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Taxing the top: How much did, does, would it matter?

The sensitivity of income inequality to changes in top income taxation in Europe

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Abstract
In the face of increasing income inequalities and the debate about taxing top incomes, this thesis estimates how much top tax rates matter for redistribution. It establishes the sensitivity of income inequality to top 10 tax rates through analysis of historic data and a simulated top tax reform of increasing top tax rates by one percentage point. Aggregate EUROMOD data from 2007 to 2019 for 28 European countries is used to analyze the relative importance of top tax rates for reducing income inequality. Income inequality is measured by the Palma ratio, and the top 10 income share. I show that in the period after the economic crisis, top tax rates contributed mildly to attenuate increases in inequality. Moreover, changes in top tax rates mattered more for trends in redistribution than did changes in the income distribution. Through the simulation, I show that changes in top tax rates matter for redistribution in all countries, regardless of their levels of inequality and redistribution. Minor increases in top tax rates can achieve a multiple of the reduction in inequalities achieved over the 12 years studied. Thereby, while top tax rates cannot fundamentally alter a country's income inequality, even minor changes at the top can attenuate inequality shocks and reverse trends in redistribution. Government revenue effects of a minor increase in top tax rates, however, are negligible.

Key words
Income inequality, tax policy, top incomes, redistribution, comparative political economy of taxation

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1. Why should I read this research?

This thesis investigates the relative importance of income taxation of the top 10% of the income distribution for income inequality – how much did, does, would 'taxing the rich' matter for the reduction of income inequality in Europe? Answering this question by quantifying the relative importance of top tax rates with the help of EUROMOD data from 2007 to 2019, the thesis contributes to both scholarly and real-life political debates. It is innovative, because it uses an unconventional income inequality indicator (the Palma ratio), and it considers a time span that has not yet been covered by research on the question of top tax policy and income inequality in Europe. Furthermore, through analysis over time as well the analysis of an increase in top tax rates for the 28 European countries in question, the thesis shows which role top tax policy could play in confronting increasing inequalities.

Quantifying the relative importance of top tax rates for redistribution

This thesis estimates the relative importance of top tax rates for distribution. Within the debate of 'taxing the rich' it thereby puts a number on how much this matters in Europe. Therefore, it informs the debate about how to fight rising income inequality. By comparing how much top tax rates contributed in the past, and how much they could potentially contribute when used deliberately to the end of increased redistribution, the room for maneuver governments have, is established. From a comparative perspective across Europe, this thesis also investigates how heterogeneous the effect on income inequality of deviations at the top of the tax schedule in the different European income tax systems is.

Europe 2007-2019, from one crisis to the next

The object of this thesis's research is the time period 2007-2019 in Europe, which is fairly recent and therefore has not yet been extensively studied. Furthermore, it thereby captures well the time and the tax policy measures enacted both during the economic and the sovereign debt crises (2008-2012) and during the recovery. By measuring the relative importance of top tax rates, it shows how big their role was and could be in confronting crises. Naturally, the next crisis, the Covid-19 pandemic puts question marks on all findings based on pre-crisis data, however, in accompanying the recovery from this recent economic shock, the findings remain relevant.

Using the Palma ratio as inequality indicator

This thesis is informative from a methodological point of view as the question of income inequality is dealt with in this thesis by means of the Palma ratio. While income inequality is more frequently measured by, e.g., the Gini coefficient, the Palma ratio measures the relative share earned by the top 10% of the income distribution divided by the share earned by the bottom 40%. Focusing on the ends of the income distribution, this indicator is more sensitive to the parts of the distribution that redistributive policies usually concentrate on.

2. List of country abbreviations

AT – Austria
BE – Belgium
BG – Bulgaria
CY – Cyprus
CZ – Czech Republic
DE – Germany
DK – Denmark
EE – Estonia
EL – Greece
ES – Spain
FI – Finland
FR – France
HR – Croatia
HU – Hungary
IE – Ireland
IT – Italy
LT – Lithuania
LU – Luxembourg
LV – Latvia
MT – Malta
NL – Netherlands
PL – Poland
PT – Portugal
RO – Romania
SE – Sweden
SI – Slovenia
SK – Slovakia
UK – United Kingdom

3. Introduction

"Reduced inequalities" is the title of the UN Sustainable Development Goal (SDG) number 10 which is to be achieved through "fiscal and social policies that promote equality" under target 10.4 (United Nations, 2022). Equivalently, the European Union's Europe 2020 strategy defines inclusive growth and the reduction of poverty as a main priority for the EU. However, the empiric reality is such that even in the wealthiest nations in the EU and the OECD, economic inequalities have widened since the 1980s (Frederiksen, 2016). This development has been exacerbated by the Covid-19 pandemic, which caused income losses for the bottom 40% of the income distribution to be larger than for the top 60% (Gerszon, Mahler & Yonzan, 2021). This development is inscribed in a dynamic made known by the work of, e.g., Piketty & Saez (2006) showing that income and wealth have become increasingly concentrated in the course of the 20th century, not only in the upper part of the income distribution, but at the very top, i.e., the top 1%, 0.1% and 0.01%, especially in English-speaking countries. However, in European advanced capitalist economies, too, income inequality has increased even faster than the OECD average, a development driven mainly by income increases for the top 10% of the income distribution (Frederiksen, 2016). Hence, European countries have so far failed to reduce income inequalities, and to deliver on SDG 10. This represents the overall imperative for public policy research to investigate both the causes of widening income inequality, as well as the policy tools at disposal to effectively reduce them.

Income inequality is a subset of economic inequalities which needs to be distinguished from other monetary inequalities, like, e.g., inequalities in capital. Distinction is also required from the multidimensional nature of social and socio-economic inequalities pertaining to, e.g., gender, age, race, or others. However, the focus on income inequality is not reductionist, since, according to the World Bank, "monetary inequality reflects, reinforces, and drives other non-economic inequalities" (World Bank, 2020). Focusing on income inequalities means focusing on inequalities of outcomes, not opportunity.

There are normative as well as instrumentalist justifications to favor the reduction of income inequalities. First, justification for redistribution can be found in political and moral philosophy, most famously in John Rawls's work and the "maximin" principle derived from his theory. Other normative accounts are represented in political targets such as by the UN or the EU. Second, from an instrumentalist point of view, empirically, economic inequality is correlated with reduced economic development and growth, especially in the long term (Berg & al., 2018). Moreover, especially for the EU, the political stakes include the fact that income inequality within and between member states is likely to negatively influence trust in the European institutions (Milanovic, 2010, as cited in Filauro & Fischer, 2021).

Economic inequalities can be politically mitigated through redistribution with different policy tools, notably income taxation and social transfers. Personal income taxation consists of taxes levied on market income (labor and capital) income, as well as social security contributions (SSC). Redistribution through transfers can be operated both cash and in-kind, as well as be means-tested and non-means-tested. Finally, public services can potentially be regarded as a

means of redistribution through the provision of goods and services free of charge which cannot discriminate between recipients, the most famous example being public schooling.
Within the tools available to policy makers, taxation is of particular interest, because it is both a redistributive tool in and of itself, and because the revenue raised through taxation can be used to provide transfers and public services. In their inherently redistributive nature, tax systems can be regressive, neutral, or progressive, depending on whether they alter the income distribution pre- and post-tax. Furthermore, in most advanced economies, personal income taxation is the main source of government revenue (OECD, 2021).[1] Moreover, income taxation has been identified as the only means of redistribution at the top of the income distribution, namely through progressive taxation (Gerber, Klemm & Mylonas, 2020).

The broader question that emerges from the above is how countries can effectively reduce income inequalities, especially at the very top of the income distribution, where most of the increase in income is taking place. The debate about 'taxing the rich' has become very prominent through the work of, e.g., Piketty & Saez (2006) in the past 20 years. However, given the complexity of income inequalities and redistribution exposed above, the question emerges how important this particular lever really is. Importantly, studies *quantifying* the relative effect of top income tax rates on redistribution specifically are rare. With the particular role taxation plays for redistribution in general and for the reduction of income inequality at the top of the income distribution in particular, the question therefore is: <u>How much did, does or would top income taxation potentially matter for the reduction of income inequality in Europe?</u>
To shed light on this research question, this Public Policy Master's Thesis tackles the question of how sensitive to changes in top income taxation indicators of income inequality are in Europe. Given the diversity in European tax-benefit systems, as well as in the way the welfare systems are financed across the continent, this thesis aims to contribute to the debate on 'taxing the rich' by investigating whether this demand is purely symbolic, or whether redistribution is actually sensitive to this policy lever, and how much so.
To this end, I investigate the following hypotheses the following: 1. Empirically, changes in the top income tax rate predict the variation of measures of income inequality, especially the Palma ratio. 2. (Minor) changes in the top income tax rate are of first order for variation in measures of income inequality, especially the Palma ratio. This research focuses on the Palma ratio, which measures the ratio of the income earned by the top 10% of the income distribution compared to the bottom 40%. I also include the top 10% income share as an indicator for inequality. In the remainder of this research, top incomes refer to the top 10% of the income distribution, and the term of inequality reduction will be used synonymously with redistribution, even though the reader should bear in mind the important nuance of redistribution when considered in exhaustivity (including notably transfers and other policies).
I use EUROMOD data, specifically, country statistics from 2007 to 2019 and aggregate EUROMOD data through the EU's Joint Research Center (JRC) website. Thus, the present

[1] There are exceptions to this pattern, among which is France, for which the main source of revenue stems from value added taxes (OECD, 2021).

research focuses on the 27 EU member states and the United Kingdom, over the period from 2007 to 2019.

My data and methodology require to underline three main caveats. First, my analysis is entirely static, thus, e.g., it does not take into account any behavioral responses to changes in taxation. Nonetheless, it should be underlined that, as prior research has shown, the driving factors of behavioral responses are avoidance and evasion (Piketty, Saez & Stantcheva, 2011). Since there are in theory tools to minimize these behaviors through better enforcement or a broadened tax base (Piketty, Saez & Stantcheva, 2011), my research remains relevant in that it shows what would be possible if accompanying measures for enforcement were to be enacted. Second, my work focuses on the top 10% of the income distribution exclusively. However, prior research has underlined both the heterogeneity of this income group, as well as the economic weight of the top 1% (e.g., Lustig, 2018). Furthermore, the time period in question is marked by the economic crisis and the stagnation since then. This means that the period may not be representative in its entirety, and that data may be less reliable. Despite these reservations, testing the sensitivity of income inequality to top income taxation statically, and over this time period remains relevant for the scholar as well as for the policy maker: How much do top taxes matter – in the face of economic shocks, too? Hence, even if not a typical work of economic research, the questions underlying my thesis are fundamentally economic in nature and therefore of first order importance for economic and social policy.
To this extent, my research is innovative in that, to my knowledge, no similar analysis to quantify the relevance of top taxes on European data has been realized on the time period in question. Furthermore, my focus on the top 10% of the income distribution is less conventional, as recent and popular research has mostly focused on the top 1%, however, it bears the advantage that it concerns a broader income group, and the impact should therefore be larger in magnitude. Moreover, the Palma ratio does not leave out of sight the developments at the bottom of the income distribution, which is also a heterogeneous group, and which is also of first order importance for income inequality.

I find that faced with the economic shocks between 2007 and 2019, top tax rates have contributed only mildly to attenuating widening income inequalities (between approximately 0.2 and 14%). However, I show that *trends* in redistribution are more closely related with trends in top tax rates (in more than 80% of cases studied), than with trends in the underlying income distribution (less than 40% of cases studied). My simulation shows that a one percentage point increase in top tax rates can lead to a multiple of the inequality reduction achieved over the 12 years studies. I find that minor increases in top tax rates reduce inequalities in absolute terms most in unequal countries, by up to 0.03 points of the Palma ratio. The relative decrease in inequalities is largest in equal countries (up to 1.8%), such that top tax rates are a relevant policy tool for all countries, regardless of their levels of inequality of redistribution. Finally, I show that such an increase could attenuate increasing inequalities by up to 76% in some countries and time periods studied.

This thesis is structured as follows: Section 4 presents theoretical concepts and the interdisciplinary state of knowledge regarding the topic of inequality reduction and top income

taxation. Section 5 explains the data and methodology employed. Section 6 presents the results of my analysis from historic analysis, and the simulated reform. Section 7 discusses limitations and concludes. Section 8 presents policy recommendations.

4. Theory and interdisciplinary state of knowledge

Before presenting what is known on the interactions of income inequality, redistribution and top income taxation, this section starts by reviewing and defining the relevant concepts which will be part of the analysis. This will allow to both have a thorough understanding of what past literature has contributed, and to motivate methodological choices presented further.

4.1. Theoretical concepts

The theoretical concepts reminded in this section are income inequality and personal income taxation, as well as measurements of income inequality and tax progressivity.

Income inequality

Income inequality, defining what is earned at the household level, accounting for number and age of household members, should be differentiated between income pre- and post-tax. While post-tax income is well defined, pre-tax income concepts can differ and therefore need to be properly defined, as well as carefully weighed in deciding which income measure is to be used for empirical analysis. The first pre-tax income concept is **market income** which is the sum of incomes perceived by different market sources (e.g., labor income). According to Guillaud, Olckers & Zemmour (2019), for distributional analysis, pensions should be included in the market income, because if excluded, "pensioners in countries that use public pensions will have zero income before transfers" (p. 7). This would inadequately represent the real income distribution. To calculate the tax rate paid by households, and, in particular, to isolate the inequality reducing effect of solely income taxation (as compared to cash-transfers), I include cash transfers in the **pre-tax income** definition, in accordance with Guillaud, Olckers and Zemmour's (2019), or Roine, Vlachos & Waldenström's (2009) concept of **gross income**. The counterpart to the concept of gross income is **net income** which defines "gross income minus allowable tax reliefs" (OECD, 2021, p. 337). Opposed to pre-tax income concepts, post-tax income is clearly defined as **disposable income,** i.e., income after transfers and taxes**.** This is the most common and best-established concept in national accounting as well as in theory and research. It is also the most encompassing concept, as it takes cash transfers into account to establish an approximation of the standard of living.[2] Under section 5.2., I outline which practical approximation of the abovementioned concept are used in this analysis.

Indicators of income inequality

To measure income inequality, a range of indicators has been developed which requires to adequately motivate the use of a particular indicator. The most common indicator for inequality is the **Gini coefficient** which measures the difference of an income distribution (Lorenz curve)

[2] Different *units* of measurement can also be distinguished, namely the household or the individual. In most statistical analyses, the unit of measurement is the household level, because it represents disposable resources more adequately. To account differences in household composition and sizes, household income is calculated considering economies of scale at the household level. Measurement at the household level is also the easiest to reconstruct because it is the unit of measurement in statistic institutions (INSEE, 2021).

from perfectly equal income distribution. It can take values from 0 (perfect equality) to 1 (all income owned by one individual).[3] A second indicator to measure income inequality is the **Atkinson index** which allows to determine which part of the income distribution contributes most to inequality, and can be used as a normative concept when weights are imposed on different income groups (U.S. Census Bureau, 2022). Alternatively, **share ratios and percentile ratios** have been developed. They focus on particular parts of the income distribution and do not take it into account as a whole, as does the Gini coefficient. One set of those indicators group **interdecile ratios**, among which the most common ones measure the ratios of the income of the top 10% to the bottom 10% of the distribution, top 10% to bottom 50% and bottom 50% to bottom 50%. Moreover, common share ratios include the **Palma ratio** (top 10% to bottom 40% of the income distribution) as well as the S80/S20 (top 20% to bottom 20%). The **top 10% income share** is another indicator of income inequality. Finally, the top 1% to top 10% ratio is used to account for the fact that the top of the income distribution is very heterogeneous. In general, the advantage share and ratio measures have in common is that they are straightforward in their interpretation, contrarily to the Gini coefficient, which requires a deeper understanding. The main caveat of share ratios is that they are insensitive to the situation of the middle-income groups.

My work focuses on the **Palma ratio** because it has been shown that empirically, the middle income shares (deciles 5 to 9) "earn about 50% of national income and that share is consistent over time and across countries" (Trapeznikova, 2019, p. 9). Furthermore, "the reality of household and individual distributions of income, and the homogeneous middle in particular, are such that the Gini contains no more useful information than the Palma" (Cobham & Sumner, 2017, p. 26). Furthermore, the Gini coefficient is mostly driven by the deciles captured by the Palma ratio (Cobham & Sumner, 2017). To compare the changes in Palma the ratio to a second indicator, I use the top 10% income share to nuance the findings. This is convenient given the data set, but also relevant since top income shares are closely related with other measures of income inequality (Leigh, 2007).

Income taxation

Income taxes, or direct taxes, are levied immediately on an entity, here households. To capture most of the fiscal burden stemming from direct taxation, in this thesis, I calculate the tax rate by the sum of personal income taxation (PIT) and social security contributions (SSC). This is in line with the literature (e.g., Guillaud, Olckers & Zemmour, 2019).

Personal income taxes (PIT) are defined as the "taxes levied on the net income […] and capital gains of individuals" (OECD, 2021, p. 337). For precision, one needs to distinguish between different government levels which can levy PIT, e.g., on state and federal level in the U.S.. As stated above, to capture the full picture of income taxation, income taxes and SSCs need to be considered. For OECD countries, SSCs amounted to a quarter of tax revenue building half of total tax revenue together with income taxes (OECD, 2021, p. 26). Importantly, it is best to

[3] The main caveat of the Gini coefficient is its insensitivity to the distribution of income along the income distribution. Trapeznikova (2019) illustrates this with the example of one economy where "half of the population receive zero income" to an economy where "three-quarters of the population earn one-quarter of total income, while the remaining one-quarter of the population receive three-quarters of the total income (split equally within the groups)," which will both have the same Gini coefficient of 0.5 (Trapeznikova, 2019, p. 7).

include both employee and employer contributions, as the latter can be large (e.g., over 70% in Sweden [OECD, 2021, p. 26]) and the incidence falls entirely on the employee.
To analyze the income tax burden borne by different parts of the income distribution and its redistributive (inequality-reducing) effect, average tax rates are defined as the amount of direct taxation paid divided by the gross income. This is because tax systems are structured in a way in which all income groups have positive statutory tax rates, while, due to, e.g., tax credits, or exemptions, average tax rates are lower than statutory rates, or even negative (Sherlock, 2017, p. 16). Therefore, the tax rate definition I will use in my analysis is calculated by dividing the sum of PIT and SSC by the pre-tax income, as defined above.

Measures of tax structure
To analyze the tax structure, Piketty & Saez (2007), define tax progressivity as a tax system in which "after-tax income is more equally distributed than before-tax income" (p. 3). To determine the progressivity of a tax system, Musgrave & Thin (1948) have coined the concept of **local progressivity**, which is the derivative of the tax rate, i.e., it is a measure of how progressive a tax is from one income quantile to the next. **Global progressivity** can be measured by the Kakwani index which determines to which extent the tax burden falls disproportionately on the upper part of the income distribution. A drawback of the Kakwani index is that it depends on the pre-tax income distribution and therefore inadequately represents the redistribution achieved through a certain tax schedule. The **marginal effective tax rate** denominates the rate at which an additional earned income unit (ex. one additional euro) would be taxed. In this study, I will use the Kakwani index.
Throughout this thesis, when mentioning the tax structure, or the tax system, I refer to the structure of income taxation exclusively.

4.2. Interdisciplinary state of knowledge

The question of the sensitivity of income inequality to changes in top income tax rates requires to consider the existing literature on income inequality, redistribution, as well as on top incomes and top income taxation.
Beginning with the empirical and scientific imperatives for redistribution, as stated in the introduction, **income inequalities** in most advanced countries have been rising. According to the OECD (2011, as cited in Frederiksen, 2016, p. 8), countries can be clustered according to the source of the rise in inequality, along the dimensions of employment rates, level of cash transfers, market income distribution, government and household redistribution and progressivity and level of tax rates. Berg et al. (2018), investigate the interaction of income inequality, redistribution, and economic growth. They show that low income inequality and higher redistribution are conducive to growth and operate through education, life expectancy and fertility (Berg et al., 2018, p. 262). Thus, the question henceforth is which policy choices concerning redistribution countries have made in response to rising inequalities, and how good they achieve their goals.
The question of **redistribution** is dealt with in the literature by determining patterns, determinants, and trends in redistribution, especially in advanced economies. First, theory and empirical research have painted a controversial picture of the relation of underlying income

inequalities and demands for redistribution. According to Moene-Wallerstein (2001), as well as Iversen & Sosckice (2009) (both cited in Verbist & Figari, 2014), more egalitarian societies demand more redistribution. On the contrary, Kentworty & Pontussen (2005) and Milanovic (2000) (both cited in Verbist & Figari, 2014) suggest that redistribution increases with market income inequality. As the recent decades have seen a widening of market income inequalities which are also associated with a decrease in redistribution (Immervoll & Richardson, 2015), this yields evidence to the first strand of research. On the contrary, Causa & Nørlem Hermannsen (2018) show that even with similar income inequality, redistribution through taxes and transfers varies between countries (p. 28). Similarly, as Verbist & Figari (2014) show, preferences for redistribution are positively correlated with increasing pre-tax inequalities.

Though it needs to be noted that measuring redistribution requires exhaustivity of policy tools (INSEE, 2021), for the objectives of this thesis, as redistribution can be achieved though transfers and taxes, the relative relevance and patterns of **taxation** are of special interest. The importance of income taxation for redistribution has been underlined by Verbist & Figari (2014) who show that personal income taxation has a redistributive role in its inequality reducing effect, and this accounts for one quarter of redistribution in OECD countries, while transfers are responsible for the first three-quarters (Causa & Nørlem Herrmannsen, 2018, p. 51). First, there is the question of the relative importance of levels and structures of taxes and transfers for redistribution. Furthermore, regarding patterns, as Guillaud, Olckers & Zemmour (2019) show, the mass of funds mobilized through taxes (tax level), or transfers (level of spending) matters more for redistribution than their structure. However, Barnes (2014) underlines that in politics, the discussion centers more around the structure of the tax and transfer systems even though this is not necessarily what is of first order economically. Furthermore, as shown in their "Paradox of Redistribution" by Korpi & Palme (1998, p. 36), the more targeted transfers are to the poor, and the more public transfers are equal, the less they actually redistribute and reduce poverty. This means that targeted transfers are linked to lower public support for redistribution. The same has been shown by Prasad & Deng (2009) on the matter of taxation. They underline that the more progressive the tax structure, the less redistribution is supported by the public, which is the case, e.g., in the U.S.. Therefore, to increase redistribution, this set of findings suggests that public support for redistribution must be achieved through non-progressive taxes (Prasad & Deng, 2009) or through non-targeted transfers (Korpi & Palme, 2009). This is also in line with Kato's (2003) popular finding that the size of the welfare state is negatively correlated with the progressivity of taxation. In determining the redistributive impact of taxes, one needs to consider the relative importance of the structure of the tax system (i.e., the degree of progressivity) as well as the level of taxation. As the same level of government revenue can be raised through either a high average tax rate, there appears to be an empirical trade-off between the average tax rate and the progressivity of the tax system, such that they act like substitutes (Verbist & Figari, 2014; Joumard et al., 2012, Causa & Nørlem Herrmansen, 2018). As Guillaud, Olckers & Zemmour (2019), show, however, neither of the two options dominate the effect on redistribution (p. 15). They find that the greater the market inequality, the more progressive taxation and targeted transfers are used as policy tools (Guillaud, Olckers & Zemmour, 2019).

The difficulty to measure tax progressivity leads to conflicting views about trends in progressive taxation. For example, Splinter (2021), based on data by the Congressional Budget

Office (CBO) suggests that progressivity of taxation has been rising in the U.S.. On the contrary, Piketty & Saez (2007) suggest that top tax rates, and thereby the progressivity of the tax schedule have declined. Similarly, for OECD countries, Gerber, Klemm & Mylonas (2020) there has been an overall declining trend in progressivity since the 1980s even if a decline in that trend can be seen since the 2000s (p. 372). For OECD countries, Causa & Nørlem Herrmannsen (2018), observe an increase in the progressivity of personal income taxation which is mainly driven by the bottom of the income distribution, i.e., not by increases at the top. On the contrary, Causa & Nørlem Herrmannsen (2018) suggest that "increasing the progressivity of PIT while keeping size unchanged would be relatively effective for PIT-driven inequality reduction" (p. 58). This is in line with Duncan & Sabirianova Peter (2012) who show that to reduce income inequality, tax progressivity is more effective at the top than at the bottom (p. 3). Thus, this thesis is in line with their research as it aims to quantify this particular policy lever, in a European data set. Finally, as shown by Guillaud & Zemmour (forthcoming), tax systems in advanced Western capitalist economies appear to be endogenously determined by the market income distribution and the average tax rate, from which the tax rate can be derived as a linear function of the income percentiles. As they suggest that deviations from this common tax schedule across countries may be of first order for redistribution (p. 19), this yields additional relevance to the investigation of the sensitivity of income inequality indicators to deviations and changes in top income taxation. Importantly, as mentioned in the introduction, tax policy is the only means of redistribution at the top of the income distribution, while at the bottom, transfers play an important role (Gerber, Klemm & Mylonas, 2020). As such, according to Avram, Levy & Sutherland (2014), direct taxation is one of the two most important policy tools to reduce inequalities, the other being public pensions (p. 3).

In researching **top incomes and top income taxation**, the elasticity of taxable income at the top is of interest to scholars as well as for policy makers. On the one hand, it has been shown that the elasticity of taxable income is higher in higher income groups (Gruber & Saez, 2002). However, this elasticity is driven primarily by avoidance and evasion, and not economic behavior such as a reduction in effort (Piketty, Saez & Stantcheva, 2011; Duncan & Sabirianova Peter, 2012). This is because the rich have more opportunities to avoid and evade taxes, than the poor (Landier & Plantin, 2016, p. 2). Leaving avoidance and evasion behaviors aside, Piketty, Saez & Stantcheva (2011) show that income elasticities are minor in the short and medium term (p. 2). On the other hand, it has been shown that the top 1% and top 10% income shares rise disproportionally in periods of high economic growth while the other 90% lose (Roine, Vlachos & Waldenström, 2009; Bivens, 2016). Furthermore, Piketty, Saez & Stantcheva (2011) suggest that tax cuts for the top 1% income shares are associated with increased income shares for those classes, but not with increased economic growth, such that the authors talk about a "zero sum bargaining model" in which only the distribution of income is subject to change, not the economic growth (p. 26). Furthermore, within the optimal taxation literature, Diamond & Saez (2011), considering a social welfare function that takes decreasing marginal utility at the top of the income distribution into account, calculate an optimal top income taxation that would be nonlinear with high and rising marginal tax rates in the order of 48 to 76 percent (p. 175). In this context, this thesis measures how smaller, and therefore more realistic changes in top tax rates would impact income inequality. Opposed to this literature, Onrubia, Picos & del Carmen Rodado (2018), calculate a positive effect on redistribution when

moving to tax schedule with neutral local progressivity. However, starting from the observation that top income shares increase while tax rates fall, Andrienko, Apps & Rees (2014) calculate based on a social welfare function (SWF), that instead of a linear tax schedule, piecewise linear taxation with four brackets is optimal (p. 24). Duncan & Sabrianova Peter (2012) perform a similar simulation to mine, showing that a one percentage increase at the top of the income distribution reaches a reduction of 0.95 points of the Gini coefficient (p. 26). Against this, the empirical reality of the recent past is such that marginal top tax rates have not only fallen over the past decades, but that the income threshold where they are applied has also increased (Frederiksen, 2016, p. 8). Moreover, tax systems have also been decomplexified and have fewer brackets (Duncan & Sabirianova Peter, 2012, p. 3). Therefore, this thesis covering a more recent time period is all the more relevant to measure the recent effect changes in top tax rates had and have on redistribution.

Hence, while all linked to the question of how much 'taxing the rich' matters for reducing income inequalities, a quantification of the effect, especially in Europe, is lacking in the body of research presented above. Based on this, my findings contribute to the comparative political economy of top income taxation and redistribution. They allow to measure the sensitivity of redistribution to one particular policy lever, namely top tax rates.

5. Data and methodology

This section first presents the underlying data and methodological choices of my thesis, as well as the limitations linked to both.

5.1. Data

To analyze the impact of top tax rates on income inequality, I use two different data sets based on EUROMOD. EUROMOD is a microsimulation model for tax-benefit systems in the 27 EU member states and the United Kingdom (until 2019). It allows to retrieve distributional statistics for the impact of PIT, SSC, and benefits. The microdata on which EUROMOD runs stems from the EU-Statistics on Income and Living conditions (EU-SILC) survey, harmonized through Eurostat (EUROMOD, 2021).

First, for the analysis over time, I use the openly available web statistics from EUROMOD over the years 2007 to 2019. These web statistics are based on different updated of the microsimulation tool, using versions G2.0 to I2.0.[4] However, since differences are small and the simulation is based on the same underlying survey data, I decide to use the full range of available web statistics, using the most updated version for years where overlapping versions exist. I refer to this data as EUROMOD-Webstatistics data. It reports average monthly household income components per decile group in Euro, including income taxes and employee SSC, however, it does not include employer SSC.[5] The data set includes data for all EU member states and the UK until 2019. As Croatia joined the EU only in 2013, the data is available starting from that year only. While there is data available for the year 2020 as well, I decide to exclude it from the analysis because of the start of the Covid-19 pandemic which is likely to lead to distortions in the data. Thus, in total, the EUROMOD-Webstatistics data comprises 330 country-years.

Second, for the analysis through a simulated tax reform, I use data directly calculated through the aggregate data of the EUROMOD microsimulation model for years 2018-2019, accessed through the online EUROMOD interface available at the website of the Joint Research Center (JRC) of the EU.[6] I refer to this data as EUROMOD-JRC data. It reports mean annual household income per decile group in local currency, income taxes and employee SSC. For the same reason as stated above, I exclude the year 2020 from my analysis. The EUROMOD-JRC data set therefore comprises 56 country-years.

Using EUROMOD bears some caveats. First, the use of survey data for distributional analysis is not ideal, because it is prone to underreport income, particularly at the top end of the income distribution (EUROMOD, 2021). Second, the use of data from microsimulation is limited by the quality and assumptions of the simulation and is necessarily a simplification of the reality of tax policy. This is in particular due to the "complexity [of] some tax credits" (EUROMOD, 2021). Third, only deciles are provided which does not allow to capture heterogeneity inside

[4] The EUROMOD Web statistics can be accessed under: http://www.euromod.ac.uk/using-euromod/statistics (Accessed: 18/04/2022).
[5] For France, the generalized social contribution (contribution sociale généralisée, CSG) is included.
[6] The EUROMOD-JRC Interface can be accessed under https://euromod-web.jrc.ec.europa.eu/euromod-jrc-interface (Accessed: 18/04/2022).

income groups which can be large, especially at the top and the bottom of the income distribution EUROMOD, 2021). Fourth, EUROMOD does not include employer SSC (but it does include employee SSC), however, as explained above, this omits parts of the actual tax burden. Furthermore, the use of aggregate data, as well as data on decile levels is not very precise; micro-data from EUROMOD, or the Luxembourg Income Study, for example, would allow greater precision.
Nonetheless, the data remains worth being exploited and has been used largely in academia, as it allows to compare countries through the harmonization by Eurostat and because openly available aggregate data on decile level remains rare.

5.2. Methodology

Before moving to the analysis, this section explains the methodological choices made, regarding the calculation of income, tax rates, as well as analytical calculations used in the findings part. The data is analyzed, and all calculations are made using the statistics software Stata.

First, based on the theoretical concepts of income measurement explained above, I use the encompassing pre-tax or gross income parameter. Given the data available in both EUROMOD data sets, I calculate the practical approximation of the pre-tax income concept by adding income taxes and social security contributions to the disposable income:

$$pretax\ income = disposable\ income + PIT + SSC$$

Thus, it includes market income, cash benefits and pensions.

Second, to calculate the tax rate, I add income taxes and employer as well as self-employed SSC and divide them by the pre-tax income as defined above:

$$tax\ rate = (PIT + SSC) \div pretax\ income$$

I calculate the Palma ratio (defined as income inequality in *disposable income*), but I also calculate the Palma ratio pre-tax, defined as the income ratio top 10% to bottom 40% in pre-tax income, in order to eventually determine the redistribution achieved through income taxation:

$$Palma\ ratio_{pre,post} = \frac{Top\ 10\ income\ share_{pre,post}}{Bottom\ 40\ income\ share_{pre,post}}$$

As a second indicator, I compare top income shares, defined as the income share of the top 10%, both pre- and post-tax.

To measure the redistributive effect of income taxes exclusively, I follow the intuition of the Reynolds-Smolensky index, which calculates the redistributive effect (RE) as follows:

$$RE = G_m - G_d$$

where G_m refers to the Gini coefficient in market income and G_d to the Gini coefficient in disposable income. Now, to adapt it to my case, where I am solely interested in the redistributive effect of income taxation, and focus my analysis on other income inequality

indicators, I calculate the absolute and relative change in Palma ratios and top income shares between pre- and post-tax:

$$RE_{abs} = Palma\ ratio - Palma\ ratio_{pre-tax}$$

$$RE_{rel} = RE_{abs} \div Palma\ ratio_{pre-tax}$$

The equivalent is calculated with top income shares. Note that the signs are inverse to the Reynolds-Smolensky index.

Moreover, I calculate absolute and relative changes in Palma ratios, top income shares and top income tax rates

$$Absolute\ Palma\ ratio\ change = Palma\ ratio_{t=1} - \ Palma\ ratio_{t=0}$$

$$Relative\ Palmaratio\ change = Absolute\ Palma\ ratio\ change \div Palma\ ratio_{t=0}$$

and equivalently for top income shares and top income taxes. I calculate this for the total change over the whole time period studies, as well as in annual changes, from one year to the next.

Furthermore, I use the Kakwani index to measure the progressivity of taxation according to the following formula:

$$K = C - \mathrm{G}$$

where C is the concentration index (how much of total taxes is paid by each part of the income distribution), and G is the Gini coefficient.

To isolate the relative effects of the underlying income distribution and top income taxation, I decompose the effect according to the following formula:

$$\Delta RE_{rel} = \ \Delta top10taxrate * palmapre_{t=0} + \Delta palmapre * top10taxrate_{t=0} + residual$$

where toptaxrate stands for the top 10 tax rate and palmapre captures the underlying income inequalities as measured by the constructed pre-tax Palma ratio. All changes are percentage changes. The residual captures the interaction of the two effects, as well as all other changes, among which tax changes at the bottom of the distribution.

6. Findings

The presentation of the findings to answer the question of how sensitive income inequality is to top income taxation proceeds in three steps. The first section characterizes European income tax systems in their relation to redistribution and income inequality. The second section focuses on how redistribution through taxes has evolved in Europe over the 12 years in question and investigates the relative role top income taxes have played. In the third section, I discuss the results of a simulated one percentage point increase in top income taxes.

6.1. Characteristics of income inequality, redistribution, and income tax policy in European countries

Prior to presenting the analysis of the trends in redistribution over time and of the simulated tax reform, I reproduce a series of stylized facts known from the literature on income inequality, taxation, and redistribution. This does not only allow to explore the data set at hand, but also to characterize the redistributive patterns and the interactions of income inequality and tax policy across European countries.

Heterogeneity of redistribution in European tax systems

Table 1 (below) summarizes characteristics of European tax systems relevant for this study, based on the EUROMOD-JRC data for the most recent year (2019). It includes the main income inequality indicators, the Palma ratio, the top income shares, and the Gini coefficient for comparison (columns 1, 2 and 3), the absolute RE in terms of the Palma ratio (column 4), the top income and median tax rates (column 5 and 6), as well as the Kakwani and Reynolds-Smolensky indices (columns 7 and 8).

Palma ratios in the 28 countries in 2019 range from 0.81 in Luxembourg (lowest income inequality) to 2.1 in Bulgaria (highest income inequality). Ranked in terms of the post-tax Gini coefficient, income inequality is lowest in Belgium (0.22) and highest in Bulgaria (0.4). Taking the top 10 income share as an inequality indicator, income inequality is lowest in Slovakia (19%) and highest in Bulgaria (31%). Furthermore, in 2019, top income tax rates range from 17.8% in Bulgaria which has a flat income tax regime, to 50.4% in Romania. Equivalently, median tax rates range from 9.3% in the Czech Republic to 41% in Romania. The tax system with the largest global progressivity as measured by the Kakwani index is found in Ireland (0.29) and the lowest in Poland (0.07). The RE of taxes as measured both by the Reynolds-Smolensky index and the absolute RE in Palma ratios is highest in Ireland and lowest in Bulgaria (Reynolds-Smolensky), or Hungary (Palma).

Table 1 Characteristics of income inequality, redistribution and tax systems (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface)

Country	Palma Ratio	Top Share Post-Tax	Gini Post-Tax	Absolute RE	Top Tax Rate	Median Tax Rate	Kakwani Index	Reynolds-Smolensky Index
AT	0.95	0.2158	0.2553	-0.3537	0.3764	0.2301	0.191	0.0673
BE	0.8365	0.1909	0.2216	-0.4355	0.4214	0.2471	0.2189	0.0844
BG	2.1111	0.3112	0.3962	-0.2017	0.1777	0.1589	0.0969	0.017
CY	1.1629	0.2384	0.3105	-0.1618	0.1817	0.0931	0.1897	0.0263
CZ	0.9293	0.2064	0.2439	-0.2001	0.259	0.1561	0.1949	0.0418
DE	1.011	0.2191	0.2718	-0.3017	0.3692	0.2505	0.1534	0.0569
DK	0.9282	0.2106	0.2436	-0.2666	0.4455	0.3414	0.0896	0.0501
EE	1.0455	0.219	0.2939	-0.3432	0.3055	0.1883	0.2017	0.0345
EL	1.1015	0.2375	0.304	-0.2169	0.2904	0.1645	0.1553	0.0373
ES	1.211	0.2301	0.3304	-0.2915	0.268	0.1306	0.1883	0.0403
FI	0.94	0.2142	0.2366	-0.2981	0.3636	0.2329	0.165	0.0578
FR	1.0561	0.2352	0.2771	-0.2485	0.299	0.1768	0.1619	0.0425
HR	1.1434	0.2174	0.2932	-0.3207	0.3021	0.1591	0.1927	0.048
HU	1.1495	0.2311	0.3131	-0.0508	0.4084	0.3684	0.0984	0.0206
IE	1.1613	0.2245	0.3003	-0.683	0.3935	0.1366	0.2944	0.0912
IT	1.1481	0.2391	0.3115	-0.3308	0.3257	0.1934	0.1715	0.0502
LT	1.5699	0.2628	0.345	-0.4281	0.3463	0.2679	0.1288	0.05
LU	0.8093	0.2003	0.2544	-0.2973	0.3557	0.1882	0.2034	0.064
LV	1.517	0.2473	0.3403	-0.3305	0.2718	0.1986	0.137	0.037
MT	1.1743	0.2306	0.2896	-0.2341	0.2255	0.1318	0.1876	0.0356
NL	0.9759	0.2168	0.2529	-0.2713	0.39	0.2647	0.1264	0.0514
PL	1.0003	0.2157	0.2862	-0.1026	0.2853	0.235	0.0744	0.0212
PT	1.2638	0.2467	0.3274	-0.4531	0.3161	0.1195	0.2486	0.0607
RO	1.2738	0.2337	0.3346	-0.5911	0.504	0.4099	0.1396	0.0528
SE	1.0635	0.2246	0.2672	-0.2365	0.3331	0.2263	0.1341	0.0426
SI	0.8807	0.1994	0.2327	-0.2219	0.3299	0.2165	0.1809	0.0532
SK	0.8198	0.1894	0.2253	-0.1075	0.2609	0.1829	0.159	0.0322
UK	1.2092	0.2402	0.3073	-0.4418	0.3165	0.1374	0.2567	0.0624
Total	1.123	0.2267	0.2881	-0.3007	0.3258	0.2074	0.1693	0.0475

From this table, it becomes clear, that the Reynolds-Smolensky index and the absolute RE in terms of the Palma ratio are closely correlated (corr = -0.77). In fact, the correlation with the relative RE is even higher (corr = -0.92). Thereby, using the measure for the RE in terms of the Palma ratio is valid and without prejudice for comparison with other works focusing on the Reynolds-Smolensky index. Equivalently, the correlation between the Palma ratio and the Gini coefficient for disposable income is of 0.91, such that again, the use of the Palma ratio in lieu of other commonly employed indicators does not limit the comparison with other studies.

Empirical trade-off between progressivity and average tax level

The empirical trade-off between the level of taxes and their progressivity is well and alive for the income tax systems across Europe, as shown in Figure 1 below (R2= 0.39 for 2018-19 average). This means that countries achieve a certain RE through either high progressivity or a high level of taxation. Thereby, countries with a high level of taxes have a less progressive tax schedule which is the case for Denmark for example. However, in fact, there is a relationship between increasing global progressivity and redistribution measured by both the Reynolds-Smolensky index (R2=0.41), and the absolute RE measured with the Palma ratio (R2= 0.38).

Yet, the relationship between the level of taxation as measured by the median tax rate and the both measures of redistribution is quasi absent for the Reynolds-Smolensky index (R2= 0.003) and for the absolute Palma ratio RE (R2= 0.001). This means that in this data set covering 28 European countries, the higher the top income tax rate, the higher the RE for the whole income tax system. In particular, the level of top income taxation is significantly and intuitively correlated with the RE of income taxes. Again, this holds true for both the Reynolds-Smolensky index (R= 0.43), and the relative RE measured in Palma ratios (R2=0.39).

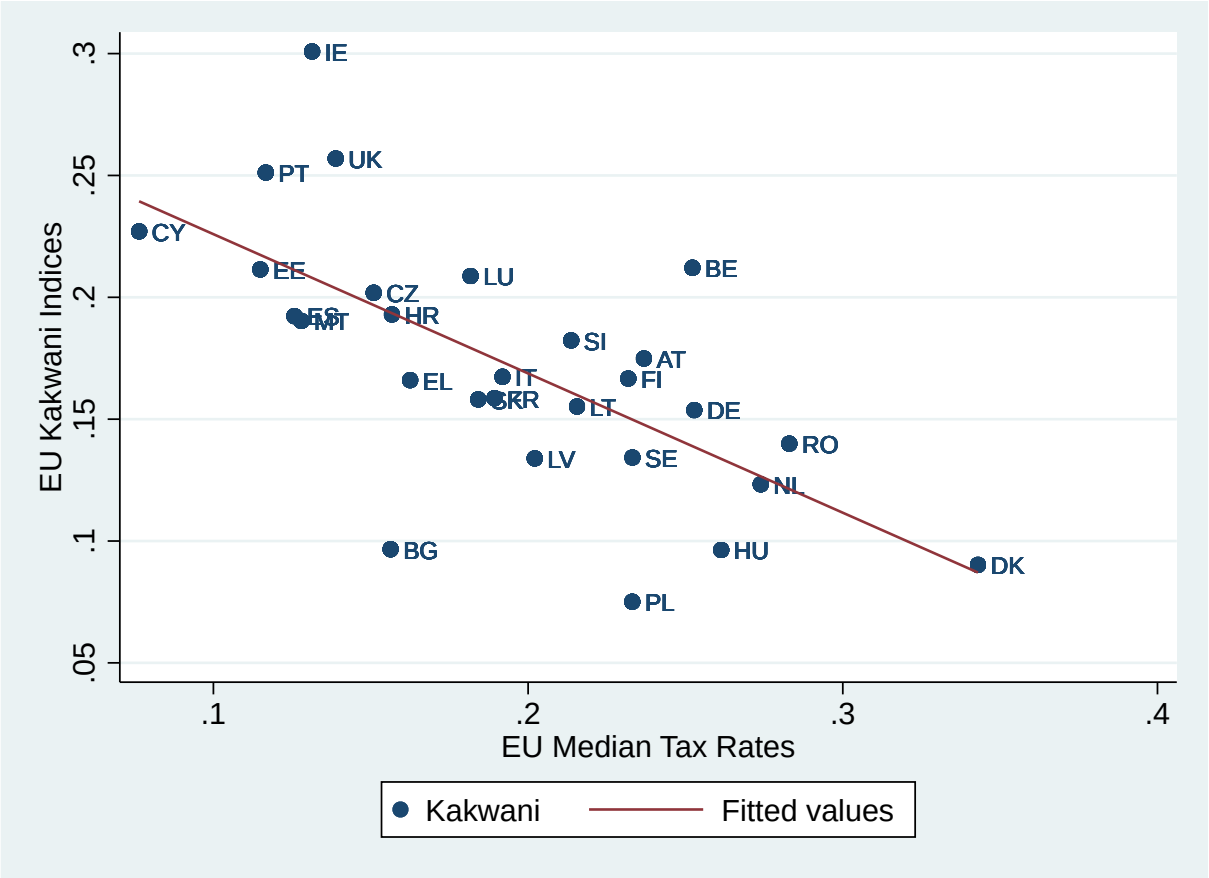

Figure 1 EU Median Tax Rate and Kakwani Index, 2019 (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface).

Furthermore, the relation between pre-tax inequalities and the level of redistribution (Reynolds-Smolensky index) is quasi absent (R2=0.002) and if any tildes towards the fact that increasing pre-tax inequalities lead to more redistribution, which goes against the findings notably of Verbist & Figari (2014).

The "Law of Rank"

Despite the relative heterogeneity in the redistributive effects of the different income tax systems exposed by these facts, I can show similarities from a distributional point of view following Guillaud & Zemmour's (forthcoming) prism of a "Law of rank." It describes the relative linearity of tax rates if calculated based on an individual's position in the income distribution and the median tax rate. I plot the linear prediction of the tax rate by both an 'endogenous' calculation following a regression of the tax rate based on the median tax rate

and the decile for each country. Moreover, I also plot the exogenous prediction based on the formula shown by Guillaud & Zemmour (forthcoming):

$$tax\ rate = 0.813 * median\ taxrate + 0.003 * income\ percentile - 0.122$$

The correlations of the actual tax rate and both the 'endogenous' prediction (0.92) as well as the prediction based on the "Law of rank" (0.9) are similar. In particular, they are the same for top 10 tax rates (0.75) such that I continue with the prediction based on the 'exogenous' 'Law of rank' uniform function.

In fact, the correlation is highest for the middle deciles (up to 0.995 for decile 5), and lowest at the ends of the income distribution (0.62 for decile 1), which is visualized in Figure 2 for 2019 (below). I then compare the actual Palma ratio to the Palma ratio that would be observed if taxation were linear in a "Law of rank" style. The Palma ratio so achieved would be 0.049 points lower than the actual Palma ratio on average. However, the difference is very heterogeneous across countries, such that the Palma ratio through linear taxation would be higher in Austria, Belgium, Estonia, Ireland, Luxembourg, Portugal, Romania and the UK. It would however be lower in the other countries. As seen above, the countries which achieve lower Palma ratios through their actual tax schedule are also the countries with the most progressive tax systems in terms of the Kakwani index. This means that the relation between the Kakwani index and the difference between the real and the "Law of rank"-Palma ratio is negative and significant (R2=0.6). This suggests that deviations from the "Law of rank" style linear shape of tax rates, i.e., heterogeneity in top income tax rates, is an indicator for disposable income inequality. Importantly, the difference in Palma ratios between the real and the "Law of rank" like Palma ratio is driven primarily by the top 10 income group (R2=0.88) as compared to the bottom 40 (R2=0.23). This means that the higher the global progressivity of the tax system, the more the deviation from the "Law of Rank" favors redistribution. The mean difference in top income tax rates from the "Law of Rank" is 0.009.[7] Finally, deviations from the linear tax rate schedule at the top are closely related with the RE of a country's income tax system, both in terms of the Reynolds-Smolensky index (R2=0.78), and the absolute RE in terms of the Palma ratio (R2= 0.55).

[7] This makes the generalization of deviations from top tax rates of +0.01, as shown section 6.3., particularly relevant.

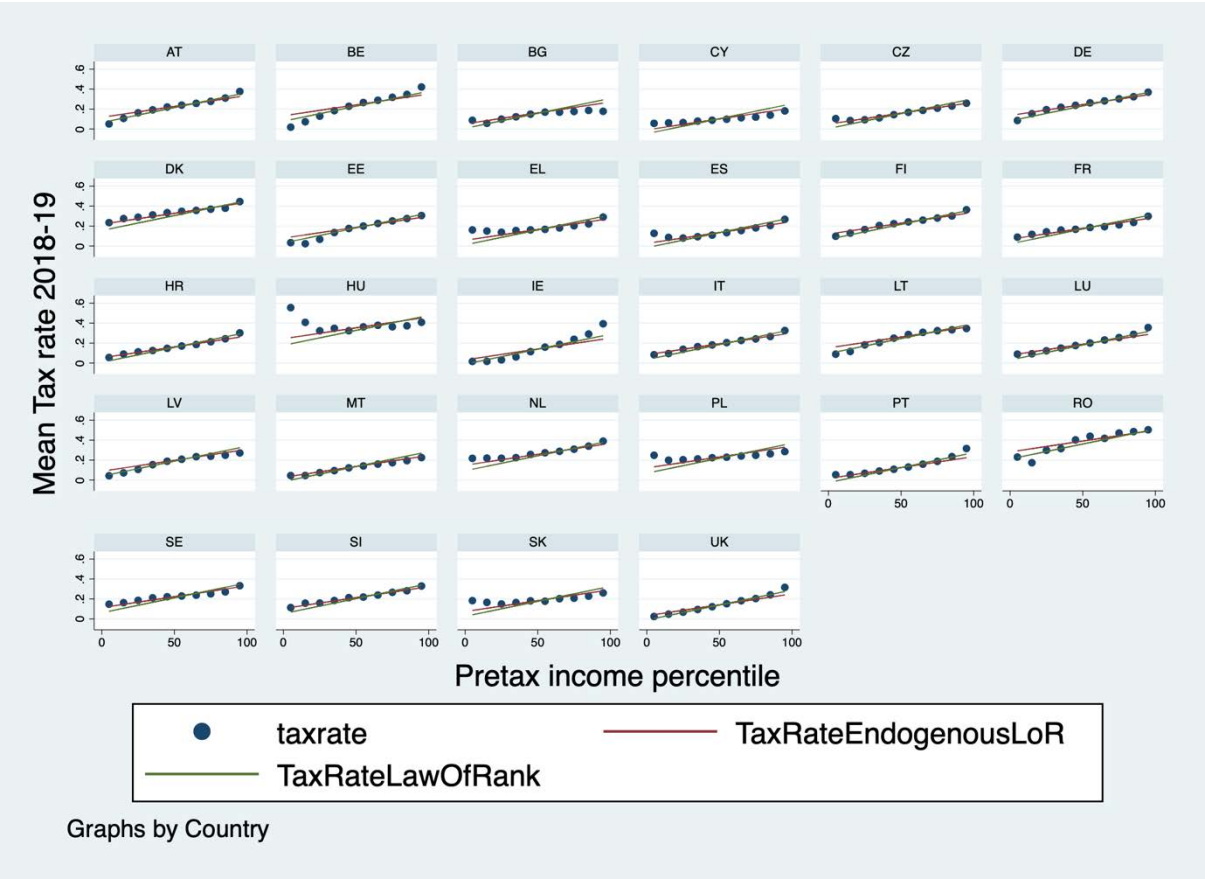

Figure 2 The "Law of Rank", by Country, applied to EUROMOD-JRC 2018-2019 data (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface).

6.2. Income inequality, redistribution, and the relevance top income taxation in Europe over time (2007-2019)

Having presented the overall interactions between tax systems, redistribution and income inequality, this part of the analysis concentrates on answering the question of how much top income tax rates matter for income inequality from a historic perspective – how much did top income taxation, and variation of the latter, matter for redistribution in the recent past?

6.2.1. Variation of inequality indicators, top tax rates, and redistribution over time

To investigate the variation of income inequality, top tax rates and redistribution over time, I first look at the evolution of the different relevant parameters over the entire time period from 2007 to 2019.

In the face of rising inequalities, two thirds of the tax systems attenuate increases in disposable income inequalities

Table 2 (below) exposes the pre-tax income distribution in 2007 and 2019 (Column 1 and 2) as measured by the Palma ratio pre-tax, as well as its absolute change between 2007 and 2019 (Column 3). Columns 4 and 5 show the Palma ratio in 2007 and 2019 respectively and redistribution as measured as the absolute change in points of Palma ratios pre- and post-tax (Column 6). Columns 7 and 8 show the absolute RE measured in terms of the Palma ratio.[8]

[8] Croatia is omitted because no data is available before 2013.

Table 2 Evolution of income inequality and redistribution, 2007-2019 (Source: author's calculations based on EUROMOD-Webstatistics)

Country	Palma Pre-Tax 2007	Palma Pre-Tax 2019	Absolute Change Palma Pre-Tax 07-19	Palma 2007	Palma 2019	Absolute Change Palma 07-19	Absolute RE 2007	Absolute RE 2019
AT	1.2031	1.2528	0.0497	0.9239	0.9221	-0.0018	-0.2792	-0.3308
BE	1.274	1.2481	-0.0258	0.8681	0.8341	-0.0341	-0.4058	-0.4141
BG	1.6529	2.2864	0.6335	1.3535	2.1431	0.7896	-0.2994	-0.1433
CY	1.1038	1.2173	0.1135	0.9906	1.0576	0.0669	-0.1131	-0.1597
CZ	1.1606	1.0983	-0.0624	0.9174	0.9072	-0.0102	-0.2432	-0.1911
DE	1.2094	1.2837	0.0743	0.9394	1.0436	0.1042	-0.27	-0.2401
DK	1.1706	1.2723	0.1017	1.0203	0.9856	-0.0347	-0.1503	-0.2867
EE	1.4659	1.3842	-0.0816	1.2729	1.1697	-0.1031	-0.193	-0.2145
EL	1.534	1.3537	-0.1803	1.3027	1.1068	-0.1959	-0.2313	-0.2469
ES	1.2209	1.4959	0.275	1.0144	1.1993	0.185	-0.2065	-0.2966
FI	1.2332	1.2908	0.0575	0.9898	0.9727	-0.0172	-0.2434	-0.3181
FR	1.0531	1.2837	0.2306	0.8877	1.0436	0.1558	-0.1653	-0.2401
HU	0.9849	1.3305	0.3456	0.7971	1.3168	0.5197	-0.1877	-0.0137
IE	1.3743	1.9851	0.6108	0.9869	1.2516	0.2647	-0.3873	-0.7335
IT	1.4642	1.5926	0.1284	1.1571	1.2256	0.0685	-0.3071	-0.3671
LT	1.7006	1.9159	0.2152	1.4672	1.5375	0.0703	-0.2334	-0.3783
LU	0.9951	1.1005	0.1054	0.7995	0.7996	0.0001	-0.1956	-0.3009
LV	2.0532	1.9272	-0.126	1.7667	1.5963	-0.1703	-0.2865	-0.3308
MT	1.2345	1.4039	0.1694	1.0555	1.1643	0.1089	-0.1791	-0.2396
NL	1.2885	1.4081	0.1196	1.0417	1.0213	-0.0204	-0.2468	-0.3869
PL	1.2584	1.0586	-0.1998	1.125	0.9657	-0.1594	-0.1334	-0.093
PT	1.8838	1.5858	-0.298	1.4975	1.1798	-0.3177	-0.3863	-0.406
RO	1.5245	1.7405	0.216	1.3673	1.3738	0.0065	-0.1572	-0.3667
SE	0.9886	1.2438	0.2552	0.8269	1.0195	0.1926	-0.1617	-0.2243
SI	1.081	1.1392	0.0582	0.859	0.9118	0.0528	-0.222	-0.2274
SK	1.0527	0.8036	-0.2491	0.8934	0.7273	-0.1662	-0.1593	-0.0764
UK	1.6833	1.5955	-0.0879	1.3194	1.2123	-0.1072	-0.3639	-0.3832
Total	1.3277	1.4184	0.0907	1.0904	1.1366	0.0462	-0.2373	-0.2818

Several observations can be made from this table. First, in 18 out of 27 countries, pre-tax income inequality has increased, in line with the observation that income inequalities are widening across the EU (e.g., Frederiksen, 2016). In three of those countries has the disposable income inequality increased even more. These countries are Bulgaria, Germany, and Hungary. Among the remaining 15 countries in which both pre-tax and disposable incomes increased, in eleven, the disposable income inequality increased less than pre-tax inequalities. Furthermore, in four countries (Austria, Denmark, Finland, and the Netherlands), the inequality in disposable income even decreased, i.e., tax policy was able to revert the trend. On the contrary, among the nine countries which saw their gross income inequality *decrease*, five (Belgium, Estonia, Greece, Latvia, Poland, and the UK) saw their disposable income inequality decrease even more. In the other four countries, inequalities in disposable income decreased less than pre-tax inequalities. Furthermore, among the 9 countries, five (Czech Republic, Estonia, Latvia, Poland, and Slovakia) had become members of the EU in the 2004 enlargement. Together, then, in 21 countries, the RE of income taxation increased, as becomes clear from the last two columns.

Looking at the structure of tax policy and top income tax rates over time, median and top tax rates can be analyzed. On average across the sample, median tax rates remained rather stable and there was only a minor increase of 0.007 points. However, countries move very heterogeneously. For instance, in Germany, Estonia, Finland, France, Italy, Latvia, the Netherlands, Poland, Sweden and the UK, median tax rates decreased while in the other countries, they increased. Moreover, looking at the top tax rate, too, the heterogeneity in European tax systems becomes clear. While top tax rates have increased in most countries, in Bulgaria, the Czech Republic, Germany, Hungary, Poland, Sweden, and Slovenia, top tax rates have decreased over the 12 years studied. In all countries in this group except for Sweden, the overall RE of taxes decreased over the time period, too. Equivalently, in all countries where top tax rates increased, redistribution increased as well (except Slovakia).[9]

The varying and evolving composition of direct taxes has no significant effect on redistribution

Table 3 (below) shows the relative part of income taxes and SSC in overall direct taxation in 2007 and 2019. The relative structure of the tax rate varies from one country to the other. In eleven (2007), and 13 (2019) countries, income taxation had a larger part in direct taxation, leaving SSC as the more important factor in most countries. The countries also differ in the degree of dominance of one or the other. For example, in France, in 2007 the SSC and income tax were at par, while in Estonia, almost 85% of direct taxation accrued to the latter. However, patterns changed between 2007 and 2019. For instance, in France, income taxation grew in relative importance, and the reverse happened in Cyprus. The structure of direct taxation neither correlates with the overall RE of taxes (corr= 0.17) nor with the trends in redistribution over time, as measured by the total difference in Palma ratios from 2007-2019 (corr= 0.01).[10]

[9] Tables can be found in the appendix.

[10] Comparing these findings with data including employer SSC would be desirable.

Table 3 Evolution in composition of household taxes (Source: author's calculations based on EUROMOD-Webstatistics)

Country	Mean Household Tax Rate 2007	Mean PIT Share 2007 (%)	Mean SIC Share 2007 (%)	Mean Household Tax 2019	Mean PIT Share 2019 (%)	Mean SIC Share 2019 (%)
AT	1082.1449	39.8971	60.1029	1341.1163	38.4294	61.5706
BE	1075.513	56.3787	43.6213	1492.8472	54.7666	45.2334
BG	94.9655	38.1753	61.8247	149.3766	38.2305	61.7695
CY	348.3288	40.8264	59.1736	378.1285	21.6101	78.3899
CZ	224.151	32.84	67.16	378.7441	37.4244	62.5756
DE	1044.5816	42.0142	57.9858	934.9616	61.6125	38.3875
DK	1740.8414	83.6442	16.3558	2528.4818	96.22	3.78
EE	164.2919	84.7799	15.2201	331.0698	74.8734	25.1266
EL	447.6213	24.0223	75.9777	395.1081	47.2146	52.7854
ES	407.6081	44.8534	55.1466	532.2932	49.0929	50.9071
FI	1026.0389	83.3075	16.6925	1308.0318	75.1834	24.8166
FR	664.6582	48.6407	51.3593	934.9616	61.6125	38.3875
HU	238.5864	41.9591	58.0409	326.2053	52.7947	47.2053
IE	857.5646	59.8755	40.1245	1396.6684	78.8834	21.1166
IT	824.7735	65.7324	34.2676	878.0014	63.5361	36.4639
LT	183.737	76.0784	23.9216	561.8508	38.2435	61.7565
LU	1240.9106	39.1485	60.8515	1740.2894	44.8038	55.1962
LV	273.5918	65.4388	34.5612	396.6677	57.7359	42.2641
MT	310.7417	36.1006	63.8994	513.4208	44.3278	55.6722
NL	1294.5017	30.2683	69.7317	1336.2468	44.4859	55.5141
PL	264.9604	47.2898	52.7102	410.544	56.7664	43.2336
PT	360.3543	34.0534	65.9466	446.2178	46.3289	53.6711
RO	94.8681	52.8885	47.1115	307.6094	19.2377	80.7623
SE	1162.0901	81.3024	18.6976	1216.1665	78.9704	21.0296
SI	583.3783	27.5608	72.4392	715.7363	28.6964	71.3036
SK	166.2086	26.273	73.727	361.0189	24.8014	75.1986
UK	1018.6355	75.5643	24.4357	996.9904	68.033	31.967
Total	636.8758	51.0709	48.9291	826.2502	51.9969	48.0031

Confronted with economic shocks between 2007 and 2019, while redistribution reacts in heterogeneous ways, inequalities continue widening overall

The evolution over the entire time period can be nuanced by a more detailed look at variations between 2007 and 2019, a period characterized by the economic shocks of the economic and sovereign debt crises, as well as the subsequent period of stagnation. Figure 3 (below) depicts the evolution of the Palma ratio, the pre-tax Palma ratio and the top income tax rate.

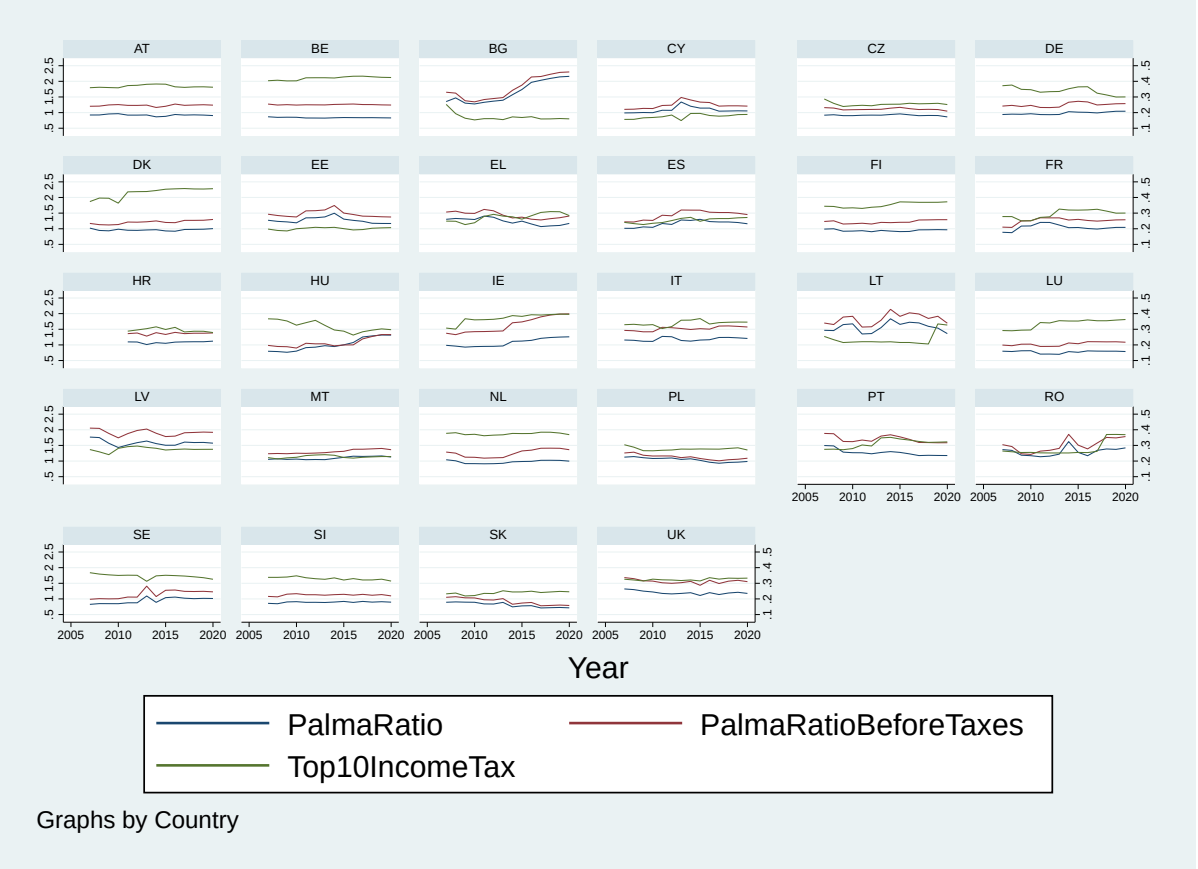

Figure 3 Palma ratio pre- and post-tax, top income tax rate, 2007-2019 (Source: author's calculations based on EUROMOD-Webstatistics).

As can be seen in Figure 3, the evolution of the different parameters differs substantially across the data set, both in terms of patterns and recent trends.

First, in all countries, Palma ratios pre- and post-tax move mostly in parallel, underlining the intuitive notion that changes in the pre-tax income distribution determine the movement of changes in disposable income. Deviations from parallelism indicate an increased relative importance of factors other than the pre-tax income distribution, among which tax policy in general and top income tax rates in particular. From visual inspection of the graphs in Figure 3, the cases of Germany in 2015, of France after 2013, Hungary after 2013, and Romania after 2018 stand out in this regard. The case of Hungary is the only among those where pre- and post-tax Palma ratios departed clearly from moving in parallel by coming *closer* together, i.e., the RE of taxes diminished. In the other countries, the Palma ratio departed more strongly from the pre-tax Palma ratio, indicating increased redistribution through taxation. On the contrary, in the case of the Netherlands for example, one can see that it is notably the underlying income distribution that became more unequal. In Romania for example, both underlying inequalities and tax rates increased, however the joint effect resulted in an overall increase of the Palma ratio, such that pre-tax inequalities dominated the effect.

Second, regarding the recent trend (looking at the last third of the sample, i.e., from 2015 to 2019) of the evolution of the Palma ratio, i.e., asking whether countries recently saw their income inequalities increase or decrease, one can determine two broad groups. In the first group, the Palma ratio is relatively stable, namely in Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Spain, Croatia, Malta, Portugal, Sweden, Slovenia, and Slovakia.

In the second group, the Palma ratio increased in the recent past in varying in degrees: Bulgaria, Germany, Denmark, Greece, Finland, France, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Romania, and the UK. This finding is in line with the literature cited above according to which income inequalities have continuously increased over the recent decades. Only Lithuania is an exception to this pattern with a recent decreasing trend in the Palma ratio; but Lithuania also starts from one of the highest levels of income inequality in the data set. Hence, income inequalities in all countries except Lithuania have increased or stagnated in the recent past.

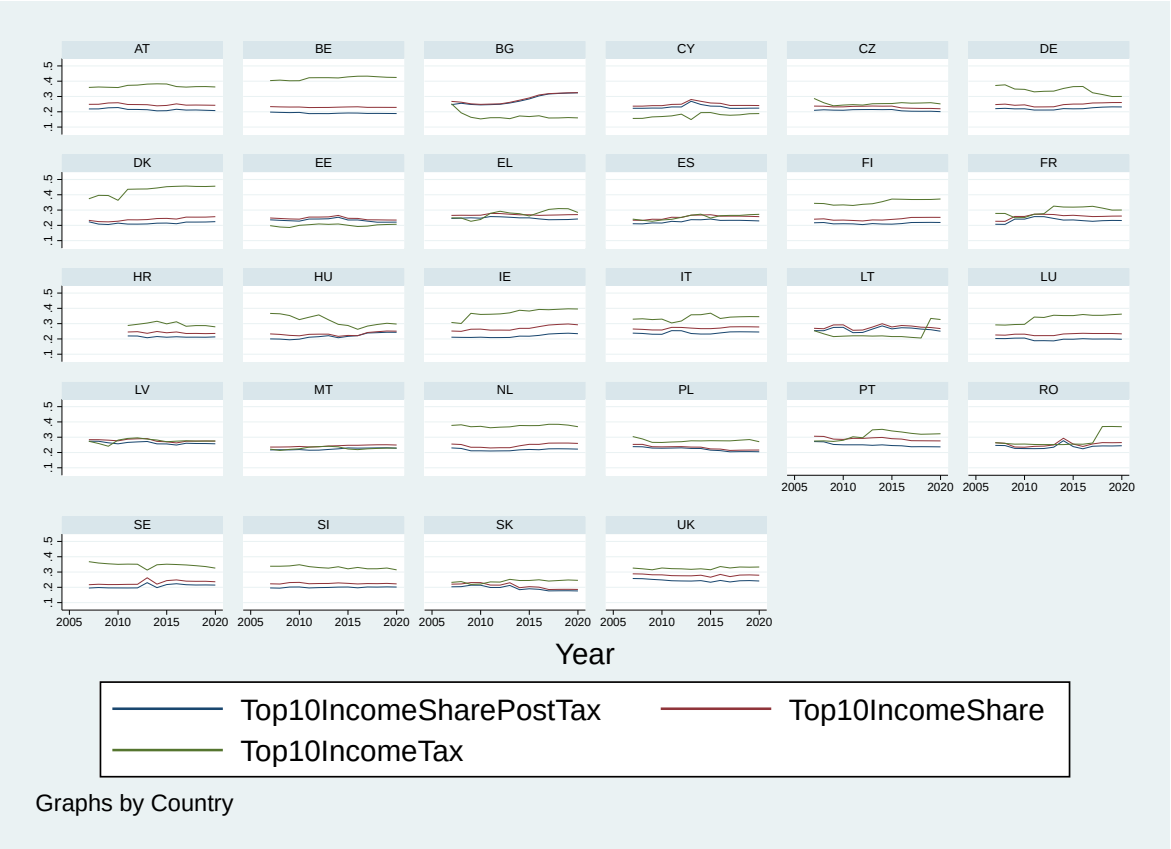

Figure 4 Top income shares, pre- and post-tax, top income tax rates, 2007-2019 (Source: author's calculations based on EUROMOD-Webstatistics).

For completeness, I also present the evolution of the top 10 income share and compare it to the evolution of the Palma ratio in Figure 4. First, departures from parallel movement appear to be less important for this indicator. There are, however, countries in which those departures are clearly visible, e.g., in Germany, Denmark, Greece, Finland, France, Hungary, Italy, Luxembourg, the Netherlands and Slovakia. Second, in trends, the top income share remains relatively stable in all countries. However, recent increases happened in Bulgaria, Germany, France, Denmark, Hungary, Ireland, and Romania. Recent decreases were experienced by Estonia, Lithuania, Poland, and Slovakia. Regarding top tax rates, while there does not seem to be a common pattern, in some of the countries, one can observe a "mirror"-like movement, i.e., when income shares increase, top tax rates decrease, and vice versa. This is in line with the literature according to which cuts in the top tax rate cause top income shares to rise (e.g., Piketty & Saez, 2006). Greece, Spain, Italy and Portugal have very volatile tax rates in general. This reflects the tax reforms and interactions with other measures for fiscal consolidation after

the sovereign debt crisis. In addition, this figure allows to visually expose tax policy shocks. For example, in France, a clear policy change in top tax rates can be seen around the year 2013, which coincides with the tax reforms increasing top income taxation having taken place. Importantly in the case of France following this increase, top income shares do not seem to vary in response. Like in France, the sharp rises in top tax rates in Greece, Ireland, Latvia, Luxembourg, Portugal, and Spain are also due to increases in statutory top tax rates between 2010 and 2011.
Lastly, and related to the previous point, top income shares remain relatively stable in all countries of the data set, independently of the level of taxes levied or the evolution of the latter.

Finally, Figure 5 shows how the RE of taxes evolved as measured both in terms of the Palma ratio and in terms of top income shares. The heterogeneity in the level of redistribution operated through the income tax system has already been discussed above. Regarding the changes and trends through time, Figure 5 exposes again that countries differ a lot in recent trends. The RE of tax policy appears to be stagnating in Austria, Belgium, Cyprus, the Czech Republic, Denmark, Croatia, France, Malta, Poland, Sweden, Slovenia, and the UK. Countries in which redistribution has decreased recently are Germany, Portugal, and Slovakia. A recent increase in the RE of taxes can be seen in Greece, Spain, Finland, Latvia, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, and Romania. In Bulgaria, Estonia, and Hungary, the evolution is very volatile.
The same patterns and levels hold for reduction of inequalities as measured by the top income share.[11]

[11] The according Figure can be found in the appendix.

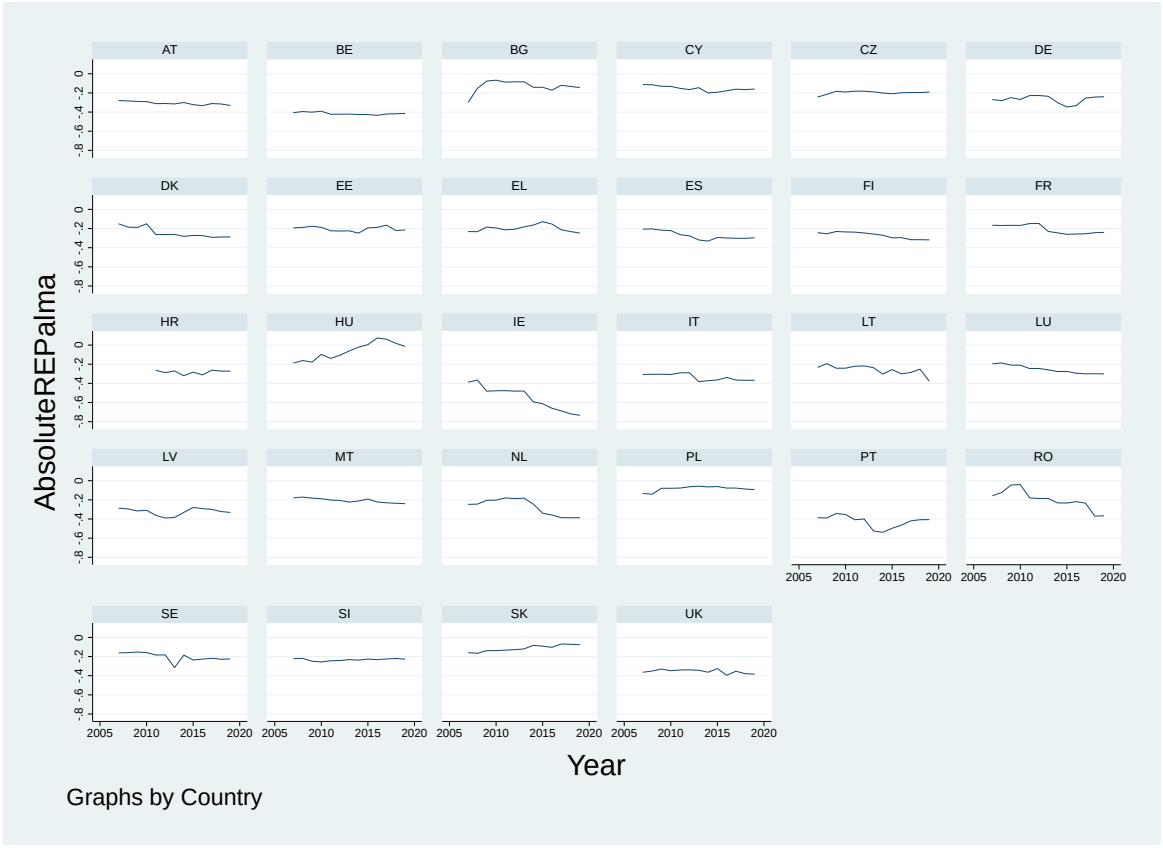

Figure 5 Absolute RE in Palma ratio, 2007-2019 (Source: author's calculations based on EUROMOD-Webstatistics).

Shocks in redistribution are sensitive to both top income taxes and pre-tax inequalities

Drawing the distribution of the most important inequality, top tax rate, and redistributive shocks, there seems to be a small correlation between the two over the whole data set. This means that changes in top tax rates which are among the 50% of the largest (positive and negative) annual tax rate changes across the data set, in that same year mildly correlate (corr=0.35) with changes in Palma ratios which fall in the 50% of the largest (positive and negative) annual changes in Palma ratios.[12] Importantly, the correlation is strongest between a positive inequality shock (Palma ratio decreases) and a positive tax rate shock (tax rates increase) (corr = 0.36). This is larger in size than for the correlation between negative inequality shocks and negative tax rate shocks (corr=0.2).

Table 4 depicts the most important inequality (Palma ratio), top tax rate and absolute RE shocks. Some of the tax rate shocks require special political contextualization. The tax rate shock in Lithuania reflects a major tax reform that moved from flat to progressive income taxation in 2019. In Romania, a tax reform in 2018 increased the share of SSC paid by employees, explaining the magnitude of the shock. Hence, the shock is likely to be an artifact, as the EUROMOD data set does not include employer contributions. It is likely that the change would have been weaker if employee and employer contributions were counted. In Denmark, a tax reform in 2010 increased personal income taxation to finance tax cuts in other areas. The

[12] I correlate annual shocks in both parameters when their value lies above (below) the respective threshold that determines the 25% largest shocks in each direction.

increase in tax rates in Ireland 2009 can be explained by the contraction of wages due to the economic crisis. The decrease in tax rates in Bulgaria in 2008 represents a tax reform which replaced a progressive tax schedule by flat taxes. The decrease in taxes in Italy in 2016 is linked to a tax reform package which included, i.a., the repeal of certain local household taxes.

In fact, when looking at the distribution of annual 'shocks' in inequalities and top tax rates, some broader elements merit further consideration. First, the largest shocks in pre-tax income inequality are larger in magnitude when they are positive (increasing inequalities) than when they are negative. Second, top tax rate changes are larger in magnitude when tax rates are increased. Third, in terms of redistributive shocks, they are also larger in magnitude when redistribution increased. Furthermore, concerning redistributive shocks, it is useful to additionally look at the distribution of shocks. It lies between -.21 and .32, i.e., there is a large amplitude over the whole sample, even if 50% of all cases are of small magnitude (-.019 to .022). A positive value indicates that redistribution has decreased, while a negative value indicates an increase in redistribution.

Furthermore, linking these shocks with Table 1 (over the entire time period), in the countries which have seen the greatest inequality shocks, top tax rates have evolved differently depending on the country. While top tax rates increased Romania, Lithuania, and Ireland, they decreased in Sweden and Bulgaria. All countries which experienced a positive inequality shock also experienced an overall worsening of inequalities in disposable income. Among the countries that experienced a positive tax rate shock, only Denmark and Portugal experienced a decrease of the Palma ratio over the entire time period. Moreover, among the countries which experienced a negative tax rate shock, all saw their Palma ratio increase.

Table 4 Disposable income inequality, top tax rate and redistribution shocks (Source: author's calculations based on EUROMOD-Webstatistics)

Positive inequality shock (Increase in inequalities)	***Positive top tax rate shock (Increase in tax rates)***	***Positive redistribution shock (Increase in redistribution)***
RO-2014 (.448)	LT-2019 (.128)	RO-2011 (-.139)
SE-2013 (.351)	RO-2018 (.108)	RO-2018 (-.135)
LT-2014 (.349)	DK-2011 (.072)	SE-2013 (-.133)
IE-2014 (.261)	IE-2009 (.066)	LT-2019 (-.126)
BG-2016 (.259)	PT-2013 (.0516)	PT-2013 (-.125)
Negative inequality shock (Decrease in inequalities)	***Negative Top tax rate shock (Decrease in top tax rates)***	***Negative redistribution shock (Decrease in redistribution)***
LT-2011 (-.344)	BG-2008 (-.059)	BG-2008 (.147)
RO-2015 (-.344)	DE-2017 (-.041)	SE-2014 (.131)
SE-2014 (-.334)	SE-2013 (-.038)	HU-2010 (.080)
PT-2009 (-.247)	CY-2013 (-.035)	RO-2009 (.078)
EE-2015 (-.243)	IT-2016 (-.035)	DE-2017 (.078)

6.2.2. Decomposing the relative effect of top taxes and the income distribution on redistribution and income inequality over time

Based on the prior observations, a decomposition of the overall change in the RE of income taxation through time allows to distinguish and quantify the relative importance of top income taxation and pre-tax income inequalities. I show that increases in top tax rates have attenuated widening income inequalities only mildly by between 0.2 and 14%. Furthermore, decreasing top tax rates always reinforce pre-tax inequalities. Moreover, I show that in more than 80% of cases, the sign of top tax changes determines the sign of trends in redistribution, while this is the case in only 38% of cases for the sign of trends in income inequality. Finally, I find that top tax rates have lost in relative importance in the recent past.
I first present the results of a simulation of how the Palma ratio would have evolved over time, if either tax rates or underlying income inequalities were fixed at 2007 levels, i.e., at the starting point of the time period in question**.** I then decompose the effect on redistribution over time into a top tax rate and an inequality effect.

The first stage of findings is based on Figures 6 and 7 (below) that show how the Palma ratio would have evolved if either top tax rates or income inequalities would have remained at 2007 levels. Figure 6 shows how the Palma ratio would have evolved if all factors except for the top income tax rate were allowed to move.[13] In this graph, if the actual Palma ratio is below the simulated Palma ratio, this means that top taxes increased, and that this led to more redistribution.[14] Figure 7 exposes what the Palma ratio would have been if pre-tax inequalities had been fixed and only the tax rate evolved.[15] In this graph, if the actual Palma ratio is below the simulated Palma ratio, this means that inequalities have decreased. As the correlations with the actual Palma ratio for the different comparisons show, the difference between letting the tax rate of only the top 10 or over the whole income distribution vary is only minor (0.843 vs. 0.841). This means that top tax rate changes are a rather good predictor of variations of the Palma ratio based on tax policy changes only, and that the top rate changes capture most of the impact on inequality of the tax policy across the whole income distribution, too. Nonetheless, holding tax policy constant, and letting only inequalities vary has a higher predictive power (correlation of 0.96), such that it remains true that the variation of pre-tax inequalities determines how the inequalities in disposable income evolve. Top tax policy can however account for the *magnitude* of changes in disposable income inequality.

Additionally, the changes over the whole period is also depicted in Table 5 where column 1 shows the percentage change in pre-tax income inequalities, column 2 shows the percentage change in top tax rates, and column 3 displays the percentage change in disposable income

[13] Palma ratio calculated with the disposable income based on pre-tax income of each following year, real annual tax rates for all deciles except the top 10, and the top 10 tax rate of 2007.
[14] The figure showing how the Palma ratio would have evolved if tax policy across the whole income distribution had remained at 2007 levels, while underlying inequalities evolve can be found in the appendix. I calculate the Palma ratio with disposable income based on the pre-tax income of each following year and the tax rate of 2007 for all deciles.
[15] Palma ratio calculated with the disposable income based on the pre-tax income of 2007 and the actual tax rate of each following year.

inequalities. Column 4 calculates the relative difference between the real and the simulated Palma ratio. As the only difference between the two is the change in top tax rates, this value approximates the relative contribution of top tax rates to the change in Palma ratio over time.[16]

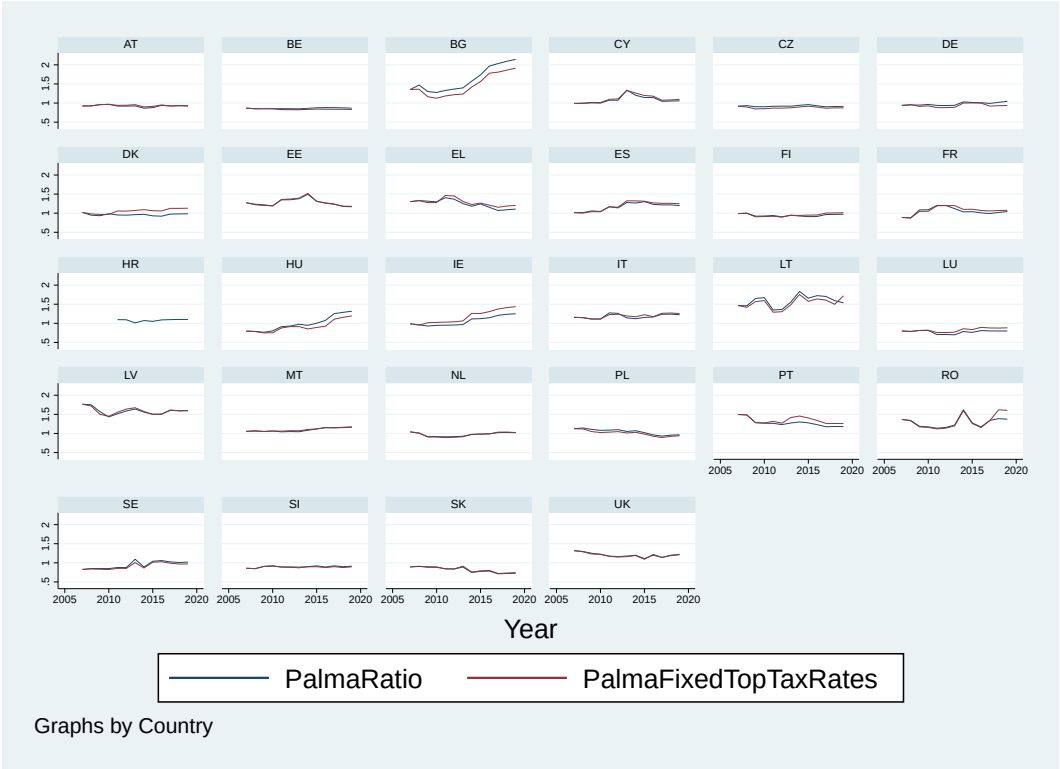

Figure 6 Palma ratio and Palma ratio if top tax rates were fixed at 2007 levels (Source: author's calculations based on EUROMOD-Webstatistics).

[16] I divide the difference between the actual and the simulated Palma ration by the simulated Palma ratio.

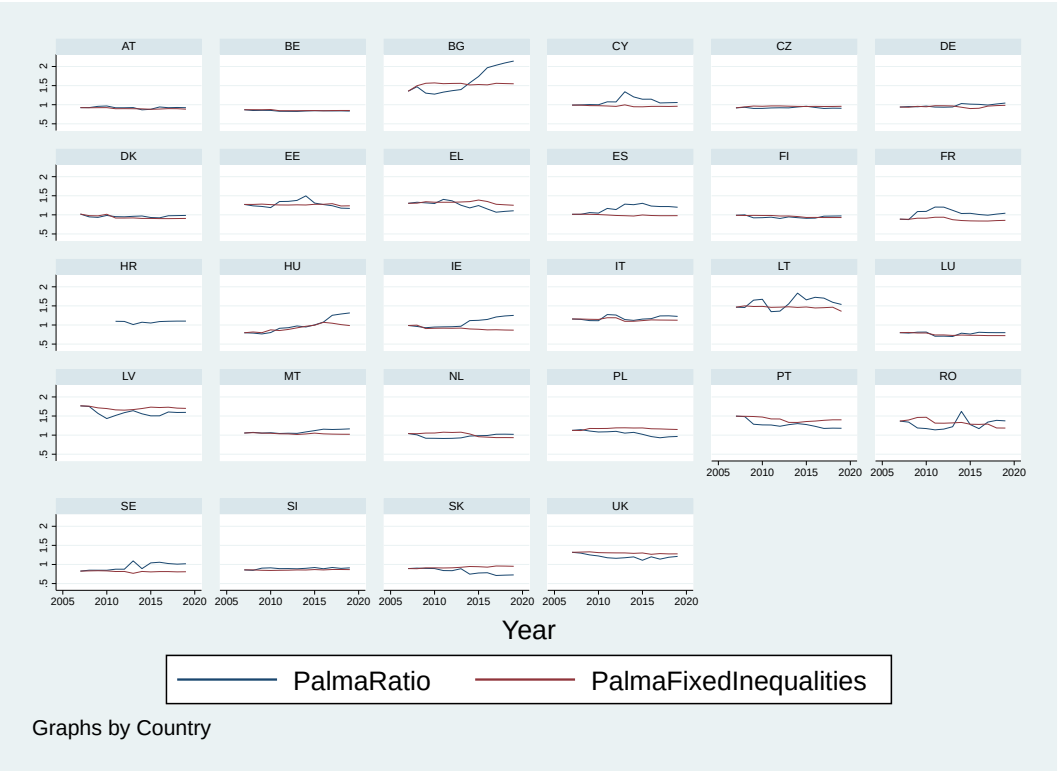

Figure 7 Palma ratio and Palma ratio if inequalities were fixed at 2007 levels (Source: author's calculations based on EUROMOD-Webstatistics).

Table 5 Relative changes in Palma ratio pre-tax, top taxes, Palma ratio post-tax, and relative impact of top taxes on Palma ratio. The „Relative Difference without Top Tax Changes" denotes by how much percent top tax rate changes between 2007 and 2019 reduced income inequalities (Source: author's calculations based on EUROMOD-Webstatistics)

Country	Relative Palma Pre Change 07-19	Relative Top Tax Change 07-19	Relative Palma Change 07-19	Relative Difference without Top Tax Changes
AT	0.0413	0.0157	-0.0019	-0.0088
BE	-0.0203	0.0537	-0.0393	-0.0365
BG	0.3833	-0.3569	0.5834	0.1206
CY	0.1029	0.1961	0.0676	-0.0364
CZ	-0.0537	-0.0964	-0.0112	0.0389
DE	0.0614	-0.1938	0.1109	0.1149
DK	0.0869	0.2148	-0.034	-0.1283
EE	-0.0557	0.0385	-0.081	-0.0095
EL	-0.1175	0.2407	-0.1504	-0.0798
ES	0.2252	0.1208	0.1824	-0.0383
FI	0.0467	0.0739	-0.0173	-0.0387
FR	0.219	0.0783	0.1756	-0.0302
HU	0.3509	-0.1755	0.6519	0.1017
IE	0.4445	0.29	0.2682	-0.129
IT	0.0877	0.0514	0.0592	-0.0252
LT	0.1266	0.3148	0.0479	-0.1073
LU	0.1059	0.2287	0.0001	-0.0944
LV	-0.0614	0.0054	-0.0964	-0.002
MT	0.1372	0.0301	0.1031	-0.0086
NL	0.0928	0.0051	-0.0196	-0.0031
PL	-0.1588	-0.0647	-0.1417	0.0283
PT	-0.1582	0.1663	-0.2121	-0.0631
RO	0.1417	0.4011	0.0047	-0.1441
SE	0.2581	-0.0869	0.2329	0.0505
SI	0.0538	-0.0351	0.0615	0.0179
SK	-0.2366	0.0672	-0.186	-0.0204
UK	-0.0522	0.0175	-0.0812	-0.0085
Total	0.076	0.0593	0.0547	-0.02

Increases in top tax rates contribute to attenuating increasing pre-tax inequalities by between 0.2% and 14.4%

If top tax rates had remained at 2007 levels, I find that the Palma ratio would have been higher in 20 out of 27 countries. This means that in 20 out of 27 countries, top tax rates contributed to reducing income inequalities between 2007 and 2019. The magnitude of the effect of top tax rates on the evolution of the Palma ratio goes as high as 14.4% in Romania and 12.8% in Denmark. The smallest contribution can be observed in Latvia (0.2%). On average, top tax rates contributed 2% to attenuate increasing inequalities between 2007 and 2019. Looking at some particular examples, in Ireland for example, while pre-tax inequalities increased by 44%,

the disposable Palma ratio rose only by 26%, with a relative contribution of top tax rates of 12.9% in attenuating the increase in inequalities.

Decreases in top tax rates are associated with increases in Palma ratios

In seven out of 20 countries, leaving top tax policies untouched, the Palma ratio would have been higher than the simulated Palma ratio. This means that in these countries, as top tax rates decreased, this resulted in a negative impact of top tax rates on the evolution of the Palma ratio. This is the case for Bulgaria, the Czech Republic, Germany, Hungary, Poland, Sweden, and Slovenia. The magnitude goes as high as a 12% larger increase in Bulgaria and 11.5% in Germany. This means, in these countries, declining top tax rates contributed to amplifying increasing inequalities. Furthermore, as becomes clear from Table 4, except for Poland and the Czech Republic (where pre-tax inequalities decreased), decreases in top tax rates were systematically associated with increases in inequalities.

Looking at Figure 7, one can track how much the underlying pre-tax inequalities moved and how much they contributed to changes in redistribution. For example, the deterioration of inequalities in Slovakia is visibly due to an increase in pre-tax inequalities rather than through changing top tax rates. The same holds for the Netherlands, where first a decrease followed by an increase of pre-tax inequalities explains the movement of the Palma ratio.[17]

To quantify the relative importance for redistribution, I decompose the change in the relative RE over time into the relative change in pre-tax income inequality and the relative change in top tax rates. This also allows to judge on the ways in which governments have used top income taxation (or not) in the past to reduce income inequality.[18] The decomposition is necessary, because the Palma ratio (in disposable income) depends on several factors which act jointly and can therefore have ambiguous or even counter-intuitive effects. For example, if the Palma ratio diminishes, it could be due to a decline in underlying inequalities or an increase in top taxes, or both. Similarly, underlying inequalities could increase, and top taxes as well, so that it becomes necessary to disentangle which change is more decisive. As the decomposition over time is sensitive to starting and end points, I look at the effect over time at different points in time: first, over the whole period from 2007 to 2019, then from 2007 to 2013 and from 2013 to 2019. The first decomposition is done over the whole time period available in the data, i.e., from 2007 to 2019.[19]

Table 6 reads as follows: The first column indicates the percentage change in the RE of taxes between 2007 and 2019. A positive value indicates an increase in the RE. The second column shows the result of the decomposition. It is an estimation of the change in the RE based on the sum of the relative change in top tax rates and the relative change in pre-tax income inequalities. Column 3 indicates how much of the actual change is explained by the model.[20]

[17] Moreover, in both sets of graphs, the impact of the economic and sovereign debt crises can clearly be seen in the cases of Germany, Greece, Spain, France, Hungary, Ireland, Italy, Luxembourg, Portugal, and Slovakia.

[18] As a reminder, the calculation reads as follows:

$\Delta\, RE_{rel} = \Delta toptaxrate_{rel} * palmapre_{2007} + \Delta palmapre_{rel} * toptaxrate_{2007} + residual.$

[19] Croatia is omitted because of missing data.

[20] It expresses the ratio of the result of the decomposition divided by the actual change.

The unexplained part accrues to the residual, consisting of the interaction of the two decomposed effects, as well as other changes, such as, e.g., tax rates at the bottom of the distribution. Columns 4 and 5 show the value of the relative percentage change in top tax rates and pre-tax income inequalities respectively. Columns 6 and 7 show the impact on the model of top tax rate changes and pre-tax income inequality changes, respectively.[21] The detailed tables for the periods 2007-2013 and 2013-2019 can be found in the appendix.

Table 6 Decomposition of change in RE into top tax rate changes and pre-tax inequality changes, 2007-2019 (Source: author's calculations based on EUROMOD-Webstatistics)

Country	Relative Change in Rel. RE 07-19	Model Estimation	Part Explained by Model	Relative Top Tax Change	Relative Palma Pre-Tax Change	Part of Top Tax in Model	Part of Palma Pre-Tax in Model
AT	0.1375	0.0338	0.2459	0.0189	0.0149	0.5605	0.4395
BE	0.0414	0.0603	1.4552	0.0685	-0.0082	1.136	-0.136
BG	-0.654	-0.4931	0.754	-0.5899	0.0968	1.1963	-0.1963
CY	0.2802	0.2326	0.8301	0.2165	0.0161	0.9307	0.0693
CZ	-0.1697	-0.1274	0.7507	-0.1119	-0.0154	0.8788	0.1212
DE	-0.1622	-0.2116	1.3045	-0.2344	0.0229	1.108	-0.108
DK	0.7556	0.284	0.3759	0.2515	0.0325	0.8856	0.1144
EE	0.1772	0.0454	0.2565	0.0565	-0.011	1.2429	-0.2429
EL	0.2097	0.3399	1.621	0.3692	-0.0293	1.0861	-0.0861
ES	0.1718	0.2017	1.1738	0.1474	0.0542	0.7311	0.2689
FI	0.2487	0.1072	0.4309	0.0911	0.0161	0.8502	0.1498
FR	0.1913	0.1434	0.7495	0.0825	0.0609	0.5751	0.4249
HU	-0.9459	-0.044	0.0466	-0.1728	0.1288	3.9239	-2.9239
IE	0.3109	0.5354	1.722	0.3985	0.1368	0.7444	0.2556
IT	0.0988	0.1041	1.0539	0.0752	0.0289	0.7227	0.2773
LT	0.4388	0.5676	1.2936	0.5354	0.0322	0.9433	0.0567
LU	0.3907	0.2585	0.6617	0.2276	0.0309	0.8804	0.1196
LV	0.2303	-0.0057	-0.0245	0.0111	-0.0168	-1.9686	2.9686
MT	0.1765	0.0677	0.3836	0.0372	0.0305	0.5497	0.4503
NL	0.4341	0.0416	0.0959	0.0066	0.035	0.1591	0.8409
PL	-0.1716	-0.1298	0.7564	-0.0814	-0.0483	0.6275	0.3725
PT	0.2484	0.2698	1.086	0.3133	-0.0435	1.1613	-0.1613
RO	1.0438	0.6489	0.6217	0.6114	0.0375	0.9423	0.0577
SE	0.1028	0.0091	0.0881	-0.0859	0.0949	-9.481	10.481
SI	-0.028	-0.0197	0.7042	-0.0379	0.0182	1.9246	-0.9246
SK	-0.372	0.0158	-0.0424	0.0708	-0.055	4.4902	-3.4902
UK	0.111	0.0124	0.1116	0.0294	-0.017	2.3746	-1.3746
Total	0.1221	0.1092	0.6854	0.0854	0.0238	0.7102	0.2898

The direction of top tax changes determines the direction of changes in redistribution

I find that in 84% of cases across the three decompositions,[22] the direction of the relative change in top income taxation determines the direction of changes in redistribution. This holds in only 38% of cases for the direction of the change in pre-tax income inequalities.

[21] It expresses the weight of each factor in the overall estimation, by dividing each individual factor by the overall estimation.

[22] Cases refer to the results for each country of the three different decompositions, i.e., 82 instances composed of 2x27 countries (2007-2019, 2007-2013) and 1x28 countries (2013-2019).

According to Table 5, countries can be clustered according to different parameters: the direction and magnitude of each variable, the precision of the model, as well as the overall redistributive effect achieved through a combination of both.
Hence, first, it should be noted in which countries redistribution increased, and in which it decreased:

- Countries where redistribution increased: AT, BE, CY, DK, EE, EL, ES, FI, FR, IE, IT, LT, LU, LV, MT, NL, PT, RO, SE, UK
- Countries where redistribution decreased: BG, CZ, DE, HU, PL, SI, SK.

Next, I cluster countries in matrices according to the direction of changes in both effects. To account for the degree to which the decomposition explains the overall change, the following three matrices differ in the degree of precision the model (>50%, >25%, and no restriction at all). Countries with increasing RE as determined above are marked with an asterisk.

With > 50%	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	CY*, ES*, FR*, IT*, LT*, RO*	BG, DE, SI
Decrease in pre-tax inequality	BE*, LU*, PT*	CZ, PL

With > 25 %	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	CY*, DK*, ES*, FI*, FR*, IE*, IT*, LT*, MT*, RO*	BG, DE, SI
Decrease in pre-tax inequality	BE*, EE*, EL*, LU*, PT*	CZ, PL

Independent of precision	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	AT*, CY*, DK*, ES*, FI*, FR*, IE*, IT*, LT*, MT*, NL*, RO*	BG, DE, HU, SE*, SI
Decrease in pre-tax inequality	BE,* EE*, EL*, LU*, LV*, PT*, SK	CZ, PL

Several observations can be made to interpret these results. First, all countries which saw their redistributive capacity increase, also saw their top tax rate increase (except Slovakia). Equivalently, all countries which saw their redistributive capacity decrease, also saw their top tax rate decrease (except Sweden). This points to the fact that changes in top tax rates are determinant for changes in redistribution. Additional evidence stems from the fact that among

the countries in which pre-tax inequalities increased, a majority still saw an increase in redistribution. Importantly, in all countries which saw their inequalities *and* their top income tax rates rise, the RE increased, such that tax policy outweighed the increase in underlying inequalities.
Third, among the countries in which inequalities decreased, a majority saw their redistribution increase, *but only if top tax rates increased at the same time*. For example, in Poland, while inequalities decrease, redistribution decreased too, which is due to decreases in top tax rates which explain approximately 50% of changes in redistribution. Fourth, in countries where both inequalities and top tax rates decreased, the decrease in top tax rates outweighed the former effect and led to a net decrease in redistribution, adding to the observation that the sign of top tax rate changes determines the change of redistribution.
Moreover, based on Table 5, in all countries except Latvia, the Netherlands and Sweden, changes in top tax rates were more important than changes in pre-tax income inequalities in determining the result of the estimation (regardless of the direction of the change). This means that in 24 out of 27 countries, top tax rate changes explain more of the change in RE. Hence, redistributive *trends* (not the comparative *level* of redistribution) are well explained by changes in top tax rates, and the letter were overall more determining of redistribution than changes in pre-tax income inequalities. Thus, for the time period from 2007-2019 the direction of top income tax changes coincides in 93% of all countries. The direction of income inequality changes coincided in only 38% of the cases.
Nonetheless, the overall heterogeneity in the percentage the decomposition can explain points to the fact that an important part of the change in redistribution is due to something else, e.g., taxation at the bottom of the income distribution, which would be in line with the findings by Avram, Levy & Sutherland (2014), for instance.

The precision by which top tax rate changes determine changes in redistribution has decreased over time

Repeating the decomposition based on two separate time periods from 2007 to 2013, and from 2013 to 2019, allows to add robustness to my analysis, and to investigate potentially different trends in the relative importance of both factors. In fact, the comparison reveals that the precision by which top tax rate changes determine changes in redistribution has decreased over time. Furthermore, over time, top tax rate changes decreased in importance for more countries. The choice of the cut-off point in the year 2013 does not only separate the sample in two parts of equal size, but it also allows to capture the effect of the financial and economic crisis (2007-2008) and the sovereign debt crisis (2009-2012), and to see how, compared to this, inequalities and tax policy evolved in their aftermath.

For the time period 2007-2013, the overall change in the RE led to:

- Increase in redistribution: AT, BE, EE, DK, ES, FI, FR, IE, IT, LU, LV, MT, PT, RO, SE, SI, UK
- Decrease in redistribution: BG, CY, CZ, DE, EL, HU, LT, NL, PL, SK.

With > 50%	Increase in top income taxes	Decrease in top income taxes
Increase in pre-tax inequality	AT*, IT*, MT*	
Decrease in pre-tax inequality	BE*, LU*, PT*	BG, CZ, DE, NL

With > 25 %	Increase in top income taxes	Decrease in top income taxes
Increase in pre-tax inequality	AT*, IT*, MT*	
Decrease in pre-tax inequality	BE*, LU*, PT*	BG, CZ, DE, NL, PL

Independent of precision	Increase in top income taxes	Decrease in top income taxes
Increase in pre-tax inequality	AT*, DK*, EE*, ES*, FR*, IE*, IT*, MT*, SK, UK*	CY, HU, LT, SE, SI
Decrease in pre-tax inequality	BE*, EL, LU*, LV*, PT*	BG, CZ, DE, FI*, NL, PL, RO*

As for the whole time period, all countries that saw their top tax rates increase also saw their RE increase (except Slovakia and Greece).[23] For example, in Ireland, increasing tax rates can explain about 30% of the change in RE; in Denmark about 60%.[24]
Equivalently, all countries which saw their top tax rates decrease, also saw their RE decrease (except Finland and Romania). For example, in Germany, decreasing tax rates can explain as much as 69% of the decrease in redistribution. For those countries not following the pattern, the model explains only very little of the change over time.
Moreover, among the countries in which pre-tax inequalities rose, a majority still saw an *increase* in redistribution. Importantly, in all countries where inequalities and their top income tax rates rose, the RE increased, such that tax policy decisions outweighed the rise in underlying inequalities (except Slovakia). Third, among the countries in which inequalities decreased, a majority saw their redistribution increase, *but only if they increased taxes at the same time*.
For this time period, then, the direction of changes in top tax rates coincides in 85% of the countries. The direction of income inequality changes coincided in only 44% of the cases.

Turning now to the second time period from 2013 to 2019, the overall pattern is drawn as follows:

- Increase in redistribution: AT, BG, CY, CZ, DK, EE, EL, FI, FR, IE, LT, LU, NL, PL, RO, UK

[23] For both Slovakia and Greece, the change in redistribution cannot be explained by the decomposition, as changes in both pre-tax inequalities and top taxes underestimate the overall change.
[24] This percentage is caluclated by multiplying the model precision by the relative part of top taxes.

- Decrease in redistribution: BE, DE, ES, HR, HU, IT, LV, MT, PT, SE, SI, SK.

Thus, more countries have seen the RE of their tax system decrease. At the same time, the overall precision of the decomposition is greater than in the two other cases. This means that the interplay of income distribution and top tax rates yields better estimates of the overall change. For more countries than in the previous period, the most important change did *not* happen in top income tax rates, but in pre-tax income inequality, namely in Bulgaria, Hungary, Ireland, the Netherlands, Slovenia, and Slovakia. Among those, the direction of that change was towards rising pre-tax income inequality in all countries except Slovakia. Nonetheless, despite this increase in pre-tax income inequality, only in Hungary and Slovenia, redistribution decreased accordingly, suggesting that in the other countries, tax policy was able to counteract the effect, like in the previous period. Hence, the direction of top tax changes and the direction of RE changes coincided by only 74%. The changes in income inequality coincided only in 32% of countries with the direction in changes in redistribution.

With > 50%	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	DK*, FI*, RO*, UK*	DE, HR, MT
Decrease in pre-tax inequality	CY*	LU*, PT

With > 25 %	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	BG*, DK*, FI*, RO*, UK*	DE, HR, IT, MT
Decrease in pre-tax inequality	CY*, EL*	LU*, PT, SK

Independent of precision	**Increase in top income taxes**	**Decrease in top income taxes**
Increase in pre-tax inequality	BE, BG*, DK*, FI*, IE*, LT*, NL*, PL*, RO*, SI, UK*	AT*, DE, HR, MT, IT, HU
Decrease in pre-tax inequality	CY*, CZ, EL*, ES, SE	EE*, FR*, LV, PT, SK

Combining the facts that changes in pre-tax income inequality in the second period were both larger and the model more significant, and that redistribution decreased in more countries, this shows that top tax policy in the period from 2013 to 2019 contributed much less to overall redistributive trends. Furthermore, comparing the patterns between the two smaller time periods, one can note that most of the countries changed patterns, i.e., they did not remain in the same quadrant of the matrix in the two periods. Only Denmark, Ireland and Greece did so. Spain, Belgium, Hungary and Germany remained in the same dimension in terms of top tax

rates (stable increase or decrease). Austria, Italy, Latvia, and Portugal remained in the same dimension in terms of pre-tax inequalities. This means that half of the countries in the data set changed the pattern entirely (along both dimensions).
Overall, then, the relative importance of top tax rates in determining trends in redistribution, while remaining predominant, has decreased in the more recent period, when pre-tax inequalities increased more strongly.

Hence, summarizing the above results on the historic relative importance of top tax rates, the following points are to be retained. The analysis has underlined the heterogeneity of European tax systems, in structures, levels and trends in taxation and its influence on disposable income inequality, in line with the findings by Verbist & Figari (2014). Moreover, both pre-tax and disposable income inequalities as measured by the Palma ratio have increased in two thirds of the countries in the sample. Top tax rates, however, contributed to attenuating increases by between 0.2% and 14.4%. Furthermore, redistributive trends over time tend to depend more on top tax rates than on pre-tax income inequalities; but for a lot of countries, changes not relating to either factor seem to have a dominant role. This partially confirms hypothesis 1, namely that top income tax rate changes can predict changes in redistribution. Finally, comparing the relative effects between 2007 and 2019, the determining role of top tax rates has decreased, while pre-tax income inequalities have continued to increase.

6.3. Income inequality in Europe under a simulated reform increasing top 10 income tax rates by one percentage point

After having investigated the impact of top income taxation over the period from 2007 to 2019, this section looks at the question of the relative importance of top income taxation from a theoretical, or hypothetical perspective - how much would it matter? To this end, I simulate a minor increase in top income taxation of the order of one percentage point. I analyze and quantify the effect this would have on changes on the income inequality indicators in question. The first subsection establishes the sensitivity to that change. Subsections 2 and 3 interpret the effect and its heterogeneity across European income tax systems across time and space, and in terms of a flat tax increase having the equivalent effect on income inequality. Subsection 4 considers the impact on government revenue.

6.3.1. Quantifying the effect of a one percentage point increase of top tax rates

To analyze how much small deviations from current top tax rates matter for income inequality and redistribution, I simulate an increase of one percentage point in top 10 tax rates.[25]
I then re-calculate the Palma ratio and the top 10 post-tax income share based on the disposable income that results from the addition of 0.01 to the actual tax rate.[26]

The choice of an exogeneous increase of one percentage point for all countries can be criticized since the relative effect of such an increase depends on a country's underlying top tax rate and income distribution. However, the choice of this exogenous increase independently from a country's characteristics allows to clearly expose differences across the 28 European income tax systems in question. Furthermore, based on the presented findings for a one percentage point increase, more differentiated and targeted policy options can easily be inferred.

A one percentage point increase of top tax rates over the whole 2018-2019 EUROMOD-JRC data set would move the average from a top 10 tax rate of 31.86% to 32.86%. The relative increase induced by a one percentage point increase for each country depends on the top income tax rate prior to the 'reform' and goes from 2.2% (Denmark) to 5.7% (Bulgaria). The relative increase is highest in countries with low top tax rates (R2=0.9).
While an exogeneous increase of one percentage point may look unrealistically large at first sight, in fact, in 10% of the country-years studied in the previous section, the top tax increase from one year to another was above one percentage point. The highest abrupt increase happened in Lithuania in 2019 with 12.82 percentage points. With changes of that order of magnitude therefore being a realistic political possibility, the relevance of quantifying the effect of such an increase goes beyond academic interest and stretches to eventualities of actual policy making.

[25] $top\ tax\ rate_{simulated} = top\ tax\ rate_{decile=10} + 0.01$.
[26] $Palma\ ratio_{simulated} = top\ 10\ income\ share_{simulated} \div bottom\ 40\ income\ share$.

Table 7 (below) displays measures of changes induced by such an increase across the 2018-2019 average. Column 1 (5) displays the mean actual Palma ratio (the actual top 10 income share) and column 2 (6) the Palma ratio (top 10 income share) resulting from the top tax rate increase. Column 3 (7) shows the absolute change in points of the Palma ratio (top 10 income share)[27] and column 4 (8) measures the percentage change in Palma ratios (top 10 income share) pre and post increase.[28]

Table 7 Effects on redistribution of a 1 percentage point increase in top tax rates (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface)

Country	Palma	Palma Simulated	Absolute Change Palma	Relative Change Palma	Top Share	Top Share Simulated	Absolute Change Top Share	Relative Change Top Share
AT	0.9475	0.9324	-0.0152	-0.016	0.2163	0.2135	-0.0027	-0.0126
BE	0.8375	0.823	-0.0145	-0.0173	0.1912	0.1885	-0.0027	-0.0141
BG	2.0912	2.0659	-0.0254	-0.0121	0.3107	0.3081	-0.0026	-0.0084
CY	1.1609	1.1468	-0.0141	-0.0122	0.2377	0.2355	-0.0022	-0.0093
CZ	0.9271	0.9146	-0.0125	-0.0135	0.2065	0.2043	-0.0022	-0.0107
DE	1.0092	0.9932	-0.016	-0.0159	0.2192	0.2164	-0.0027	-0.0124
DK	0.9313	0.9145	-0.0168	-0.0181	0.211	0.208	-0.003	-0.0143
EE	1.1322	1.117	-0.0152	-0.0135	0.2242	0.2218	-0.0023	-0.0105
EL	1.0987	1.0832	-0.0155	-0.0141	0.2377	0.2352	-0.0026	-0.0108
ES	1.2183	1.2016	-0.0166	-0.0136	0.2307	0.2283	-0.0024	-0.0105
FI	0.9364	0.9216	-0.0147	-0.0157	0.214	0.2113	-0.0027	-0.0124
FR	1.0445	1.0295	-0.015	-0.0144	0.2343	0.2317	-0.0026	-0.0111
HR	1.1424	1.1261	-0.0164	-0.0143	0.2175	0.2151	-0.0024	-0.0112
HU	1.1464	1.1286	-0.0178	-0.0155	0.2278	0.2251	-0.0027	-0.012
IE	1.1538	1.1348	-0.019	-0.0165	0.2242	0.2213	-0.0029	-0.0128
IT	1.1602	1.143	-0.0172	-0.0148	0.2395	0.2368	-0.0027	-0.0113
LT	1.5032	1.4808	-0.0224	-0.0149	0.2659	0.263	-0.0029	-0.011
LU	0.806	0.7936	-0.0125	-0.0155	0.2	0.1976	-0.0025	-0.0124
LV	1.5205	1.4996	-0.0209	-0.0137	0.2478	0.2452	-0.0026	-0.0104
MT	1.1691	1.154	-0.0151	-0.0129	0.2306	0.2283	-0.0023	-0.01
NL	0.9778	0.9617	-0.0161	-0.0165	0.2173	0.2145	-0.0028	-0.0129
PL	1.0006	0.9866	-0.014	-0.014	0.2159	0.2135	-0.0024	-0.011
PT	1.2647	1.2462	-0.0185	-0.0146	0.2469	0.2442	-0.0027	-0.011
RO	1.2915	1.2685	-0.023	-0.0179	0.2331	0.2298	-0.0032	-0.0138
SE	1.0595	1.0435	-0.016	-0.0151	0.2243	0.2217	-0.0026	-0.0117
SI	0.8784	0.8653	-0.0131	-0.0149	0.199	0.1966	-0.0024	-0.012
SK	0.8129	0.802	-0.011	-0.0135	0.189	0.1869	-0.0021	-0.011
UK	1.1982	1.1807	-0.0176	-0.0147	0.2394	0.2367	-0.0027	-0.0112
Total	1.1222	1.1057	-0.0165	-0.0148	0.2268	0.2242	-0.0026	-0.0115

[27] The absolute change in Palma ratio (in top income shares) is calculated as follows:
$palma\ absolute\ change = palma_{top\ tax\ increase} - palma_{org}$.

[28] The relative percentage change is determined as follows:
$palma\ relative\ change = (palma_{top\ tax\ increase} - palma_{org})/palma_{org})$.

Minor changes in top tax rates can reverse redistributive trends and achieve a multiple of inequality reduction over 12 years

Analyzing the sensitivity of the Palma ratio and top income shares to a one percentage point increase in top tax rates, I find that this minor change is always equality-enhancing. In 15 out of 27 countries, its order of magnitude outperforms the reduction of inequality reached over 12 years, and in half of all countries, it can even reverse decreasing trends in redistribution. Thus, it can countries on a path towards more redistribution through such a change.

The mean difference in absolute points of Palma ratio amounts to -0.0164. This means that on average, the Palma ratio decreases by 0.0164 points, resulting in an average Palma ratio of 1.106 instead of 1.122. The effect ranges from -0.0254 (Bulgaria) to -0.0109 (Slovakia). Thereby, the average absolute impact goes into the opposite direction as the average RE in Palma ratios over time (which is stable, or slightly increasing with 0.004). Thus, the effect reached by the hypothetical reform is also 4.5 times larger in magnitude than the total average change over the 12 year-period investigated above. The largest decrease in Palma ratio in absolute terms is achieved in Bulgaria, Romania, Lithuania, Latvia, and Ireland. Furthermore, even the smallest absolute change observed in the simulation (Slovakia) is stronger in inequality reduction than more than 50% of all total changes in the RE observed in the sample from 2007 to 2019. The average decrease is approximately similar to the Palma ratio reduction that Finland achieved over the whole time period from 2007 to 2019; i.e., over 12 years. Finally, one can compare the decrease in Palma ratios achieved in the simulation to each country's individual evolution of the Palma ratio over the whole period in question. The effect goes as high as 8 times the change of the Palma ratio over the whole period (Austria), and as low as 0.05 times the change (Portugal), next to reversing the sign in the 14 countries in which inequalities were increasing between 2007 and 2019.

The mean relative percentage change is -1.48%. This means that compared to the actual Palma ratio before the simulated reform, the top increase of one percentage point decreases the Palma ratio by more than one percent in all countries. The largest percentage change is achieved by Denmark, Belgium Romania, Ireland, and the Netherlands.

The absolute change in top income share points is -0.0026 such that the average share decreases from 22.68% to 22.42%. The impact on top income shares ranges from -.0032 (Romania) to -.0021 (Slovakia). The largest absolute decrease is obtained in Romania, Ireland, Denmark, Lithuania and the Netherlands. The average absolute change over the years being 0.0002, the decrease achieved by a one percentage point increase (-0.0026) goes in the opposite direction and is 12 times larger in magnitude. Nonetheless, it remains small in absolute terms. The reality underlying this fact is again the relative stability of the top 10 income share over time, as shown before. Hence, like for the Palma ratio, even the smallest change in top disposable income shares is larger than 50% of all total changes over the whole period observed. Again, this is comparable to the total change in post-tax top income shares achieved by Finland over 12 years. Moreover, comparing it to each country's own evolution over the whole period in question, the effect reaches from 2.6 times the change in top income shares over the whole period (Denmark) and -3.32 times the change in Cyprus (reversing trends).

The relative percentage change is of -1.15%, i.e., the one percentage point increases the disposable income share by the top 10 by slightly more than 1% and the largest percentage change is reached in Denmark, Belgium, Romania, the Netherlands, and Ireland.
In absolute terms, in the country with the largest percentage change (Denmark), this amounts to an annual decrease in disposable of DKK 13,887, approximately EUR 1,867 by current exchange rates, i.e., approximately EUR 156 per month. In the country with the smallest percentage change (Bulgaria), it amounts to EUR 701, i.e., less than EUR 100 per month.

Absolute changes are largest in more unequal countries, while relative changes are largest in more equal countries

The above findings allow to discern two facts on which countries would benefit most from this 'reform' in terms of inequality reduction.

(1) First, the absolute change in Palma ratio is greatest in countries with high Palma ratios and low levels of redistribution.
(2) Second, the relative change and the greatest sensitivity to an increase in top tax rates is observed in countries which have already high levels of redistribution and high top tax rates, due to scale effects.

This underlines that changes in top income taxation matter for countries with both high and low income inequality, but for different reasons. The fact that the *absolute* decrease is largest for countries starting from high Palma ratios is arithmetically due to the fact that it is driven by income inequalities and a one percentage point increase will have a larger impact on a larger Palma ratio than on a smaller one. The larger *relative* impact on more redistributive is due to the fact that it is more sensitive to the top tax level.

These two relationships are shown in Figure 10 (below). The upper left corner plots the difference in Palma ratios achieved by the 'reform' against the level of Palma ratios. It shows that the higher the Palma ratio, the greater the absolute decrease achieved by the simulated reform (R2= 0.79). This holds true with measuring disposable income inequalities by the post-tax Gini coefficient (R2=0.68), too. The relationship is even more pronounced when regarding pre-tax income inequalities, as measured by the Palma ratio pre-tax (R2= 0.81) at the bottom left corner.
Equivalently, the middle left-hand corner exposes a clear negative relationship between decreasing redistribution levels and decreasing changes to the Palma ratio achieved by a one percentage point increase at the top. It shows that the lower the redistribution levels prior to the simulated reform, the lower the percentage decrease in Palma ratios achieved by that "reform" (R2= 0.44). This relation remains valid when employing the Reynolds-Smolensky index to measure the RE (R2= 0.53). As said above, this is due to the sensitivity to top income taxes prior to the increase (R2= 0.98).
For top income shares, as can be seen in the top right corner, the relation between the absolute change in points of top income shares and the underlying value of top income shares is quasi absent (R2= 0.06). The relationship is slightly stronger when considering pre-tax top income shares (R2= 0.24), bottom right corner. The discrepancy with the findings for the Palma ratio is due to the fact that higher Palma ratios are driven by both high top income and low bottom income shares. Through the latter, differences are accentuated, and they are smaller in

magnitude for top income shares. However, when taking out the 'bias' pertaining to the ratio vs. share discrepancy, i.e., looking at relative changes, the same conclusion as for the Palma ratio can be drawn. This means that the relative change achieved by the simulated reform depends on the underlying redistributive capacity of tax policy (middle right panel of Figure 10, R2= 0.51). Again, this is also true using the Reynolds-Smolensky index (R2= 0.54).
Hence, since the differences in top income shares are less pronounced across countries, for the magnitude of the reduction of income inequality as measured by the top 10 income share exclusively, the tax level is more determining than the pre-reform level of top income shares. That is, policy matters more for the effect of the simulated reform than the pre-tax distribution of income.

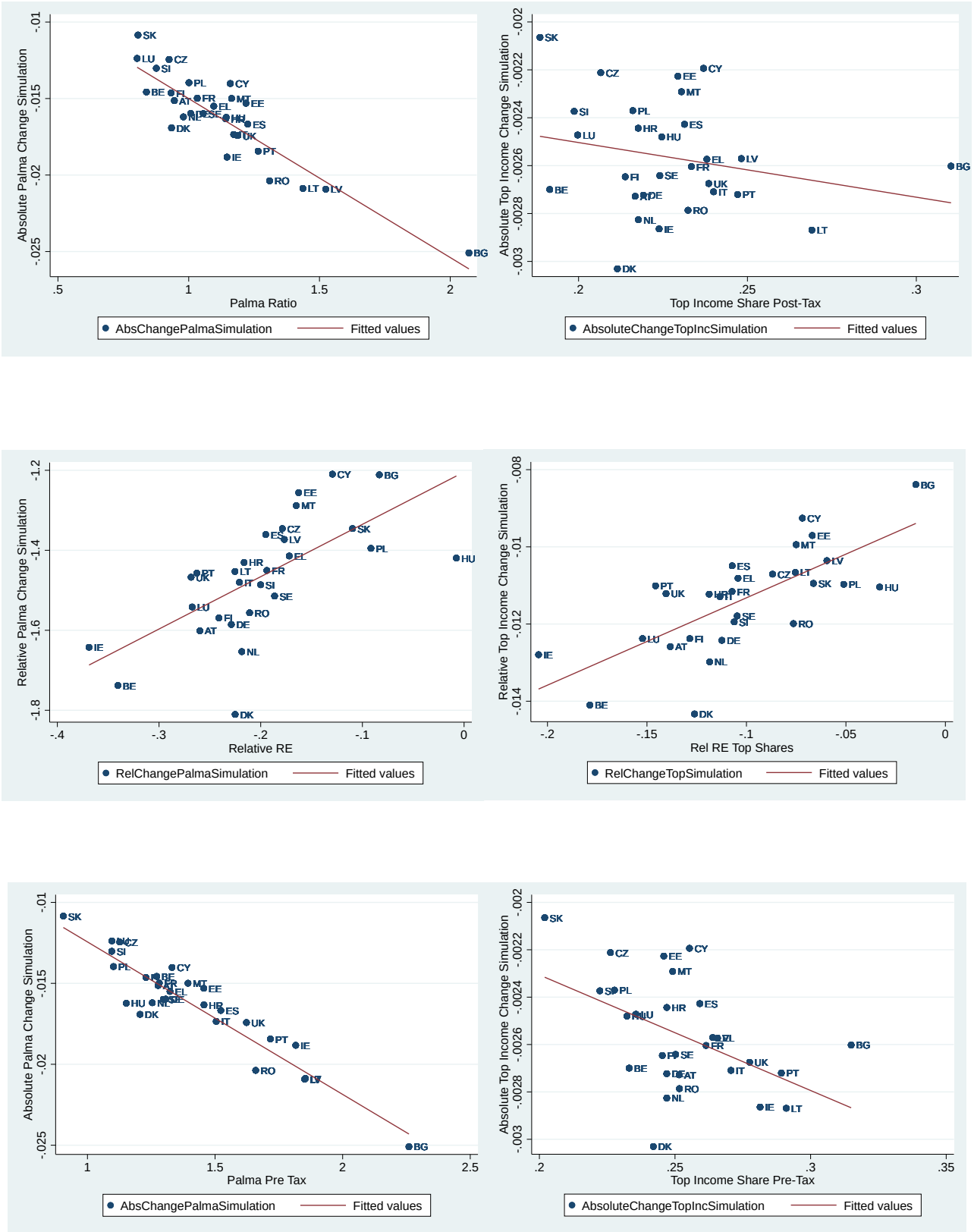

Figure 8 Relation of changes in RE with post-tax inequalities (first row), relative RE (second row), pre-tax inequalities (third row); measured in Palma ratio (left side) and top income shares (right side), all figures for 2008 (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface).

6.3.2. Impact of the simulated increase in top income tax rates through time and space

Having presented some elements to interpret the magnitude of the change induced by a one percentage point increase in the top 10 tax rate, this section compares it to a country's position compared to the other countries in the sample and to its own trajectory through time. I find that while a small increase in top tax rates does not allow a country to fundamentally change its relative position in inequality, it can however mitigate deteriorating inequalities by up to 76% compared to its own trajectory.

Minor changes in top tax rates do not change a country's international comparative position

First, Figure 11 (below) presents how the increase in top tax rates would alter the average position of one country as compared to the others in the sample.[29] The graph shows that the overall positioning of countries does not change, and thus that the underlying inequalities, both pre- and post-tax determine a country's position. This means that minor changes in tax progressivity at the top do not allow for countries to fundamentally change their position as compared to other countries. This also holds for the average across the 2007-2019 sample, as presented on the left-hand side of Figure 11.

Regarding post-tax top income shares, the pattern is similar, as exposed in Figure 12. The position of a country as compared to the others would not change fundamentally.

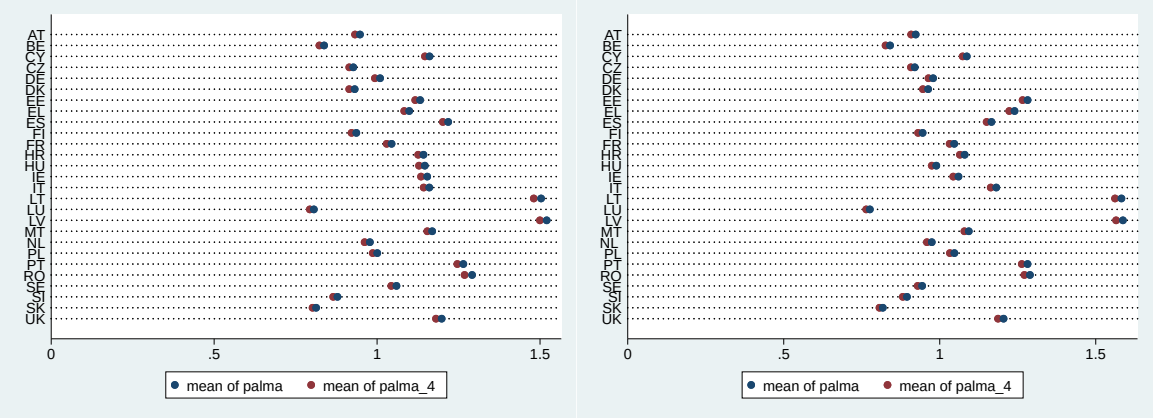

Figure 9 Palma ratio and Palma ratio with one percentage point increase in top tax rates; mean for 2007-2019 (left side), 2018-2019 (right side) (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface). "Mean of palma" refers to the mean of the Palma ratio, "Mean of palma_4" refers to the mean of the Palma ratio after the simulation.

[29] Due to its high Palma ratio, Bulgaria is excluded from the graph for better visualization.

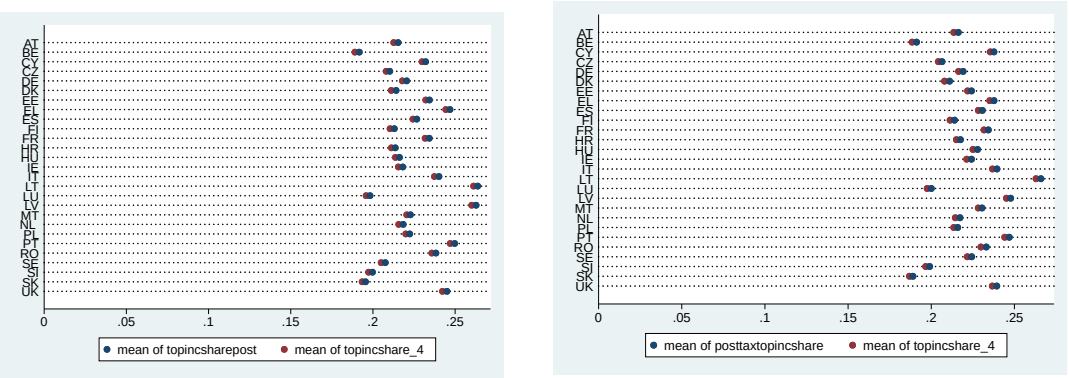

Figure 10 Top income share, and top income share with one percentage point increase in top tax rates; mean for 2007-2019 (left side), 2018-2019 (right side) (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface/ EUROMOD-Webstatistics). "Mean of topincsharepost"/"mean of posttaxtopincshare" denotes the mean of the post-tax top income share, "mean of topincshare_4" denotes the mean of the top income share after the simulation.

Minor changes in top tax rates can attenuate inequality shocks by between 3.2% and 76%

Second, I look at a country's positioning following changes in top tax rates compared to its own trajectory over time. I find that increasing only top tax rates can be a relevant policy tool when inequalities are on the rise.

The average change induced by the hypothetical top tax rate compares to the individual average annual change (i.e., the change in Palma ratios from one year to the next). In all countries except for Portugal and Slovakia, the mean change induced by the top tax rate increase is higher than the average annual change. In Greece and Poland, the change is very similar to the mean annual change.[30]

Moreover, comparing this hypothetical change to the change countries have gone through over the entire time period from 2007 to 2019, as said above, in 16 countries the inequality reduction achieved through the hypothetical reform is larger than the inequality reduction over 12 years. Only in 10 countries was the inequality reduction over time larger than the one of a hypothetical reform. These countries are Belgium, Denmark, Greece, Estonia, Finland, Latvia, the Netherlands, Portugal, Slovakia and the UK.

Looking at the detailed changes over the 2007-2013, 2013-2019 and 2007-2019 periods, it becomes clear that increasing top tax rates by only top one percentage point can attenuate trends in redistribution by up to 76%. Table 7 shows the differences in Palma ratios over 2007-2019 (column 1), the absolute change induced by the 'reform' (column 2), and the absolute change both taken together would achieve (column 3).[31] Positive values signify an amplication of an already decreasing trend in income inequalities. Negative values under one show by how much increasing inequality is attenuated. Negative values above one signify a reversal of trends (e.g., from rising inequalities to decreasing). Very high values, like the one for Luxembourg stem from very small overall changes.

For the overall time period 2007-2019, in Romania and Luxembourg, the reform would reverse deteriorating or stagnating income inequalities. A one percent top tax increase could

[30] Table can be found in the appendix.

[31] Tables for other time periods can be found in the appendix.

furthermore attenuate increasing inequalities by between 3.2% (Bulgaria) and up to 32.8% (Lithuania). For the period 2007-2013, one can see that this can substantially decrease the widening of income inequality. In Austria and Germany, the Czech Republic, and Italy, this increase would revert the trend of increasing Palma ratios. It could attenuate the increase in inequalities by between 6% (Sweden) and 48% (Slovenia). For the period 2013-2019, with inequalities increasing even stronger, a reversion would only be possible in Belgium. Nonetheless, such an increase of one percentage point at the top can attenuate the increase by between 3.4% (Bulgaria) and 76% (Denmark).[32]

Table 8 Income inequality evolution 2007-2019 and possible relative decrease from a one percentage point increase at the top (Source: author's calculations based on EUROMOD-Webstatistics)

Country	Absolute Palma Change 07-19	Absolute Change Simulation	Absolute Change + Simulation	Relative Change from Simulation
AT	-0.0018	-0.0145	-0.0163	8.1694
BE	-0.0341	-0.0145	-0.0486	0.4263
BG	0.7896	-0.0256	0.764	-0.0324
CY	0.0669	-0.013	0.0539	-0.1944
CZ	-0.0102	-0.0123	-0.0225	1.1961
DE	0.1042	-0.0149	0.0893	-0.1431
DK	-0.0347	-0.0181	-0.0528	0.5201
EE	-0.1031	-0.0147	-0.1179	0.1428
EL	-0.1959	-0.016	-0.2119	0.0818
ES	0.185	-0.0164	0.1685	-0.0888
FI	-0.0172	-0.0154	-0.0326	0.899
FR	0.1558	-0.0149	0.1409	-0.0957
HR	.	-0.0155	.	.
HU	0.5197	-0.0189	0.5008	-0.0363
IE	0.2647	-0.0208	0.2439	-0.0784
IT	0.0685	-0.0187	0.0497	-0.2738
LT	0.0703	-0.0231	0.0472	-0.3284
LU	0.0001	-0.0125	-0.0124	-110.356
LV	-0.1703	-0.022	-0.1924	0.1293
MT	0.1089	-0.0151	0.0938	-0.1387
NL	-0.0204	-0.0164	-0.0369	0.8054
PL	-0.1594	-0.0135	-0.1729	0.0847
PT	-0.3177	-0.0174	-0.3351	0.0547
RO	0.0065	-0.0218	-0.0153	-3.3694
SE	0.1926	-0.0153	0.1772	-0.0797
SI	0.0528	-0.0135	0.0393	-0.2563
SK	-0.1662	-0.0097	-0.1758	0.0582
UK	-0.1072	-0.0181	-0.1253	0.1693
Total	0.0462	-0.0165	0.0296	-3.805

Thus, while a minor increase of top tax rates would not fundamentally alter a country's position of income inequality in international comparison, it would however outperform its historic inequality reduction in the majority of European countries. It can also attenuate increases in inequalities between 3.2% and 76%. Said differently, for example, while a one percentage point

[32] Tables for top income shares can be found in the appendix.

increase at the top will not allow Italy to reach an equal level of income inequality as Sweden, it would allow Italy to attenuate more than a quarter of increases in inequalities between 2007 and 2019.

6.3.3. Flat tax increase equivalences

Another way to look at the impact of a one percentage point increase at the top on the entire disposable income distribution is to compare it to other possible 'reforms.' For instance, a flat tax increase across the entire income distribution may politically be conceived as fairer. The intuition behind this comparison is that a flat tax increase can still be improving inequalities arithmetically. Consider the following very simplified example: the top 10 earn 100 and face a tax rate of 0.3; the bottom 40% earn 80 and face a tax rate of 0.15. Their disposable incomes are 70 and 68 respectively, resulting in a Palma ratio of 1.029. Now, increasing the tax rate by one percentage point for everyone, the disposable income become 69 and 67.2 respectively, resulting in a Palma ratio of 1.027 which is slightly lower. Hence, the flat increase was equality-enhancing. Thus, the question to be asked here is of which order of magnitude a flat tax rate increase across the whole income distribution would need to be in order to achieve the same level of inequality reduction as achieved by the increase only at the top, and how this differs across countries. Thereby, variations across the different countries are also a sign of the heterogeneity across the EU.[33]

An inequality-equivalent flat tax increase would require major disruptions in European tax systems

The mean increase that would be necessary, based on the 2018-2019 sample, is 7.8 percentage points. The highest increase would need to be made in Poland (10.7 percentage points), and the lowest in Belgium with 2.9 percentage points. For the 2007-2019 sample, the average increase is 5.7 percentage points, and the highest increase would be necessary in Poland and Bulgaria with more than 14 percentage points. The lowest increase would have to be made in Ireland with 2.9 percentage points. Thus, such a reform would be of a much larger order of magnitude than the one percentage point increase at the top and therefore represent a major disruption of tax systems.

Comparing this to how tax levels have actually evolved over the 2007-2019 period, I draw a comparison with the difference in median tax rates. In fact, the flat tax rate increase reaching a similar inequality reduction is much larger than the change of median tax rates over time. Only in two countries (Ireland and Lithuania) would the inequality-equivalent flat increase be smaller than the overall change over 12 years, which is due to the progressive tax reforms having taken place in those two countries. However, in most countries, an inequality-equivalent flat tax increase would require a multiple of the actual annual changes. For visualization,

[33] To calculate the inequality-equivalent tax rate, I first calculate the ratio of the change of Palma ratios induced by a one percentage point increase at the top as compared to a one percentage point change along the whole income distribution. Then, the new tax rate with the equivalent effect is the sum of the actual tax rate plus the equivalence parameter calculated before, divided by 100:
$taxrate_{equivalent} = 0.01 \times \frac{relative\ Palma\ change\ 1\%\ increase\ top}{relative\ Palma\ change\ 1\%\ increase\ all} + taxrate_{org}$.

Figures 13 and 14 show what such an increase would mean graphically, comparing the real tax rate to both the flat increase and the increase only at the top one for the year 2008 and one for 2019. Because of the sheer order of magnitude of the increase that would be necessary to achieve the same level of income inequality reduction, the political feasibility of such an increase is questionable.

Table 9 Flat tax increases in percentage points, 2018-19 and 2007-19 averages(Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface/based on EUROMOD-Webstatistics)

Country	Flat Tax Increase 2007-2019	Flat Tax Increase 2018-2019
AT	0.0397	0.0372
BE	0.0299	0.029
BG	0.1475	0.116
CY	0.0809	0.0787
CZ	0.0561	0.0556
DE	0.0466	0.0431
DK	0.0515	0.044
EE	0.0728	0.0504
EL	0.0737	0.0588
ES	0.053	0.0508
FI	0.0449	0.041
FR	0.0627	0.0514
HR	0.0479	0.0454
HU	-0.0945	0.7683
IE	0.0295	0.0268
IT	0.0451	0.0445
LT	0.0716	0.045
LU	0.041	0.0369
LV	0.0591	0.0556
MT	0.0628	0.0597
NL	0.0479	0.0453
PL	0.142	0.1069
PT	0.0403	0.0376
RO	0.1049	0.039
SE	0.057	0.0536
SI	0.0479	0.0492
SK	0.0854	0.0876
UK	0.0435	0.0369
Total	0.0569	0.0784

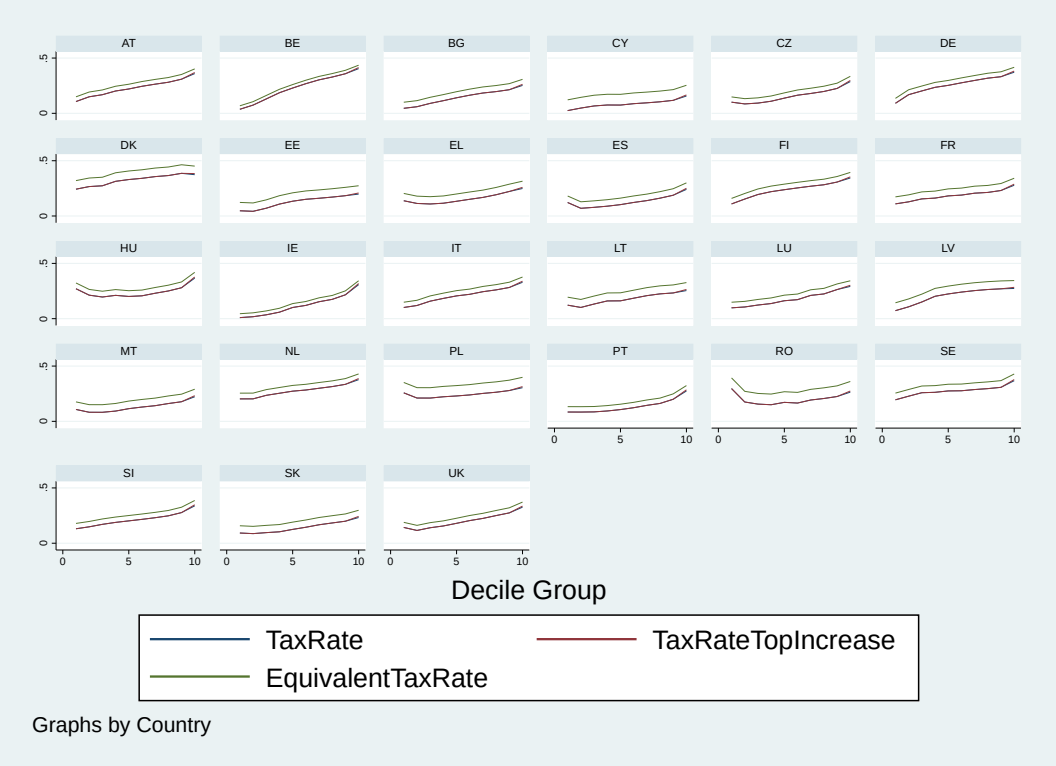

Figure 11 Tax rate, tax rate with top tax increase, inequality-equivalent flat increase, 2007 (Source: author's calculations based on EUROMOD-Webstatistics).

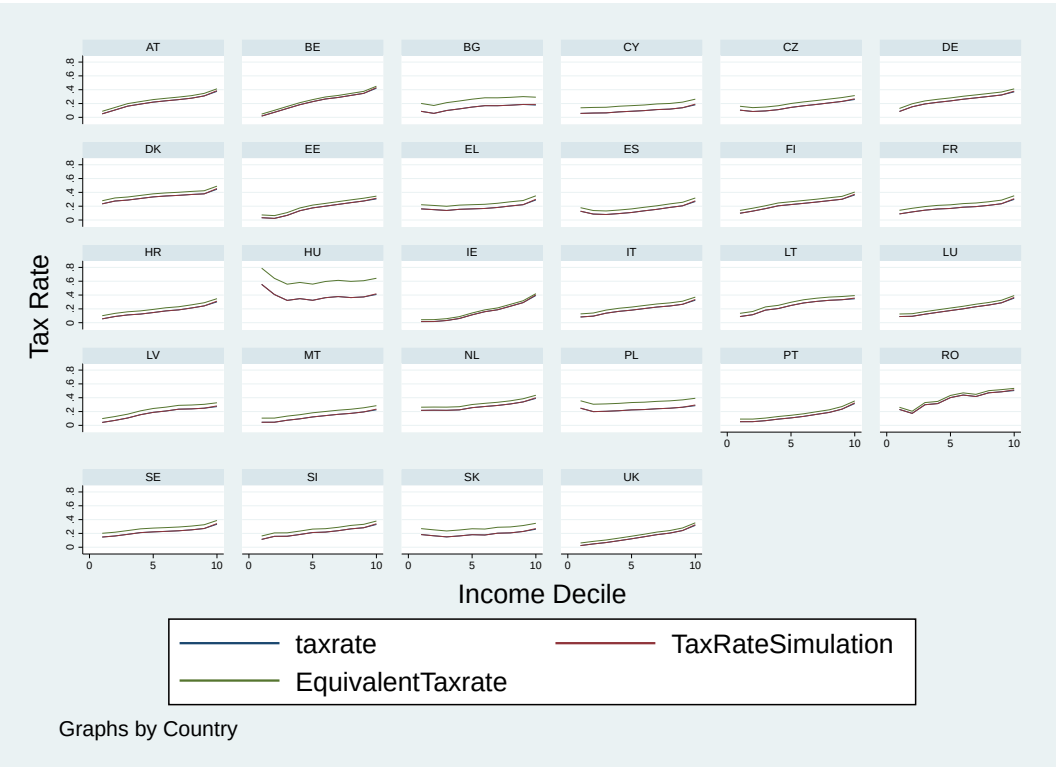

Figure 12 Tax rate, tax rate with top tax increase, inequality-equivalent flat increase, 2019 (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface).

6.3.4. Implications for government revenue

Finally, considering the effect on government revenue from income taxation induced by the simulated tax reform is relevant not only because raising revenue is the primary objective of taxation. The increase in government budget may also enable the state to further redistribute through transfers or the investment in public services. The EUROMOD-JRC data allows to calculate the change on government revenue for both a one percentage point increase at the top, as well as the inequality-equivalent flat increase would induce. To do so, I calculate the percentage change in government revenue from income taxation.[34]

Government revenue increases by a change in top tax rates would be small, but are related with increasing levels of redistribution

Table 10 Revenue change from a 1 percentage point top tax rate increase, and an inequality-equivalent flat increase, in percent (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface)

Country	Revenue Change 1% Top	Revenue Change Flat Increase
AT	0.9507	13.6307
BE	0.8025	9.8538
BG	2.066	70.0351
CY	2.434	65.6341
CZ	1.3667	28.2081
DE	0.8665	14.9983
DK	0.6571	12.1759
EE	1.3302	29.1186
EL	1.2852	27.901
ES	1.5639	27.5276
FI	0.8992	15.5774
FR	1.1995	23.405
HR	1.3043	20.8832
HU	0.8878	272.597
IE	1.2851	10.3773
IT	1.1659	18.4913
LT	1.1629	15.873
LU	1.0487	15.2726
LV	1.2108	25.121
MT	1.5535	37.4633
NL	0.7866	14.8331
PL	1.0138	43.6426
PT	1.5885	17.9113
RO	0.8663	10.7662
SE	0.9577	20.9294
SI	0.9553	19.6424
SK	1.1243	42.1867
UK	1.419	16.8716
Total	1.2054	33.6046

The mean percentage change induced by the top 10 tax rate increase amounts to +1.2% of government revenue raised through income taxation across the data set. It is smallest in Belgium (0.8%) and largest in Cyprus (2.4%). It is no surprise that the impact on government revenue by a flat increase across the whole income distribution is much and unrealistically larger, since the increase in points of taxation is not only larger than one, but it is also multiplied by the entire income distribution. The mean increase of government revenue from income taxation so achieved would amount to 33.6%. The highest increase would be observed in Bulgaria (70%), and the lowest increase in Belgium (9.9%).

The magnitude of the increase in government revenue from income taxation by increasing top tax rates by one percentage point is mildly negatively correlated with pre-existing redistribution levels (R2=0.2) through the level of existing top tax rates (R2=0.69).[35] Hence, the larger the redistribution level already achieved, and the higher the top tax rate, the lower the positive impact on government revenue from an increase in top income taxation. This result is intuitive as the relative impact of a one percentage point increase on the tax rate is much higher in countries in which top tax rates are low as shown under 6.3.1.. The magnitude is also negatively correlated with the

[34] I calculate government revenue by the following:
$Government\ revenue = \sum mean\ taxes\ per\ household\ per\ decile * number\ of\ households\ per\ decile.$

[35] Hungary as an outlier is excluded.

median tax rate of a country (R2=0.63). Hence the higher the overall level of taxation, the lower the impact on government revenue from an increase of top 10 income tax rates. The three regressions are shown graphically in Figure 15. Therefore, and quite intuitively, it shows that an increase in top tax rates has a higher marginal effect in a country which starts from low median levels of taxes and of low levels of top income taxation. On the contrary, the magnitude of the effect on government revenue is not correlated with pre-tax income inequalities (R2=0.01).

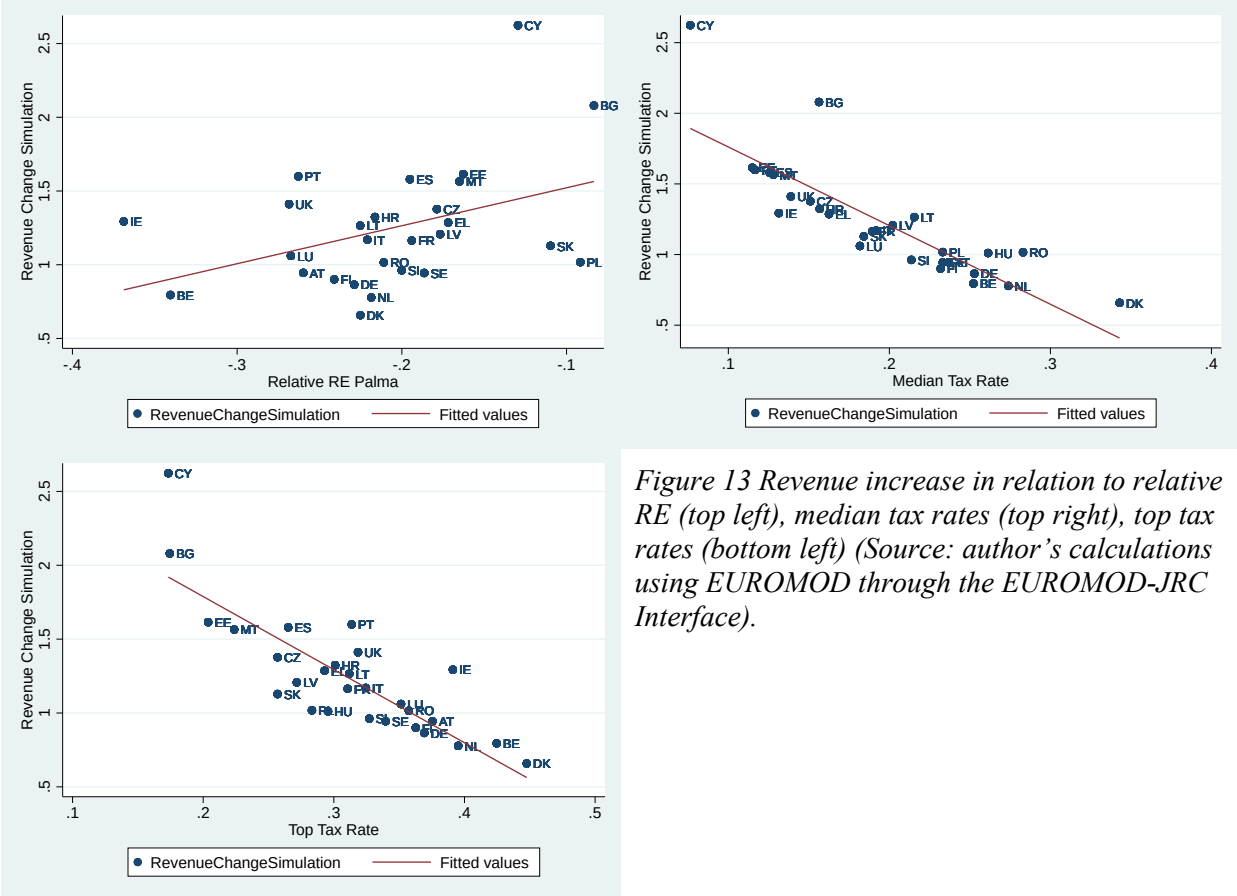

Figure 13 Revenue increase in relation to relative RE (top left), median tax rates (top right), top tax rates (bottom left) (Source: author's calculations using EUROMOD through the EUROMOD-JRC Interface).

In conclusion, this part has shown that the impact on redistribution of a minor increase in top income tax rates would be relatively small and not fundamentally alter a country's position as compared to its European neighbors. Nonetheless, for most countries, such a change would counteract the trend of increasing inequalities and could attenuate a substantial part of increasing inequalities, e.g., in crises. Compared to other reforms, the small increase at the top outperforms a flat increase, when considering the disproportional change in tax levels the latter would require. Furthermore, increasing top tax rates is relevant in countries with high and low inequalities, since the effect depends on both the underlying inequality and the redistributive policies in place. Yet, the increase of government revenue through the simulated reform is also rather small. As the increase in government revenue is highest in the countries with low levels of redistribution, however, such a reform could be equality-enhancing through both the direct effect on income inequalities and the increase in revenue available potentially for the provision of transfers or public services. One may also hypothesize the existence of a positive feedback

loop as soon as redistribution through the tax system is reformed to be more equality-enhancing, when the reform increases redistribution first through the tax system and second through the larger funds available for redistribution.

7. Limitations and Conclusion

There are several limitations to my study. First, my analysis is purely static, i.e., behavioral responses to policy changes are ignored. However, these responses can be large, especially for top income groups, and concern mainly tax avoidance and evasion. Tax avoidance and evasion can happen, e.g., through leaving a jurisdiction to face lower taxes elsewhere, or through shifting labor income to capital income which may face different tax rates. Further studies should therefore reproduce the analysis but dynamically include a measure to account for and quantify behavioral responses.
Second, due to limitations in the data, I can only study the effect of top tax rates for the average of the top 10% income group. However, as shown by previous research, the top of the income distribution is particularly heterogeneous, and repeating my analysis on the level of the top 1% or top 0.1% would allow to quantify the impact of increasing top tax rates on an even more detailed scale. Furthermore, the findings so achieved would allow to target tax reforms even better. In particular, it would be insightful to apply the analysis trade-off between levels and progressivity of taxes, as well as of the trade-off between targeting and levels for redistribution to the level of the top 10 income group.
Third, the findings being limited to the most recent time period, they should be treated with caution, as the time between 2007 and 2019 includes the economic and sovereign debt crises as well as the years of economic stagnation following the crisis years. In particular, a reproduction of my analysis on a longer time frame, and for a larger number of economic shocks throughout history could shed light on the real-life and long-term relevance of top income tax rates.
Fourth, my analysis focuses specifically on the redistributive effect of direct taxation. However, two elements would merit broader investigation in future research. The first would be to consider the specific parts of direct taxation (e.g., labor taxes, property taxes, etc.), and how changes in the respective parts would impact redistribution. Second, analyzing the interplay with the entire tax system (e.g., consumption taxes) and its role in financing the welfare state would allow for greater exhaustivity in evaluating the importance of top income taxation for redistribution.
Finally, my research is limited by the quality of data available. The EUROMOD data I have used is harmonized and its frequent use in research has proven its quality. Nonetheless, aggregate data in this form bears the risk of being unprecise. Reproducing my analysis with micro data could add robustness to the findings. In addition to the availability of high-quality data, research on income inequality frequently relies on different assumptions. These need to be made because reliable distributional data is not systematically and internationally comparably provided by national statistical institutions.

This research aimed to determine and quantify the relevance of changes in top income taxation to reduce income inequalities in Europe. I have shown that in the past, European countries were able to counteract small parts of increasing inequalities with top tax rates. Furthermore, the direction of changes in top tax rate determines the direction of redistributive trends in Europe in more than 80% of all cases studied. This compares to only under 40% of cases in which the sign of the change in income distribution predicted the change in redistribution correctly. I can

thereby confirm hypothesis 1, that changes in top tax rates determine trends in inequality. In the past, top tax rates were able to contribute only mildly to attenuating increases in income inequalities. However, through this lever, my simulation of an increase in top tax rates has shown that even small changes could attenuate even up to 76% of increases in income inequalities. The effect of increases in top tax rates has been shown to be largest in absolute terms in countries with high income inequality. However, in countries with higher levels of redistribution, the relative change achieved was highest. Thus, the lever of top income taxation for redistribution matters for all countries, regardless of their redistributive patterns. Nonetheless, the changes so induced do not suffice in and of themselves to counteract increasing pre-tax income inequalities entirely. Hence, this partly confirms hypothesis 2, that top tax rates are of first order importance for income inequality: While they have relevance, especially in the face of rising income inequalities, they cannot exclusively and entirely counteract this pattern. Moreover, the changes in government revenue induced by a one percentage point increase are minor, even if they concern the richest 10% of the income distribution.

In conclusion, my findings show that top income taxation can be one lever in reducing income inequalities, in particular when facing rising inequalities as is currently the case. Nevertheless, to sustainably reduce inequalities, comprehensive reforms, including, e.g., the level of taxation, as well as the design of transfers must be promoted, too, since the magnitude of the inequality reduced induced through top income taxation is insufficient.

8. Policy recommendations

Having presented the findings of my research on the sensitivity of income inequality top income taxation, this last section presents four policy recommendations. They concern both concrete policymaking as well as improvements to facilitate policy evaluations in the field of tax policy and inequality in Europe in the future. First, quantifiable income inequality targets are presented as a potentially useful tool to guide future policy on redistribution. Second, measurement and provision of official data on inequality should be improved and harmonized. Third, increased international cooperation should be sought on the matter of income taxation. Finally, top income taxation should be used in a targeted and differentiated way to reduce income inequality, especially in times of deteriorating inequalities.

Introduce quantifiable income inequality targets

My findings have shown that disposable income inequalities mostly stagnate, and that redistribution through the tax system is also contingent on the pre-tax income distribution, which is becoming more unequal in most countries in my data set. Faced with this reality, the introduction of quantifiable targets for income inequality would ensure a path towards decreasing inequalities, and it would create accountability for policymakers. Thereby, European economies would be better equipped to address rising inequalities.

Policy targets exist in many political fields; targets for government budget, targets for military spending, targets for inflation, targets for unemployment. However, in the field of income inequality, clear, quantifiable, and internationally comparable targets have not yet been formulated. Targets for the reduction of poverty exist, for instance in the EU 2020 strategy which aims to lift 20 million citizens out of poverty, or in the SDGs, which aim to eradicate extreme poverty by 2030. However, targets to reduce income inequality seem to be of second order for policymakers. Yet, the formulation of measurements besides the traditional GDP to judge how well an economy is doing has been underlined at multiple occasions, e.g., by the "High-Level Group on the Measurement of Economic Performance and Social Progress" (Stiglitz, Fitoussi & Durand, 2018). As income inequality is closely linked with other socio-economic outcomes, as exposed in the introduction, it is a relevant candidate for the better measurement of the state of the economy. Moreover, defining verifiable, quantifiable, and internationally comparable inequality targets would allow to compare findings like the ones presented in this work against a benchmark. Vice versa, the quantifications and elements of interpretation suggested in this thesis can be a starting point to inform the definition of income inequality targets. In addition, inequality targets would allow to translate the (rising) public interest in the topic of inequalities into political objectives policymakers can be held accountable for.

The evidence-based elaboration of income inequality targets should therefore be fostered. Based on the findings presented above, income inequality targets could take different foci. One way of framing them could be to determine a specific rate of inequality reduction per x years. Another option could be to make the target contingent on the evolution of pre-tax income inequalities. For example, they could prescribe by how much percent increasing inequalities must be attenuated, or by how much percent decreasing income inequalities must be amplified. Another alternative would be a specific income inequality to be attained, e.g., a specific Palma

ratio value. With such a target to be attained, the findings I have presented above could be extended to showcase how much top tax rates could contribute to achieve such goals. Thus, research on how such inequality targets could be developed should be promoted. Furthermore, international cooperation on this matter should be sought to allow for international comparability.

Improve measurement and provision of data on inequality

The research and political interest in income inequality has continuously been increasing, however it is constrained by a range of data limitations. To facilitate research in this field, these limitations should be addressed, also in order to be able to formulate better policies to reduce inequalities, based on even more precise data.

Income inequality research is based on a range of different data sources and methodologies. They include, i.a., survey data/micro sources, or secondary sources like the World Income Inequality Database (WIID), they differ in the adjustments and/or imputations made, and which assumptions are made by researchers (Lustig, 2018, pp. 52-53). As spelled out in the literature review, as well as in the comparison with my findings, the different methods and data sources employed can lead to differing and sometimes contradictory results on income inequality and tax policy. Based on the research led for this Master's thesis, the recommendation to establish national distributed accounts presented, e.g., by the INSEE expert group on measuring inequalities and redistribution (INSEE, 2021) should be reiterated here. The report argues that measuring redistribution requires exhaustivity including statistics on taxes and contributions, just like cash and in-kind transfers (INSEE, 2021, p. 13).

Different organizations and research bodies are advancing the topic, e.g., at the OECD (Expert Group on Micro Statistics on Income, Consumption and Wealth, EG ICW) (INSEE, 2021). These efforts should be supported. Moreover, at the national and the EU level, common standards should be adopted timely to provide internationally comparable data, e.g., in the form of national distributional accounting. This will allow research and policy evaluation to accurately measure redistribution and income inequalities.

Reinforce international cooperation in tax matters

While my analysis has shown that raising top income taxes is relevant for reducing income inequality, the most important criticism of this proposal is that increasing tax rates would lead to more tax avoidance and evasion among the rich. One way to address avoidance and evasion behavior can be to set common standards internationally which may make it more difficult to engage in these behaviors.

An analogy to this can be drawn the debate on corporate tax rates. Tax avoidance and evasion by the most profitable firms has long been an argument against rising domestic corporate tax rates. Yet, international cooperation has started to achieve results in fighting corporate tax avoidance and evasion, e.g., within the G20/OECD Inclusive Framework on Base Erosion and Profit Shifting. While the issues at stake are naturally very different in income taxation, the international consensus reached on corporate taxation should underline that multilateral cooperation in tax matters can be successful. By seeking cooperation in using income taxes to the ends of reducing income inequalities, for example at the level of the EU, this is one element

that could potentially address the question of avoidance and evasion behavior, next to measures aiming at broadening the tax base, or improving the enforcement of tax rules.

Use targeted and differentiated top income taxation to reduce income inequality, as part of an equality-enhancing policy package

My research has shown that 'taxing the rich' is not just a question of mere symbolism. The findings presented above have shown that top tax rates matter for redistribution in most countries, regardless of their level of income inequality and redistributive policies in place. It has played a part in attenuating increases in income inequalities in the past, and I have shown that even minor increases at the top may even reverse redistributive trends. As underlined by my findings as well, income inequalities are likely to continue increase, which makes the imperative to employ a broad range of policy tools to address them all the more relevant. Top tax rates are one of several policy tools at hand, and a more deliberate and targeted use of top tax policy for the end of reducing income inequality is advisable.

Nevertheless, my findings have also shown that top tax rates alone do not fundamentally change income inequality in international comparison. This also means that top tax rates or tax policy alone cannot erase income inequality. Increasing the level of taxes and transfers is at least as necessary to credibly fight income inequality. Furthermore, a focus only on the top of the income distribution omits the importance and heterogeneity of the lower income classes. Focusing on improving the situation of lower income classes, through increased levels of redistribution and subsidized income cannot be substituted by taxation at the top exclusively. In conclusion, 'taxing the rich' should be explicitly used to contribute to reduce income inequality. Yet, 'taxing the rich' should not go without, or substitute 'promoting the poor.'

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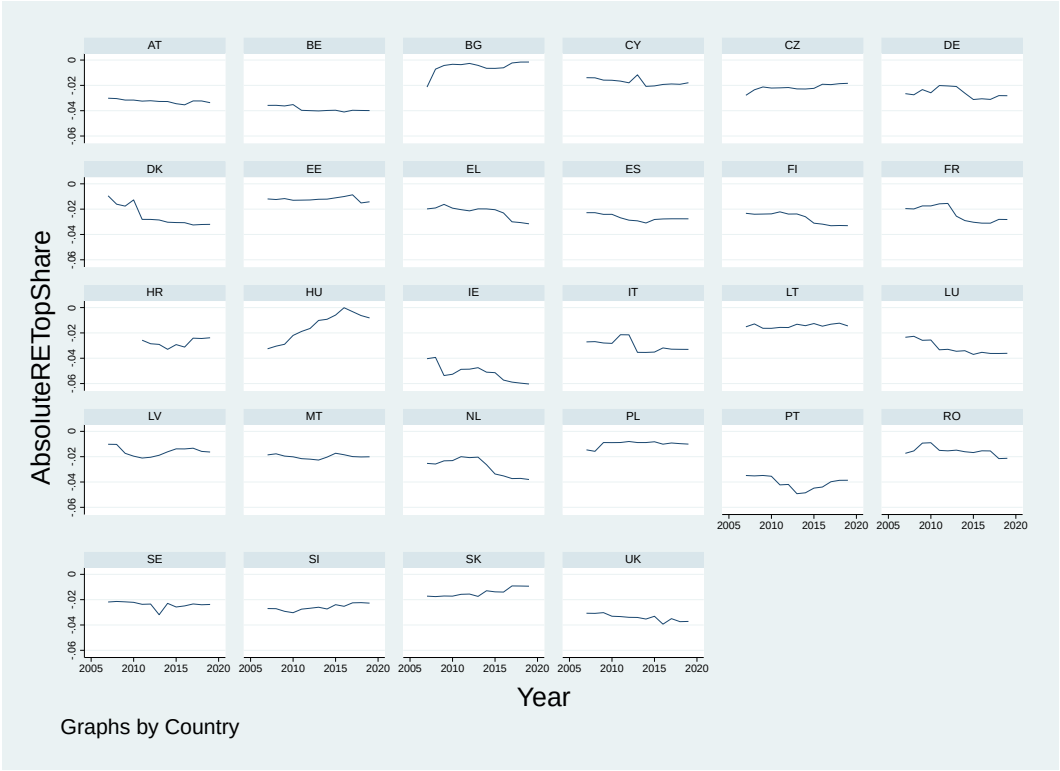
10. Appendix

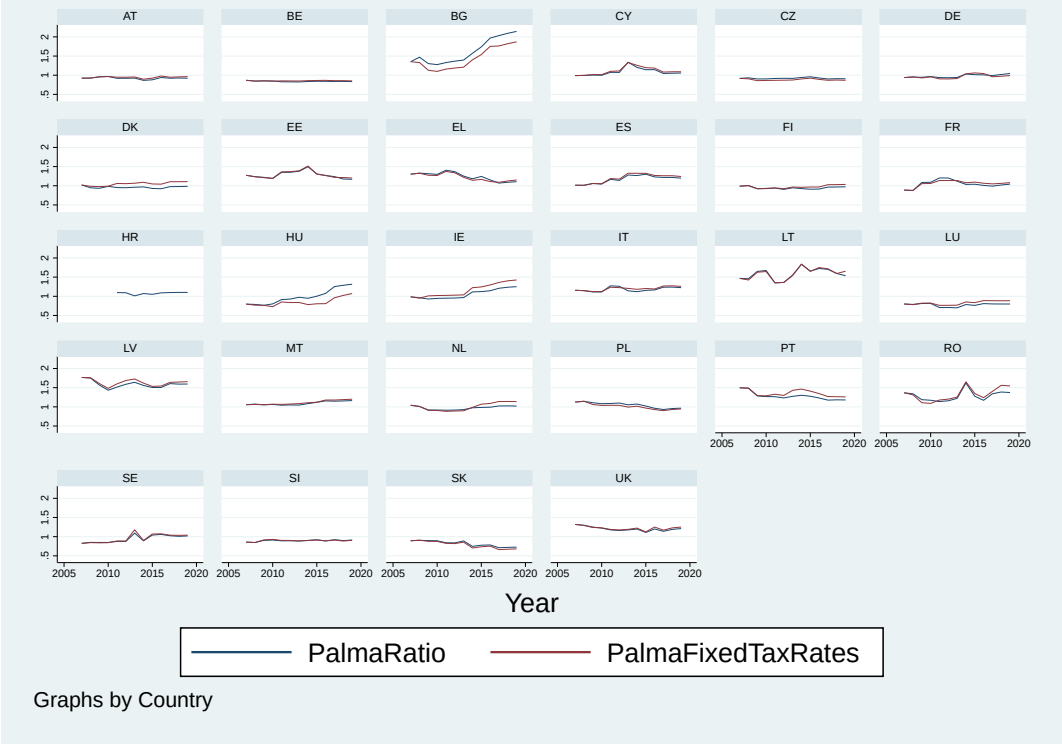
10.1. Evolution of median tax rates and top tax rates, 2007-2019 (Source: author's calculations based on EUROMOD Webstatistics)

Country	Median Tax Rate 2007	Median Tax Rate 2019	Top Income Tax 2007	Top Income Tax 2019
AT	0.2326	0.2171	0.36	0.37
BE	0.2488	0.2576	0.4	0.43
BG	0.1525	0.1554	0.25	0.16
CY	0.0815	0.0979	0.16	0.19
CZ	0.1509	0.1615	0.29	0.26
DE	0.2647	0.1766	0.37	0.3
DK	0.3355	0.3474	0.37	0.45
EE	0.1427	0.1276	0.2	0.21
EL	0.1447	0.1761	0.25	0.31
ES	0.1224	0.1292	0.24	0.27
FI	0.2462	0.2351	0.34	0.37
FR	0.1857	0.1766	0.28	0.3
HR	.	0.1639		0.29
HU	0.2215	0.2636	0.37	0.3
IE	0.1109	0.148	0.31	0.4
IT	0.2134	0.2104	0.33	0.35
LT	0.1734	0.2773	0.25	0.33
LU	0.1673	0.1821	0.29	0.36
LV	0.2322	0.2053	0.27	0.27
MT	0.1223	0.1288	0.22	0.23
NL	0.2784	0.2218	0.38	0.38
PL	0.246	0.2381	0.3	0.28
PT	0.1151	0.1382	0.28	0.32
RO	0.1842	0.2851	0.26	0.37
SE	0.2759	0.2374	0.37	0.34
SI	0.2092	0.2233	0.34	0.33
SK	0.135	0.191	0.23	0.25
UK	0.1927	0.1693	0.33	0.33
Total	0.1921	0.1979	0.3	0.31

10.2. Absolute RE in top income shares, 2007-2019 (Source: author's calculations based on EUROMOD Webstatistics)



10.3. Palma ratio and Palma ratio if tax rates were fixed at 2007 levels (Source: author's calculations based on EUROMOD Webstatistics)



10.4. Decomposition of relative effects on redistribution, 2007-2013 (Source: author's calculations based on EUROMOD Webstatistics)

Country	Relative Change in RE 07-13	Model Estimation	Part Explained by Model	Relative Top Tax Change	Relative Palma Pre-Tax Change	Part of Top Tax in Model	Part of Palma Pre-Tax in Model
AT	0.0935	0.0841	0.8995	0.0731	0.011	0.869	0.131
BE	0.0616	0.0515	0.8359	0.0602	-0.0087	1.1693	-0.1693
BG	-0.6849	-0.6632	0.9684	-0.6369	-0.0263	0.9604	0.0396
CY	-0.0471	0.0019	-0.0396	-0.0522	0.0541	-27.9755	28.9755
CZ	-0.1846	-0.153	0.829	-0.1398	-0.0132	0.9135	0.0865
DE	-0.1037	-0.1299	1.2534	-0.1196	-0.0103	0.9206	0.0794
DK	0.6643	0.2183	0.3286	0.2015	0.0168	0.9231	0.0769
EE	0.06	0.0806	1.3426	0.0621	0.0185	0.7708	0.2292
EL	-0.1584	0.1805	-1.1391	0.1966	-0.0161	1.0893	-0.0893
ES	0.1787	0.2049	1.1467	0.1302	0.0747	0.6354	0.3646
FI	0.0811	-0.0173	-0.2129	-0.0093	-0.008	0.5359	0.4641
FR	0.0856	0.2592	3.0289	0.1809	0.0783	0.6978	0.3022
HR	.	.	.	.	.	.	.
HU	-0.6893	-0.0926	0.1344	-0.1118	0.0191	1.2067	-0.2067
IE	0.1771	0.298	1.6826	0.2817	0.0163	0.9453	0.0547
IT	0.1937	0.1406	0.7259	0.1271	0.0135	0.9037	0.0963
LT	-0.0384	-0.2239	5.8263	-0.2372	0.0133	1.0593	-0.0593
LU	0.3733	0.2035	0.5452	0.2145	-0.011	1.054	-0.054
LV	0.3577	0.1027	0.287	0.1065	-0.0039	1.0376	-0.0376
MT	0.2111	0.1103	0.5226	0.1041	0.0062	0.9441	0.0559
NL	-0.1447	-0.0837	0.5786	-0.0317	-0.052	0.3784	0.6216
PL	-0.5133	-0.1499	0.292	-0.1141	-0.0358	0.7615	0.2385
PT	0.4218	0.4877	1.1562	0.5001	-0.0124	1.0253	-0.0253
RO	0.2774	-0.092	-0.3317	-0.0715	-0.0206	0.7766	0.2234
SE	0.3672	0.0094	0.0256	-0.1474	0.1568	-15.6611	16.6611
SI	0.0093	-0.028	-3.012	-0.0398	0.0118	1.4222	-0.4222
SK	-0.2145	0.0799	-0.3726	0.0893	-0.0094	1.1175	-0.1175
UK	0.0453	-0.0746	-1.6472	-0.043	-0.0317	0.5756	0.4244
Total	0.0326	0.0298	0.5798	0.0212	0.0086	-0.7757	1.7757

10.5. Decomposition of relative effects on redistribution, 2013-2019 (Source: author's calculations based on EUROMOD Webstatistics)

Country	Relative Change in RE 13-19	Model Estimation	Part Explained by Model	Relative Top Tax Change	Relative Palma Pre-Tax Change	Part of Top Tax in Model	Part of Palma Pre-Tax in Model
AT	0.0402	-0.0487	-1.2101	-0.0526	0.004	1.0812	-0.0812
BE	-0.019	0.0083	-0.4355	0.0077	0.0006	0.9327	0.0673
BG	0.098	0.153	1.5619	0.0686	0.0844	0.4485	0.5515
CY	0.3435	0.3525	1.0263	0.3794	-0.0269	1.0763	-0.0763
CZ	0.0184	0.0282	1.5375	0.0303	-0.002	1.0719	-0.0719
DE	-0.0653	-0.0932	1.4265	-0.1239	0.0307	1.33	-0.33
DK	0.0548	0.0622	1.1347	0.0446	0.0176	0.7164	0.2836
EE	0.1105	-0.034	-0.3079	-0.0059	-0.0281	0.1734	0.8266
EL	0.4375	0.1272	0.2908	0.1431	-0.0158	1.1245	-0.1245
ES	-0.0058	0.0032	-0.5498	0.0205	-0.0173	6.4207	-5.4207
FI	0.155	0.1232	0.7948	0.0988	0.0245	0.8015	0.1985
FR	0.0974	-0.1235	-1.2686	-0.1076	-0.0159	0.8712	0.1288
HR	-0.0618	-0.0484	0.7833	-0.0701	0.0217	1.4475	-0.4475
HU	-0.8259	0.0199	-0.0241	-0.0725	0.0924	-3.6382	4.6382
IE	0.1137	0.24	2.1117	0.1021	0.138	0.4253	0.5747
IT	-0.0795	-0.0337	0.4233	-0.0497	0.016	1.4753	-0.4753
LT	0.4963	0.9602	1.9348	0.9448	0.0155	0.9839	0.0161
LU	0.0127	0.0633	4.9935	0.0104	0.0529	0.1638	0.8362
LV	-0.0938	-0.1032	1.1003	-0.0894	-0.0138	0.8664	0.1336
MT	-0.0285	-0.0378	1.3229	-0.0634	0.0257	1.6797	-0.6797
NL	0.6767	0.1323	0.1956	0.0338	0.0985	0.2558	0.7442
PL	0.7021	0.0188	0.0268	0.0318	-0.013	1.6898	-0.6898
PT	-0.122	-0.1823	1.4945	-0.141	-0.0413	0.7735	0.2265
RO	0.6	0.7207	1.2012	0.6608	0.0599	0.9168	0.0832
SE	-0.1934	0.0662	-0.3423	0.1031	-0.0369	1.5575	-0.5575
SI	-0.0369	0.008	-0.2174	0.0021	0.0059	0.2603	0.7397
SK	-0.2005	-0.068	0.3389	-0.0164	-0.0516	0.2413	0.7587
UK	0.0629	0.0829	1.3184	0.0671	0.0158	0.8092	0.1908
Total	0.0817	0.0856	0.7379	0.0699	0.0158	0.927	0.073

10.6. Mean annual absolute change in Palma ratios and change from one percentage increase in top tax rates (Source: author's calculations using EUROMOD through the EUROMOD-JRC interface/EUROMOD Webstatistics)

Country	*Absolute Change in Palma ratio from Simulation*	*Mean Annual Absolute Change in Palma ratios*
AT	-0.0152	-0.0001
BE	-0.0145	-0.0028
BG	-0.0254	0.0658
CY	-0.0141	0.0056
CZ	-0.0125	-0.0009
DE	-0.016	0.0087
DK	-0.0168	-0.0029
EE	-0.0152	-0.0086
EL	-0.0155	-0.0163
ES	-0.0166	0.0154
FI	-0.0147	-0.0014
FR	-0.015	0.013
HR	-0.0164	0.0006
HU	-0.0178	0.0433
IE	-0.019	0.0221
IT	-0.0172	0.0057
LT	-0.0224	0.0059
LU	-0.0125	0
LV	-0.0209	-0.0142
MT	-0.0151	0.0091
NL	-0.0161	-0.0017
PL	-0.014	-0.0133
PT	-0.0185	-0.0265
RO	-0.023	0.0005
SE	-0.016	0.016
SI	-0.0131	0.0044
SK	-0.011	-0.0138
UK	-0.0176	-0.0089
Total	-0.0165	0.0038

10.7. Evolution of Palma ratio 2007-2013 and relative change from simulated reform (Source: author's calculations based on EUROMOD Webstatistics)

Country	Absolute Palma Change 07-13	Absolute Palma Change Simulation	Absolute Change + Simulation	Relative Change from Simulation
AT	0.0014	-0.015	-0.0135	-10.5877
BE	-0.0432	-0.0143	-0.0575	0.3312
BG	0.043	-0.0165	0.0265	-0.3844
CY	0.3492	-0.0157	0.3334	-0.0451
CZ	0.0006	-0.0123	-0.0117	-21.2622
DE	0.0012	-0.0141	-0.013	-12.0564
DK	-0.0585	-0.0171	-0.0756	0.2926
EE	0.1059	-0.0174	0.0885	-0.1641
EL	-0.0501	-0.0174	-0.0675	0.3479
ES	0.2662	-0.0175	0.2488	-0.0656
FI	-0.0423	-0.0144	-0.0567	0.3399
FR	0.2318	-0.0166	0.2152	-0.0716
HU	0.1778	-0.0144	0.1633	-0.0813
IE	-0.02	-0.0154	-0.0354	0.768
IT	-0.0144	-0.0178	-0.0322	1.2387
LT	0.086	-0.0199	0.0662	-0.2311
LU	-0.1004	-0.0108	-0.1112	0.108
LV	-0.126	-0.023	-0.149	0.1829
MT	-0.0096	-0.0138	-0.0233	1.4407
NL	-0.1129	-0.0147	-0.1276	0.1301
PL	-0.0717	-0.0146	-0.0863	0.2031
PT	-0.2229	-0.0196	-0.2424	0.0877
RO	-0.1465	-0.0163	-0.1628	0.1114
SE	0.2679	-0.0159	0.2519	-0.0595
SI	0.0279	-0.0132	0.0148	-0.4712
SK	-0.0033	-0.0119	-0.0152	3.5938
UK	-0.143	-0.0172	-0.1603	0.1206
Total	0.0146	-0.0158	-0.0012	-1.3401

10.8. Evolution of Palma ratio 2013-19 and relative change from simulated reform (Source: author's calculations based on EUROMOD Webstatistics)

Country	*Absolute Palma Change 13-19*	*Absolute Palma Change Simulation*	*Absolute Change + Simulation*	*Relative Change from Simulation*
AT	-0.0032	-0.0145	-0.0177	4.5525
BE	0.0091	-0.0145	-0.0054	-1.5946
BG	0.7466	-0.0256	0.721	-0.0343
CY	-0.2822	-0.013	-0.2953	0.0461
CZ	-0.0108	-0.0123	-0.0231	1.1323
DE	0.103	-0.0149	0.0881	-0.1447
DK	0.0238	-0.0181	0.0057	-0.7588
EE	-0.209	-0.0147	-0.2238	0.0705
EL	-0.1458	-0.016	-0.1618	0.1098
ES	-0.0812	-0.0164	-0.0977	0.2022
FI	0.0252	-0.0154	0.0098	-0.6127
FR	-0.076	-0.0149	-0.0909	0.1962
HR	0.0901	-0.0155	0.0746	-0.1716
HU	0.3419	-0.0189	0.323	-0.0552
IE	0.2847	-0.0208	0.264	-0.0729
IT	0.0828	-0.0187	0.0641	-0.2263
LT	-0.0157	-0.0231	-0.0388	1.4703
LU	0.1005	-0.0125	0.088	-0.1241
LV	-0.0444	-0.022	-0.0664	0.496
MT	0.1184	-0.0151	0.1033	-0.1275
NL	0.0925	-0.0164	0.0761	-0.1778
PL	-0.0877	-0.0135	-0.1012	0.154
PT	-0.0948	-0.0174	-0.1122	0.1832
RO	0.153	-0.0218	0.1312	-0.1426
SE	-0.0753	-0.0153	-0.0906	0.2039
SI	0.0249	-0.0135	0.0113	-0.5439
SK	-0.1628	-0.0097	-0.1725	0.0594
UK	0.0359	-0.0181	0.0177	-0.5057
Total	0.0337	-0.0165	0.0172	0.128

10.9. Evolution of top income shares 2007-19 and relative change from simulated reform (Source: author's calculations based on EUROMOD Webstatistics)

Country	*Absolute Top Share Change 07-19*	*Absolute Top Share Change Simulation*	*Absolute Change + Simulation*	*Relative Change from Simulation*
AT	-0.0086	-0.0026	-0.0113	0.3035
BE	-0.0092	-0.0027	-0.0119	0.2909
BG	0.0756	-0.0026	0.073	-0.0347
CY	0.0006	-0.0021	-0.0015	-3.3191
CZ	-0.0058	-0.0022	-0.008	0.3755
DE	0.0118	-0.0026	0.0092	-0.2174
DK	-0.0012	-0.0032	-0.0044	2.5707
EE	-0.0155	-0.0022	-0.0177	0.1402
EL	-0.0072	-0.0026	-0.0098	0.3667
ES	0.0206	-0.0024	0.0181	-0.1187
FI	0.0026	-0.0027	-0.0001	-1.0535
FR	0.0252	-0.0026	0.0227	-0.1013
HU	0.0433	-0.0027	0.0407	-0.0612
IE	0.026	-0.003	0.023	-0.1162
IT	0.0085	-0.0029	0.0057	-0.3353
LT	0.0059	-0.0029	0.003	-0.4891
LU	-0.003	-0.0025	-0.0055	0.8285
LV	-0.015	-0.0027	-0.0177	0.1769
MT	0.0139	-0.0023	0.0116	-0.1664
NL	-0.0062	-0.0028	-0.009	0.4543
PL	-0.0325	-0.0023	-0.0348	0.0706
PT	-0.034	-0.0027	-0.0367	0.0787
RO	-0.0038	-0.0029	-0.0067	0.7767
SE	0.0204	-0.0026	0.0178	-0.1256
SI	0.0069	-0.0024	0.0045	-0.3471
SK	-0.0258	-0.0019	-0.0277	0.0757
UK	-0.0135	-0.0028	-0.0163	0.2051
Total	0.003	-0.0026	0.0004	0.0085

10.10. Evolution of top income shares 2007-13, and relative change from simulated reform (Source: author's calculations based on EUROMOD Webstatistics)

Country	*Absolute Top Share Change 07-13*	*Absolute Change from Simulation*	*Absolute Change + Simulation*	*Relative Change from Simulation*
AT	-0.0023	-0.0027	-0.005	1.2052
BE	-0.0056	-0.0027	-0.0083	0.4709
BG	-0.0064	-0.0023	-0.0087	0.3557
CY	0.0437	-0.0023	0.0413	-0.0531
CZ	0.0004	-0.0023	-0.0019	-5.5672
DE	-0.0145	-0.0025	-0.017	0.1743
DK	0.0051	-0.003	0.0022	-0.5787
EE	0.0071	-0.0023	0.0048	-0.3262
EL	0.0076	-0.0026	0.0049	-0.3488
ES	0.033	-0.0025	0.0305	-0.0751
FI	-0.0047	-0.0025	-0.0072	0.5416
FR	0.0444	-0.0028	0.0416	-0.0622
HU	-0.0015	-0.0026	-0.004	1.742
IE	0.0054	-0.0026	0.0027	-0.491
IT	0.006	-0.0028	0.0031	-0.4729
LT	0.008	-0.0025	0.0056	-0.3105
LU	-0.0042	-0.0024	-0.0066	0.5595
LV	0.007	-0.0028	0.0042	-0.3979
MT	0.0071	-0.0023	0.0048	-0.3189
NL	-0.0238	-0.0026	-0.0265	0.1111
PL	-0.0174	-0.0024	-0.0198	0.1398
PT	-0.0103	-0.0029	-0.0132	0.2773
RO	-0.0141	-0.0024	-0.0165	0.1715
SE	0.0453	-0.0026	0.0427	-0.0572
SI	0.0021	-0.0024	-0.0003	-1.1218
SK	0.0093	-0.0022	0.007	-0.2417
UK	-0.0133	-0.0027	-0.016	0.2024
Total	0.0042	-0.0025	0.0017	-0.1656

10.11. Evolution of top income shares 2013-19, and relative change from simulated reform (Source: author's calculations based on EUROMOD Webstatistics)

Country	*Absolute Top Share Change 13-19*	*Top Share Change Simulation*	*Absolute Change + Simulation*	*Relative Change from Simulation*
AT	-0.0029	-0.0026	-0.0055	0.9171
BE	0.0005	-0.0027	-0.0022	-5.2543
BG	0.0622	-0.0026	0.0596	-0.0421
CY	-0.039	-0.0021	-0.0412	0.0549
CZ	-0.0157	-0.0022	-0.0179	0.1398
DE	0.0278	-0.0026	0.0253	-0.0918
DK	0.0162	-0.0032	0.013	-0.1963
EE	-0.0204	-0.0022	-0.0226	0.1065
EL	-0.003	-0.0026	-0.0056	0.8849
ES	-0.0075	-0.0024	-0.01	0.3254
FI	0.017	-0.0027	0.0143	-0.1601
FR	-0.0105	-0.0026	-0.0131	0.2425
HR	-0.0019	-0.0023	-0.0042	1.2524
HU	0.0204	-0.0027	0.0178	-0.1298
IE	0.0406	-0.003	0.0376	-0.0743
IT	0.0085	-0.0029	0.0056	-0.3371
LT	-0.0028	-0.0029	-0.0057	1.0341
LU	0.0139	-0.0025	0.0114	-0.1801
LV	-0.0159	-0.0027	-0.0186	0.167
MT	0.0083	-0.0023	0.006	-0.2795
NL	0.0304	-0.0028	0.0276	-0.0925
PL	-0.0196	-0.0023	-0.0219	0.1168
PT	-0.02	-0.0027	-0.0226	0.1342
RO	0.0142	-0.0029	0.0113	-0.206
SE	-0.023	-0.0026	-0.0256	0.1111
SI	0.0005	-0.0024	-0.0019	-4.4306
SK	-0.0429	-0.0019	-0.0448	0.0454
UK	0.0062	-0.0028	0.0035	-0.4443
Total	0.0015	-0.0026	-0.0011	-0.2281