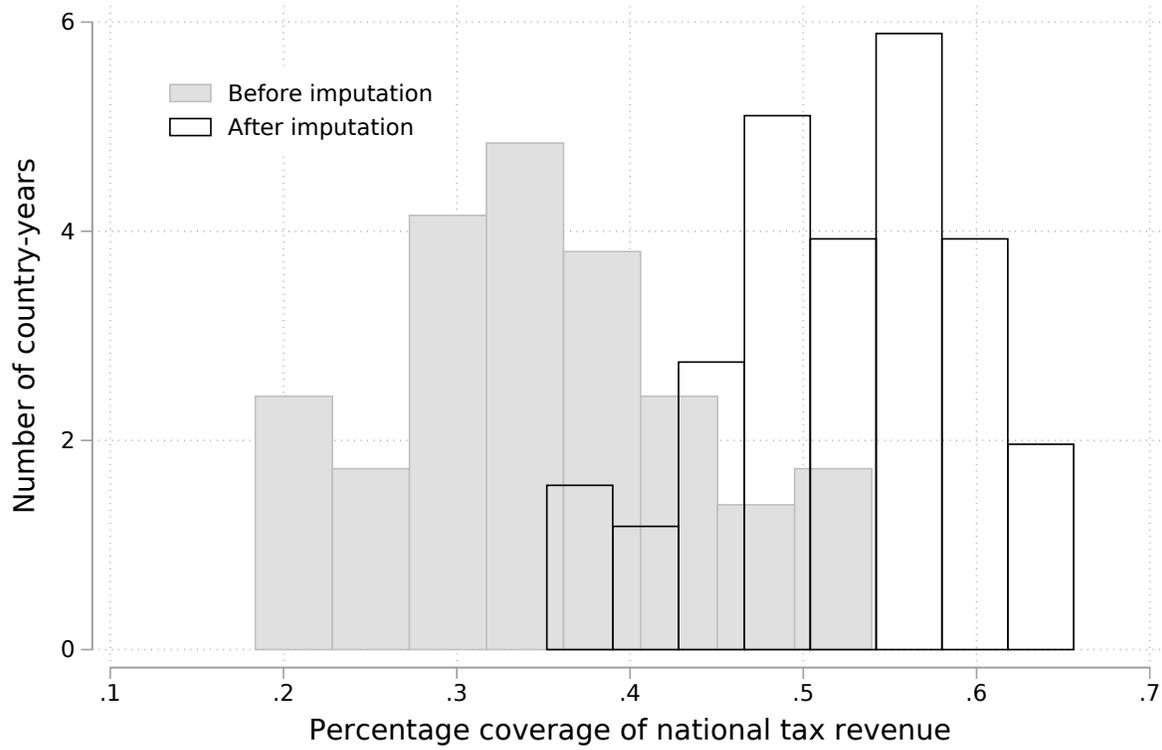


Figure 3: Tax coverage before and after imputation of employer social security contributions.

*Source:* Revenue Statistics, OECD.

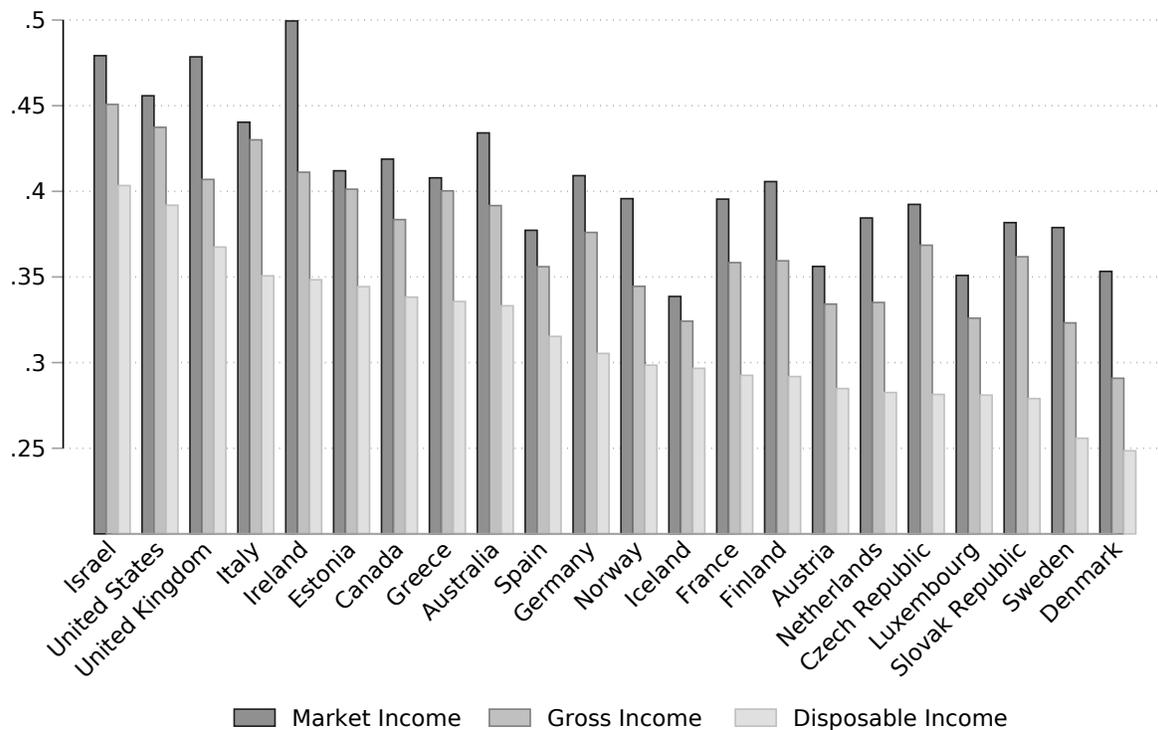


Figure 4: Inequality (Gini coefficient) at different income stages.

*Note:* Market income is the sum of all labour income and capital income including private and public pensions. Gross income results from adding transfers and disposable income results from subtracting taxes. Countries are ranked in decreasing order of disposable income inequality. Data refers to year 2004, except for Australia (2003), France and Sweden (2005), Greece, Ireland and Spain (2007), Estonia and Israel (2010).

*Source:* Author's calculation based on LIS micro data with imputations.

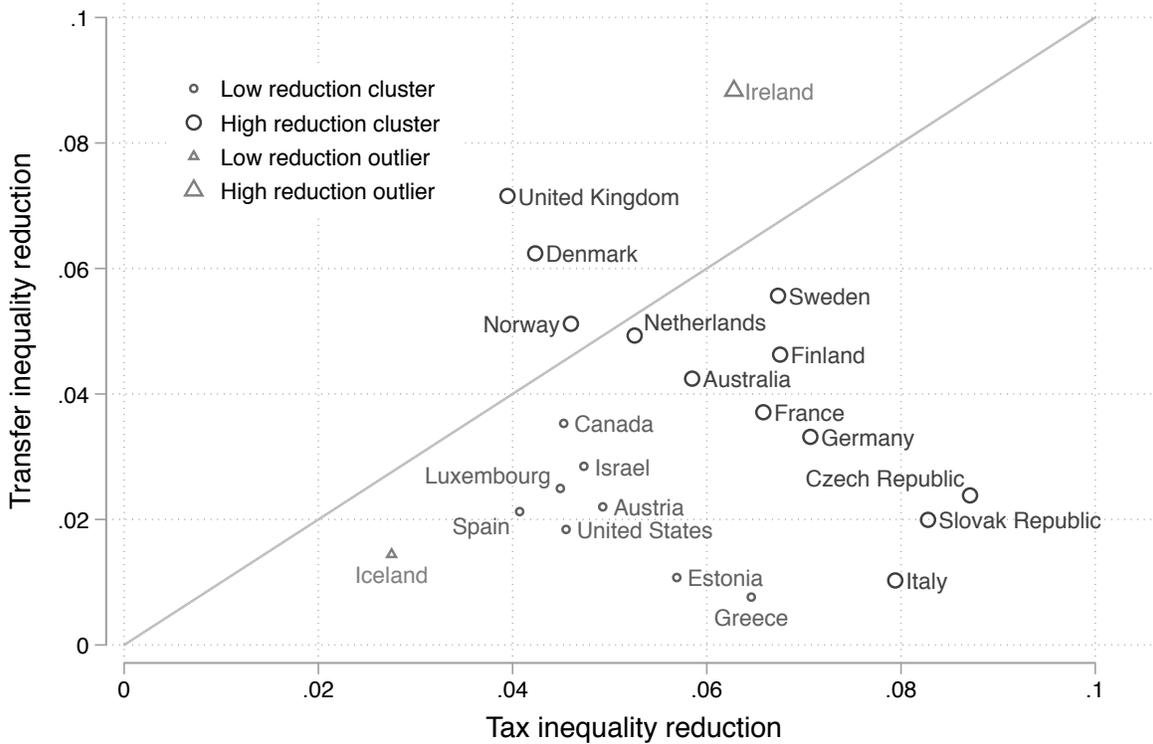


Figure 5: Tax and transfer contribution to inequality reduction.

*Note:* The vertical axis shows the reduction of inequality between market income and gross income (Reynolds-Smolensky index). The horizontal axis shows the reduction of inequality between gross income and disposable income. Countries below the 45 degree line rely more on taxes than transfers for redistribution. The total redistribution between market and disposable income is centred around 0.07 Gini points in the low reduction cluster of countries and 0.11 Gini points in the high reduction cluster.

*Source:* Author's calculation based on LIS micro data with imputations.

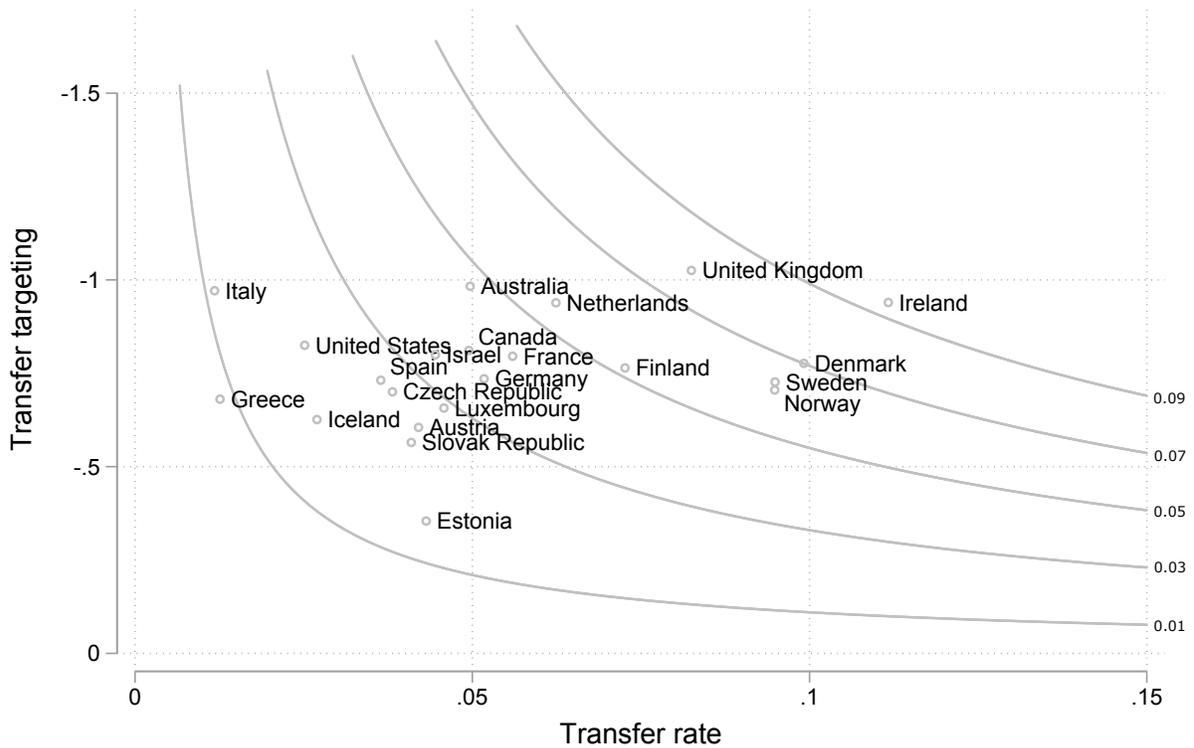


Figure 6: Vertical redistribution due to transfers: rate versus targeting.

*Note:* The closer the targeting index is to zero the lower the intensity to which transfers are targeted to poor households. The curves show the resulting vertical redistribution measured in Gini points as indicated at the end of each curve. Two points on the same curve represent the same vertical redistribution obtained by different combinations of average rates and targeting. Vertical redistribution does not measure re-ranking and might slightly overstate the effective redistribution from transfers. For example, Australia and Finland both achieve a reduction of 0.05 Gini points but with different combinations of transfer rate and targeting. Australia has a low transfer rate (5 percent of market income), and transfers are highly targeted (Kakwani index of -0.98). Finland has a relatively higher transfer rate (7 percent), but transfers are targeted less intensely (-0.76). *Source:* Author's calculation based on LIS micro data with imputations.

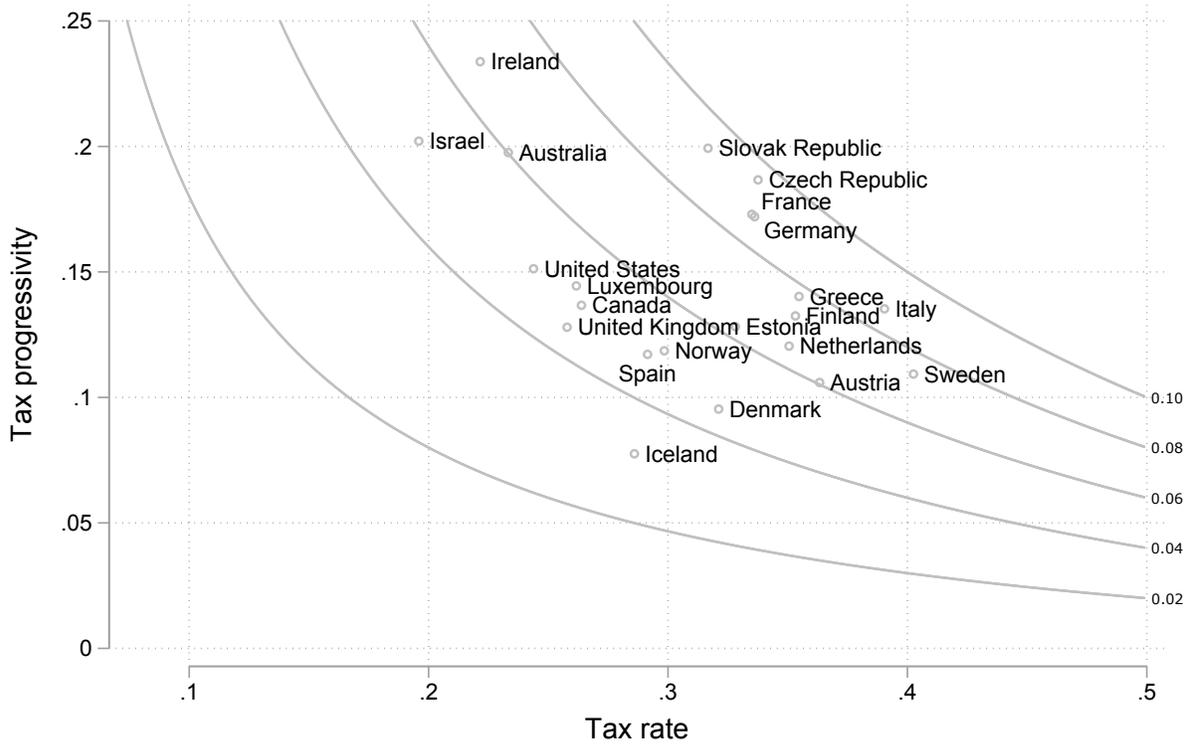


Figure 7: Vertical redistribution due to taxes: average tax rate versus progressivity.

*Note:* The curves show the resulting vertical redistribution from combinations of average tax rates and tax progressivity measured by the reduction in the Gini index. Vertical redistribution does not measure re-ranking and might slightly overstate the effective redistribution from taxes. Two points on the same curve represent the same redistribution obtained by different combinations of progressivity and average rates. For instance, Australia and Austria achieve the same tax redistribution of 0.06 Gini points with different combinations of tax rate and progressivity. Australia has a low tax rate (23 percent of gross income), and taxes are highly progressive (Kakwani index of 0.20). In contrast, Austria has a high tax rate (36 percent), but progressivity is much lower (0.11).

*Source:* Author's calculation based on LIS micro data with imputations.

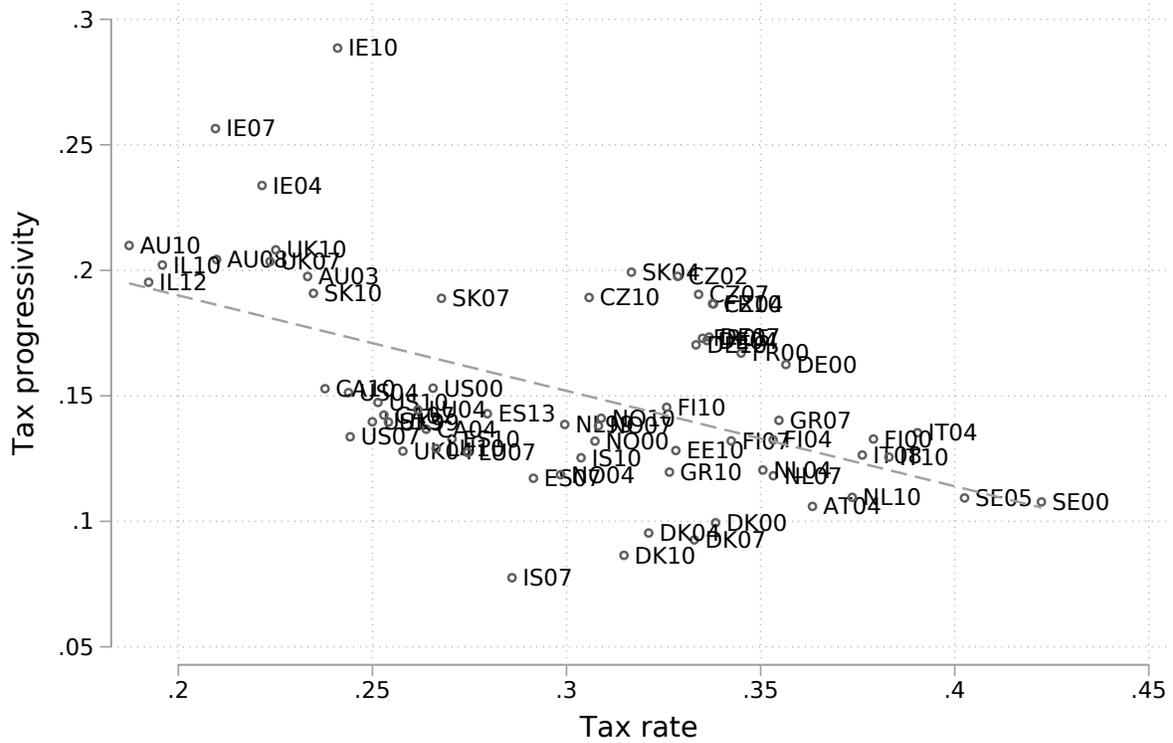


Figure 8: Incompatibility between high average tax rate and high progressivity.

*Note:* There is a decreasing relationship between progressivity and the average tax rate. Labels show the country-year codes from LIS.

*Source:* Author's calculation based on LIS micro data with imputations.

## 7 Table

Table 1: Income Definitions

Income Concept	Definition	Transition	LIS variables
Market income	gross labour income + capital income + employer ssc + pensions		hil + (hic-hicvip) + hsscerc + (pension - hitsap)
Gross income	gross labour income + capital income + employer ssc + pensions + social transfers (other than pensions)	Market income + monetary transfers (other than pensions)	hil + (hic-hicvip) + hsscerc + (pension - hitsap) + (hits - hitsil - hitsup)
Disposable income	gross labour income + capital income + pensions + social transfers (other than pensions) - employee ssc - income taxation	Gross income - income taxation and social security contributions (employer and employee)	hil + (hic-hicvip) + (pension - hitsap) + (hits - hitsil - hitsup) - hxits - hxiti

*Note:* Based on LIS data. Unit of observation is the household with a correction for household size using the square root scale. Employer social security contributions is imputed for all country-years since the underlying household surveys do not measure taxes on employers. For certain surveys, employee social security contributions and personal income tax are also missing so these missing observations are imputed. Pensions include public pensions (work-related and universal) and private pensions but exclude assistance pensions. United Kingdom and Ireland are exceptions. Due to uncertainty in the data coding, we included assistance pension (hitsap) in pensions. Transfers includes all cash transfers but excludes pensions as defined above.

## A The distributional impact of public pensions

We categorise pensions as market income. Therefore, the contribution of pensions to inequality reduction is not measured. This appendix describes a separate analysis to measure the impact of public pensions.

We compute the share of public pensions in factor income for each country-year. Factor income is defined as market income excluding pensions and is the sum of all labour and capital income. We also compute the Kakwani index of public pensions ranked by market income. The Kakwani index measures the degree to which public pensions are targeted at the poor.

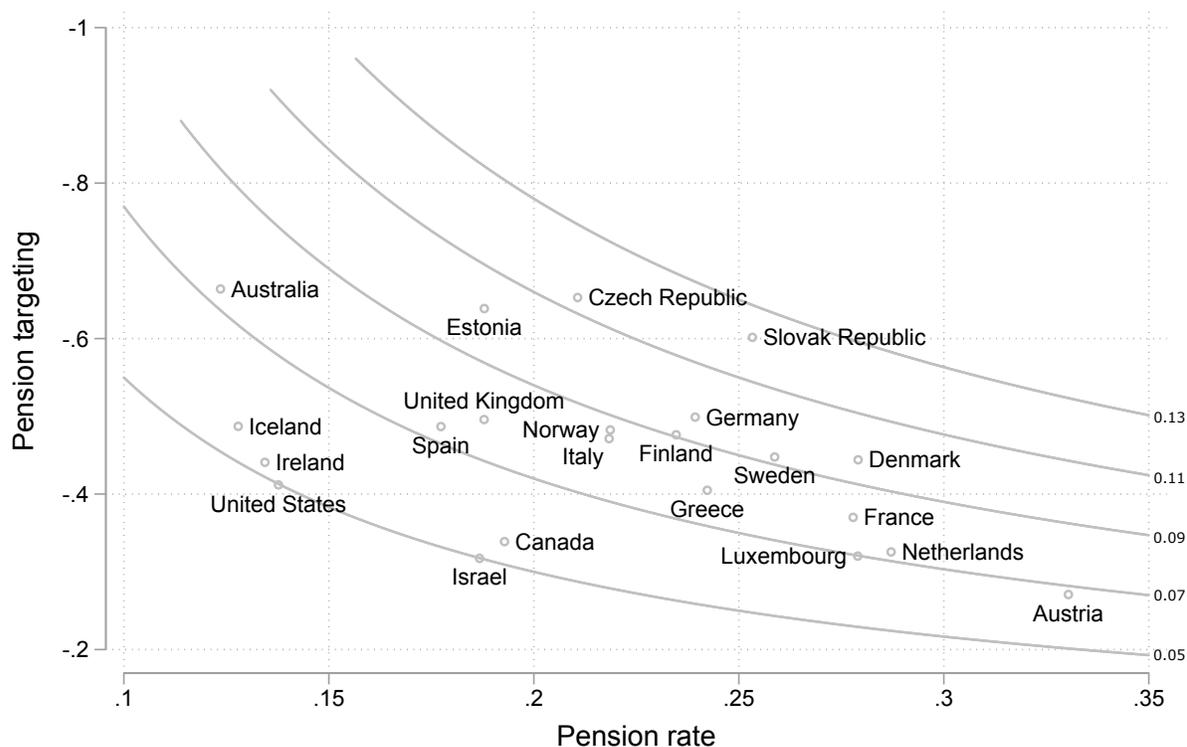


Figure A1: Inequality reduction due to pensions: average rate and targeting.

*Note:* The closer the targeting index is to zero the less pensions are targeted at poor households. The curves show the change in the Gini index before and after pensions are added to market income, but without corrections for re-ranking. Two points on the same curve represent the same reduction obtained by different combinations of pension targeting and pension rates.

*Source:* Author's calculation based on LIS micro data

Figure A1 shows negative correlation between average rate of pensions and targeting of pensions as suggested by Korpi and Palme (1998). For most countries the impact of pensions on inequality appears stronger than the impact from taxes or transfers.

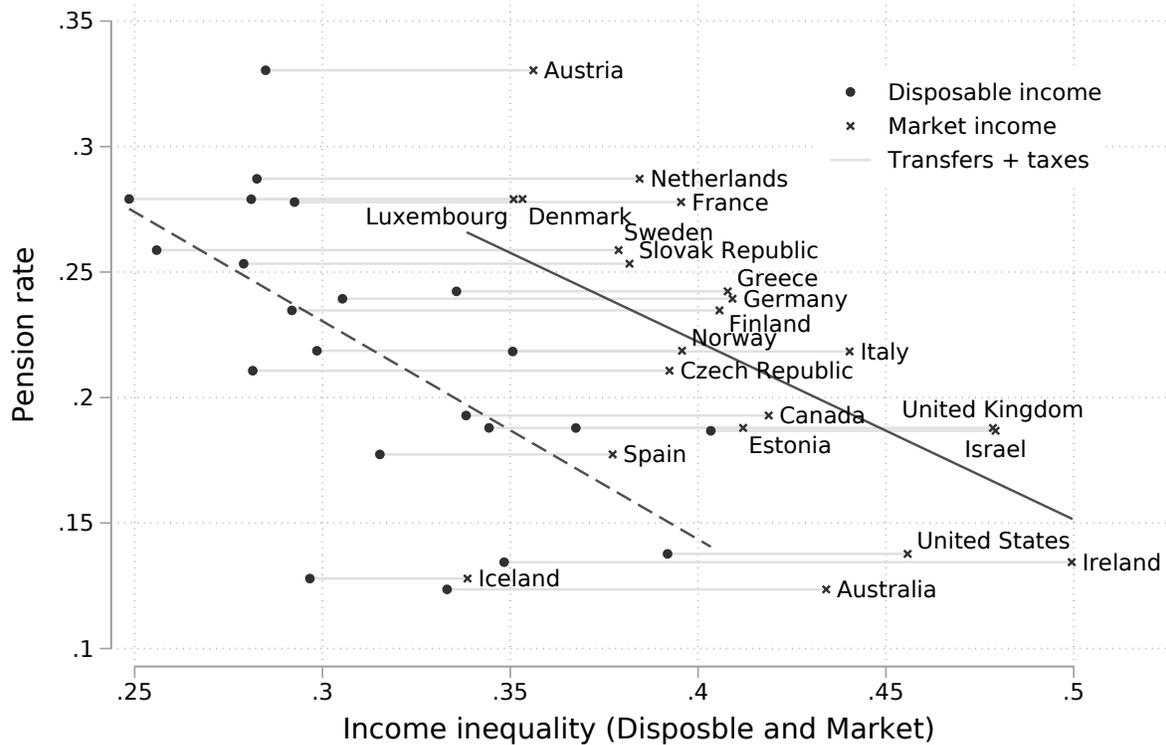


Figure A2: Pension rate and inequality at disposable income and at market income

*Note:* As the average pension rate increases inequalities in market income (X points) or in disposable income (solid circles) tend to decrease. The residuals are mainly due to targeting of pensions. The horizontal distance between income inequality at market income and at disposable income shows the magnitude of redistribution from transfers and taxes.

*Source:* Author's calculation based on LIS micro data with imputations.

Countries where market income inequality is low (Nordic and Bismarckian countries) are also countries where the redistribution conveyed by pensions is high. This suggests that countries where public pensions are less generous and redistributive do not achieve the same level of inequality by other means such as through savings or private schemes. As shown in Figure A2, the pension rate is strongly correlated with the level of market income and disposable income inequality.

## B Impact of imputed tax on the LIS dataset

Imputing missing taxes on labour income has a large impact on the average tax rate and tax progressivity measured from LIS household data. As shown in Figure B1, the imputations raise the average tax rate by a large factor and decrease progressivity for most countries. In addition to the magnitude of the impact, it is striking how heterogeneous the effect is across countries. Some countries, such as France, show large changes from the imputations, whereas others, such as Canada, show small changes.

Due to the heterogeneity, international comparisons without these imputations will be biased. Studies based on the LIS data without imputations will underestimate the tax rate and, for most countries, overestimate progressivity. Take France and Germany as an example. Before imputation, France is shown as highly progressive with a low average tax rate—nowhere close to Germany in the distribution of average tax rate and progressivity. In stark contrast, after imputation, France and Germany show an almost identical average tax rate and progressivity.

The imputations also change the balance of redistribution between taxes and transfers (Figure B2). Since the imputations raise the average tax rate, the redistribution from taxes is increased substantially for many countries. Finland, Netherlands, Sweden, and France are shown to rely more on transfers before imputations and more on taxes after imputations (since these countries cross the 45 degree line). Clusters of countries differ before and after imputations. Czech Republic and Slovak Republic are clustered with Israel and Austria before imputations and these pairs of countries differ greatly after imputations. In summary, the imputations provide a far more accurate picture of the combination of policy levers each country uses for redistribution.

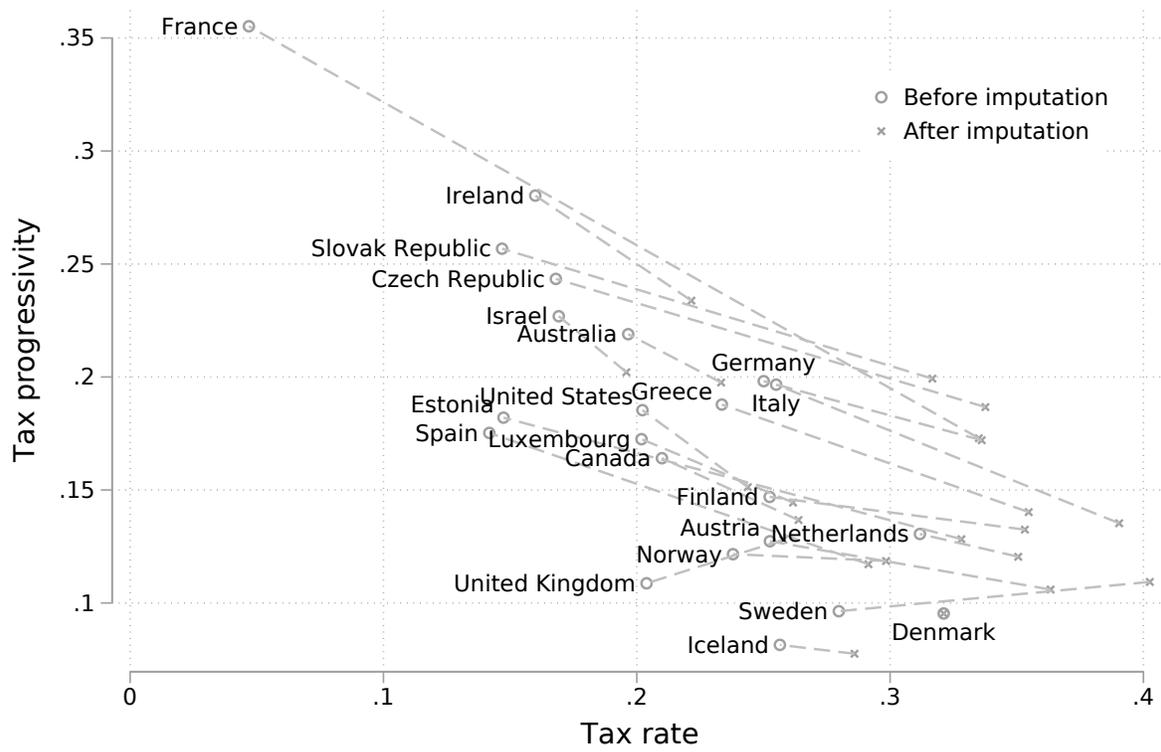


Figure B1: Impact of tax imputations on the tax rate and progressivity.

Source: Author's calculation based on LIS micro data

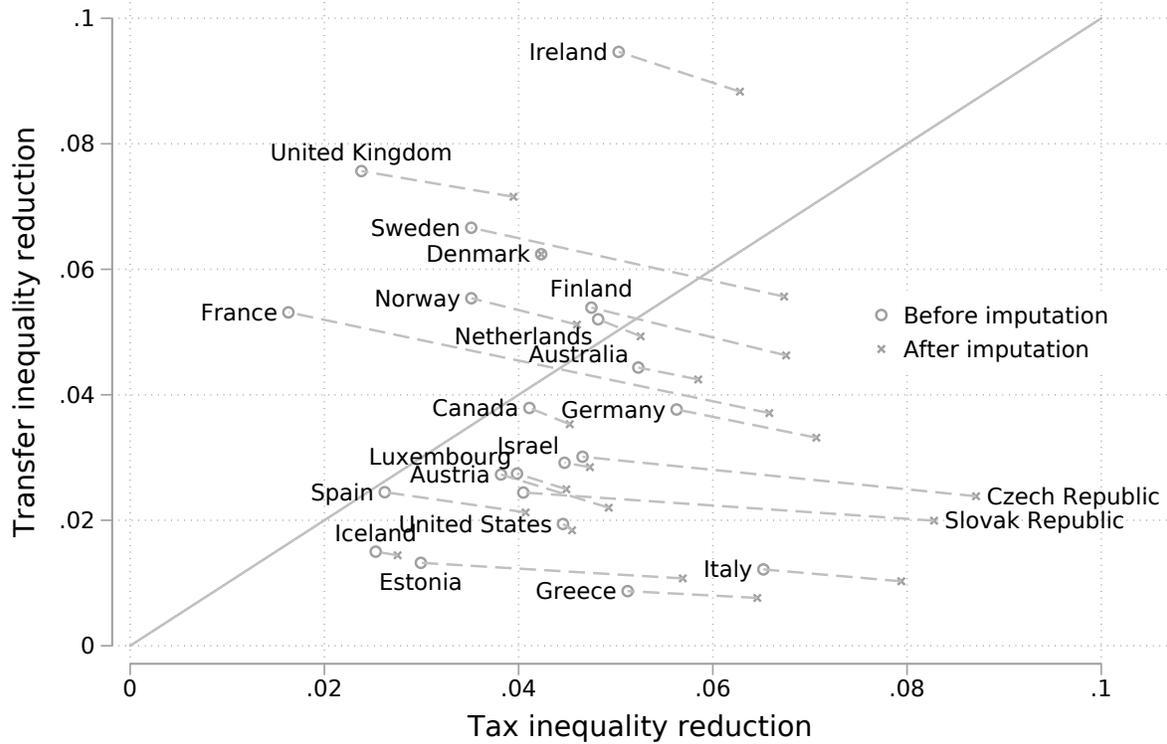


Figure B2: Tax and transfer contribution to inequality reduction before and after tax imputations.

*Note:* The X points reproduce Figure 5 and the O points produces the same graph with the original LIS data. The differences between the points show that imputing employer social security contributions changes the redistribution due to taxes and therefore the overall monetary redistribution for a number of countries. Data refers to year 2004, except for Australia (2003), France and Sweden (2005), Greece, Ireland and Spain (2007), Estonia and Israel (2010).

*Source:* Author's calculation based on LIS micro data

## C Results shown with alternate scatter plots

The fitted line in Figure C1 shows the magnitude of redistribution obtained as a function of the transfer rate, for a targeting value fixed at its sample mean (Kakwani index of -0.77). As the transfer rate increases the effective redistribution due to transfers increases almost linearly with correlation of 0.90. Any deviation from the fitted line can be interpreted as the increased (or decreased) redistribution obtained through a higher (or lower) intensity of targeting, as compared to the average targeting. The lack of large deviations from the fitted line shows that targeting only makes a small contribution to inequality reduction. .

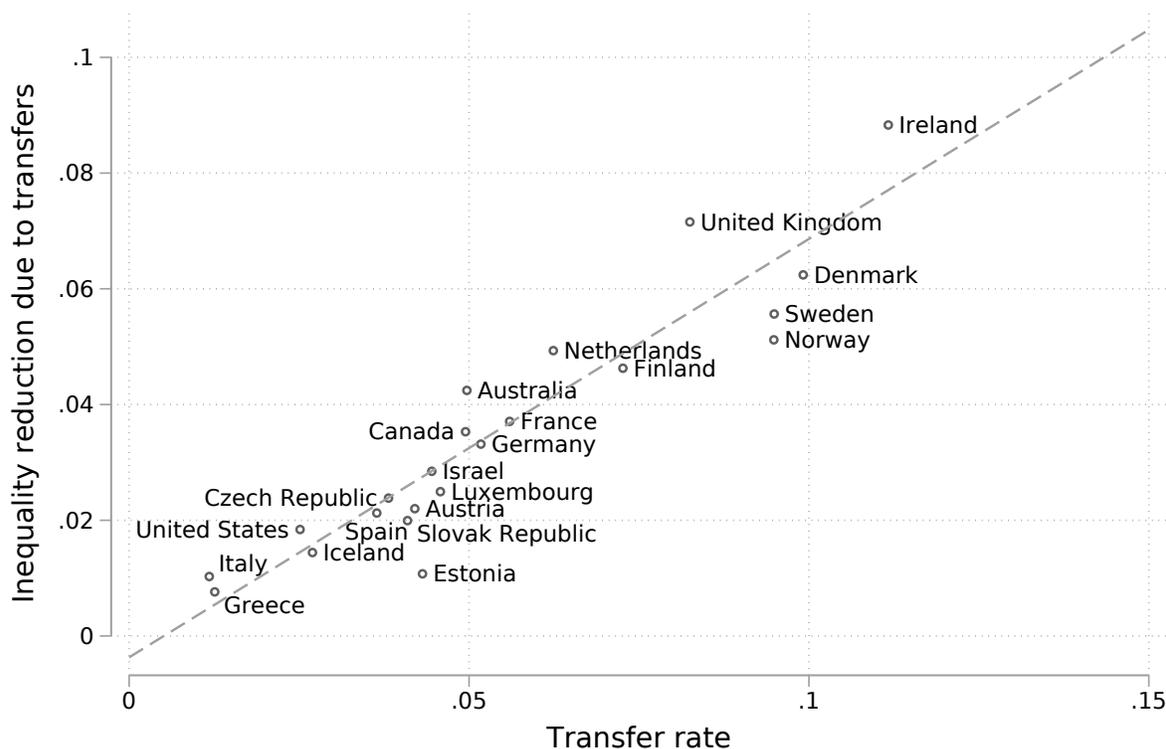


Figure C1: Redistribution due to transfers and transfer rate.

*Source:* Author's calculation based on LIS micro data

The fitted line in Figure C2 shows redistribution due to taxes as a function of the tax rate with progressivity fixed at the sample mean (Kakwani index of 0.15). In contrast to transfers, the reduction of inequality due to taxes is not linearly related to the tax rate.

For an average tax rate of 33 percent and progressivity at the sample mean, the Gini index would be reduced by 0.06 points between gross and disposable income. However, Denmark reaches only 0.04 points due to relatively low tax progressivity. With a comparable tax rate, Slovakia reduces by 0.08 points due to strong progressivity.

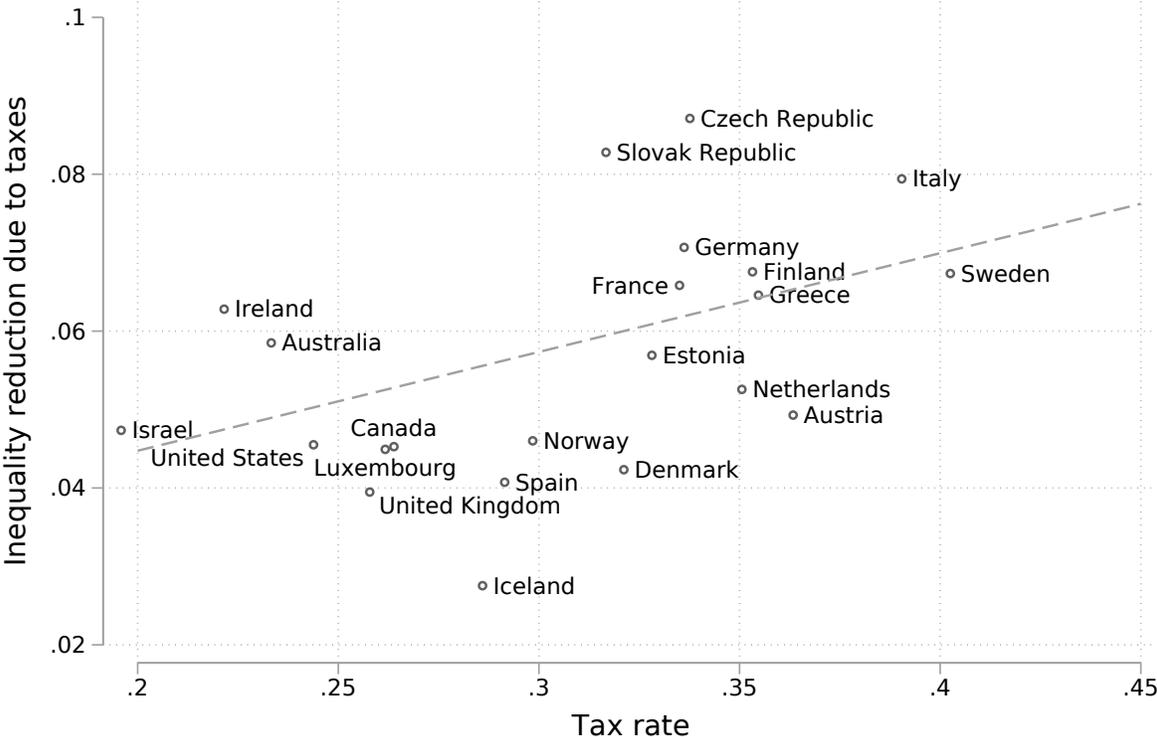


Figure C2: Redistribution due to taxes and tax rate.

Source: Author’s calculation based on LIS micro data with imputations.



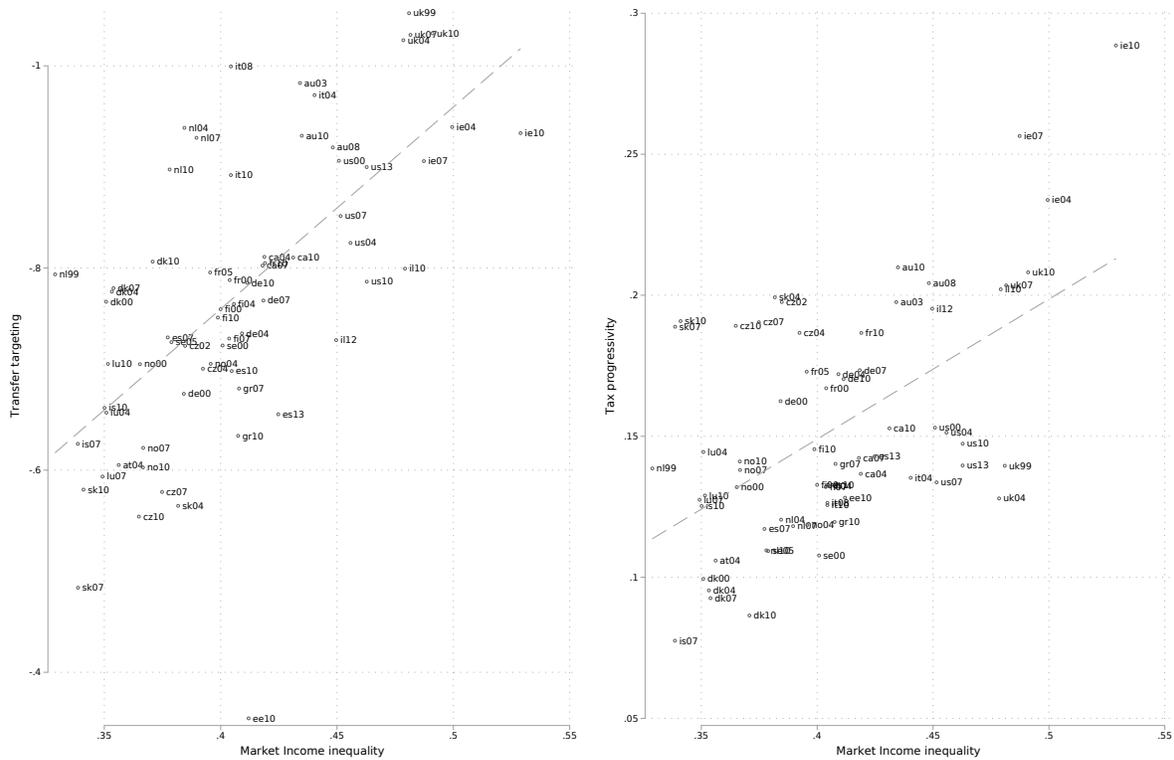


Figure D2: Market income inequality and the intensity of tax progressivity and transfer targeting.

*Note:* There is an increasing relationship between market income inequality and the use of transfer targeting and tax progressivity.

*Source:* Author’s calculation based on LIS micro data with imputations.