What Makes Personal Income Taxes Progressive? A Decomposition Across European Countries Using EUROMOD

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Abstract

In this paper we investigate the redistributive role of personal income taxes, with a focus on the EU-15 countries, using EUROMOD, the EU-wide tax-benefit model. Progressivity of taxes is one of the major determinants of the equalizing capacity of taxes. In most of these countries the top tax rates have been reduced, as well as the number of tax bands. Hence, it is commonly thought that the progressivity of these taxes has been reduced. However, the effects on overall progressivity (and hence on disposable income inequality) are less obvious than they may appear at first sight, given that the personal income tax system is a complex of different measures. In this paper we decompose the progressivity impact of personal income taxes over its different components. We pay specific attention to the role of the zero-taxed part that is present in almost all countries considered here. Moreover, we try to gain more insight into the role of the top tariff by simulating an increase of the top rate in all countries with 5 percentage points.

JEL Classification: C81; D31; H23; H24
Key words: income redistribution; income taxes; social insurance contributions; microsimulation; European Union; EUROMOD

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1 Introduction

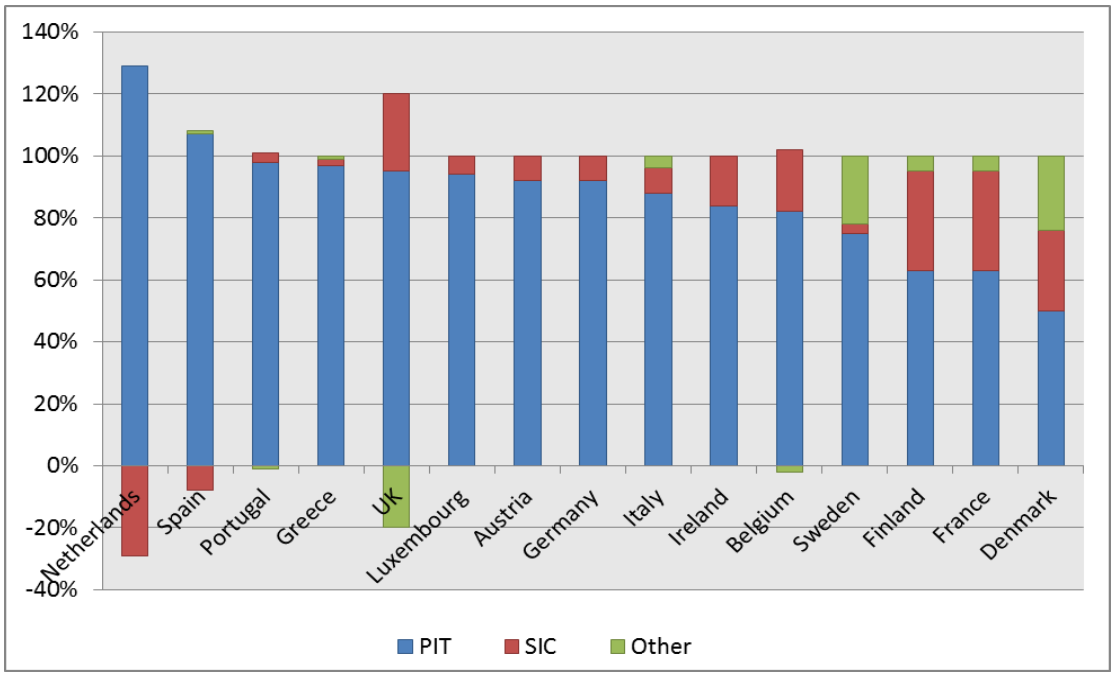
Over the last few years concern for income inequality in European countries has increased remarkably (OECD 2008 and 2011; Salverda et al. 2013) and the redistributive role played by taxation is of utmost importance in shaping the distribution of disposable income across countries. Inequality reduction through taxes depends on the one hand on their departure from proportionality, i.e. the degree of progressivity, and on the other hand on the tax level. In Europe many countries have gone through major or minor personal income tax reforms over the past years, which may also change their capacity to reduce inequality. A striking example is the strong reduction in the marginal tax rates that occurred in many countries. However, one needs to be careful when assessing the effects of such changes on overall progressivity, as progressivity is not only determined by the bands and rate structure, but also by provisions like tax exemptions, tax allowances, deductions and credits. The issue is further complicated by the fact that redistributive outcomes of the tax system are not only affected by changes in statutory rules, but also by changes in the underlying income distribution following from socio-demographic changes (e.g. ageing), labour market developments, and fiscal drag.

In this paper we use EUROMOD, the EU-wide microsimulation model, to compare the redistributive effect of social security contributions and direct taxes in the EU-15 countries (i.e. those countries that formed the European Union before 1st May 2004). We build further on an earlier study on this topic, namely Verbist (2004), which presented the first international comparison of the redistributive effect of personal income taxes in the 15 countries of the EU in 1998. The paper is structured as follows. In section 2 we discuss the relationship between inequality and the redistributive effect of taxes. In section 3 we briefly explain the main methodological aspects in measuring the redistributive effects of taxes, while section 4 presents the tax-benefit model EUROMOD, as well as the underlying data. Next, we present empirical findings in section 5, focusing on the how progressivity of personal income taxes comes about. The last section brings the conclusions together.

2 Income taxes and redistribution

Taxes are an important factor when studying income inequality. Empirical estimates of inequality reduction through direct taxes depending on the methodology used. While most empirical analyses report that taxes are responsible only for, on average, one quarter of the reduction in income inequality across countries, Fuest et al. (2012) show that income taxes and social contributions are by far the most important source of income inequality reduction following a decomposition analysis by factor components which is based on a different normative focus. In a previous paper (Verbist and Figari, 2013) we investigated empirically whether there is a link between pre-tax income inequality and redistribution through taxes, and whether there is a relationship between progressivity of taxes and the average tax level. For the EU-15 we found a strong negative relationship between progressivity and tax level, pointing towards a trade-off between the two, namely that high tax level go together with low progressivity and vice versa. The taxes considered in Verbist and Figari (2013) are personal income taxes (PIT), social insurance contributions (SIC) and other taxes. In most countries personal income taxes turned out to provide the largest contribution to inequality reduction direct through taxes (see Figure 1). In 11 countries PIT accounts for more than 80% of inequality reduction of the three types considered. In two countries it was even more than 100%: in Spain and the Netherlands personal income taxes compensated for the regressive effect of social insurance contributions. In the Nordic countries and France, the weight of personal income taxes is smaller, but still it is the most important contributor

Figure 1: Relative contribution of PIT, Sic and other taxes to overall progressivity (Π_T = 100%)



Note: Countries are ranked from high to low contribution to total progressivity.
Source: Authors' analysis based on EUROMOD

Given the important relative contribution of personal income taxes, the aim of this paper is to delve deeper into the way the redistributive effect of taxes comes about. What makes these taxes progressive? Much attention has gone to the top rate in the tariff structure, especially in the literature on top incomes (see e.g. Atkinson and Leigh, 2010; Atkinson and Piketty, 2010; OECD, 2011). These top rates have gone down considerably over the past decades, also in the fifteen countries we are considering in this paper: on average the top rates in the EU-15 have been reduced from 45.5% (1998) to 38.6% (2008) (see also Verbist & Figari, 2013). It can be argued that lowering these tax rates has increased work effort and entrepreneurship, or has reduced tax evasion, thus leading to a substantial increase in top incomes shares over the past decades. OECD (2011) notes that those countries that over the past 30 years made earlier and bigger cuts in their top tariffs (e.g. United States) witnessed bigger rises in the shares of top incomes. There are indications that the elasticity of taxable income is indeed larger for higher incomes (see e.g. Gruber and Saez, 2002; Saez et al. 2012), suggesting that decreasing marginal tax rates on high income individuals would increase their taxable income substantially with potential important effects on the tax revenue (OECD, 2011).

But the top rates are not the only determinant of progressivity outcomes. The personal income tax system is a complex of many measures, including exempt income components, allowances, deductions, credits and of course the rate structure. It is the interaction of these different components with one another and with the actual taxable income distribution that brings inequality reduction through taxes about, as will be further elaborated in the next section. Despite the recognised importance of the redistributive effect of income taxes, international comparative studies on the vertical equity aspects of taxation are still rather rare. Early examples include: Berglas (1971) who presents results for UK, France, US, West-Germany and Japan; Kakwani (1977a) who compares Australia, Canada, UK and US, based on official data; Zandvakili (1994) who compares 8 LIS-countries by using the measures from the generalised entropy family; Atkinson et al. (1995) for a number of LIS-countries; Wagstaff and van Doorslaer provide more recent results, focussing on the financing of health care (2001, Wagstaff et al. 1999a, 1999b, van Doorslaer et al. 1999). Immervoll and Richardson (2011) is one of the few studies that investigates the redistributive impact of taxes and benefits over time, using data from LIS, but they focus on the working-age population only. An empirical assessment of the redistributive role of income taxes is particularly needed in a period of continuous changes to the tax system. Sabirianova Peter et al. (2010) document that 30% of high income countries changed yearly both statutory rates and thresholds of their Personal Income Tax between 1996 and 2005. The consequences of tax reforms are less clear than it may appear at first sight. For example, a reduction of the marginal tax rate does not necessarily mean low progressivity because the final effect depends on the overall structure of the tax system and the interaction with the distribution of taxable income.

In this paper we build further on Wagstaff and Van Doorslaer (2001) and Verbist (2004) and provide insight into the progressivity and redistributive effect of the different personal income tax components. Our results illustrate that distributive outcomes can in some cases be counter to expectations or policy design intentions. We aim to provide insight into the reasons of such possible counterintuitive outcomes, while our empirical evidence may serve as a guidance for 'marginal' tax reforms.

3 Measuring the redistributive and progressivity effect of taxes

Following common practice in the literature we use the term "redistributive effect of taxes" for the change in income inequality achieved through taxes. The redistributive effect of taxes depends on the one hand on the departure from proportionality, i.e. the degree of progressivity, and on the other hand on the tax level, measured by the average tax rate. A tax system is called progressive when the proportion of income that is collected as tax liability increases with income (i.e. the average tax rate increases with income). When measuring the redistributive effect of taxes, we (implicitly) compare the existing tax system with a proportional tax that yields the same revenue. This (hypothetical) proportional tax is distributionally neutral, as it preserves the relative pre-tax income differences.[1]

For measuring the redistributive and progressivity effects of tax instruments we follow the literature initiated by Musgrave et al. (1948) and Kakwani (1977a, 1977b) that propose a number of indexes in the Lorenz curve framework.[2]

We measure the redistributive impact by using the Reynolds-Smolensky (1977) index, which equals the difference between the Gini coefficient of pre-tax income and the concentration coefficient of post-tax income:

$$RS = G_X - C_{X-T} \qquad (1)$$

Following Kakwani (1977a) the progressivity is given by the difference between the concentration coefficient of taxes and the Gini of pre-tax income[3]:

$$\Pi_T = C_T - G_X \qquad (2)$$

[1] This applies only within the framework of scale-invariant inequality measures, which are used here.

[2] Other measures for progressivity and redistributive effect have been proposed in the literature. For information on measures based on e.g. distances and relative concentration curves, see Lambert (2001).

[3] For large samples the minimum value of the Kakwani index is - (1 + G_X) (i.e. when the poorest person pays all the tax, C_T = -1), while its maximum value is 1 - G_X, what corresponds with maximal progressivity. More details on the derivation of these formulae can be found in e.g. Lambert (2001) and Verbist (2004).

There is a close link between the measures of progressivity and those of redistributive effect. The redistributive effect appears to be a function of progressivity and of the tax level, i.e. total tax as a fraction of total net income *t/(1-t)*:

$$RS = \frac{t}{1-t}\Pi_T \qquad (3)$$

Moreover, progressivity can be decomposed over the different factors that build up a tax system. The personal income tax schedule is a complex of various measures. Final tax liability is determined by different factors: the pre-tax income, tax exempt (categories of) income, tax deductions and tax allowances that can be applied on pre-tax income, the rate schedule and tax credits. The pre-tax income includes all income components before tax, and thus determines to a great extent tax liabilities.

Taxable income must be distinguished from pre-tax income. Some categories of income are part of pre-tax income, but are not included in the concept of taxable income; we refer to these income concepts as tax exemptions *E* (e.g. child benefits in most countries).

A further distinction between pre-tax and taxable income arises from the existence of tax allowances and deductions. Tax allowances *A* are a fixed amount subtracted from pre-tax income. Tax deductions *D(X)* also reduce taxable income. Contrary to tax allowances, they are not a fixed amount but their level is a function of pre-tax income. The effect of the different components can be measured by using decomposition formulae that make clear how the rate structure and the various tax advantages contribute to overall progressivity and redistribution. We use the analytical framework presented in Pfähler (1990) and Loizides (1988). Other decompositions are possible, but this one has the advantage that it follows the logic of the tax system. The transition from pre-tax income *X* to taxable income *Y* can be represented as:

$$Y = X - E - A - D(X)$$

The rate schedule r(.) is then applied to taxable income, thus leading us to gross tax liability $T_g = r(Y)$. Finally, we find net (or final) tax liability *T* by reducing gross tax liability T_g with total tax credits *K*:

$$T_{pit} = T_g - K.$$

Net (or disposable) income is $N = X - [\, r(X - E - A - D(X)) - K] = X - T_{pit}$

Progressivity of (net) personal income tax liabilities (or shortly 'net progressivity') results from the effect of gross tax liabilities minus that of tax credits, as $T_{pit} = T_g - K$. The average tax rate is $t_{pit} = t_g - k$, where t_g is the average rate of gross tax liabilities (T_g/X) and *k* is the average rate of tax credits ($k = K/X$). Thus, we find:

$$\Pi_{T_{PIT}} = \frac{t_g}{t_{pit}}\Pi_{T_g} + \frac{k}{t_{pit}}\Pi_K \qquad (7)$$

Π_{Tg} is the Kakwani index of gross tax liabilities. Π_K shows the degree of disproportionality of tax credits *K* relative to the distribution of pre-tax income, or $\Pi_K = G_X - C_K$. A positive Kakwani index of tax credits indicates that the tax credit goes relatively more to the lower end of the income distribution, and is thus pro-poor.

Progressivity of gross tax liabilities (or 'gross progressivity') results on the one hand from the effect of the tax rate structure, which we call 'direct progressivity', and on the other hand from the effect of the tax base structure, which is 'indirect progressivity'[4]:

$$\Pi_{Tg} = \left(C_{Tg} - C_Y\right) + \left(C_Y - G_X\right) \qquad (8)$$

The first term of this formula measures *direct progressivity*, which follows from the progressive tax rate schedule applied on taxable income. We call this the pure rate effect, which is represented by the index[5]:

$$\Pi_R = C_{T_g} - C_Y \qquad (9)$$

The second term looks at *indirect progressivity*, which is caused by taxable income falling short of pre-tax income and is measured by C_Y - G_X. Gross tax liability T_g= *r(Y)* is calculated on taxable income *Y = X - E - A - D(X)*, i.e. income after subtraction of exempt income *E*, tax allowances *A* and tax deductions *D(X)*. Analogously with (6) we can write:

$$C_Y - G_X = \frac{e}{1-e-a-d}\Pi_E + \frac{a}{1-e-a-d}\Pi_A + \frac{d}{1-e-a-d}\Pi_D \qquad (10)$$

with :

- *e* as the average rate of exempt income and $\Pi_E = G_X - C_E$ measuring the disproportionality of exempt income;
- *a* as the average rate of allowances and $\Pi_A = G_X - C_A$ measuring the disproportionality of allowances;
- *d* as the average rate of deductions, and $\Pi_D = G_X - C_D$, measuring the disproportionality of deductions.

[4] The terms 'direct' and 'indirect' progressivity come from Pfähler (1990), but the content is not exactly the same. Pfähler defines direct progressivity as C_T-C_Y , which means that it contains both the pure rate effect and the effect of tax credits, whereas we reserve the term for the pure rate effect $C_{T_g} - C_Y$. For indirect progressivity, Pfähler uses the expression C_{E+A+D} -G_X, i.e. progressivity of tax-free income w.r.t. pre-tax income.

[5] For some countries the rate effect we measure here includes also other elements. In some countries there exists the option to have individual or joint taxation (e.g. Ireland, Luxembourg, Spain; see also O'Donoghue et al. 1999); the effect of this distinction is measured in the rate effect. This is also the case for the "quotient familial" in France. These remarks have to be born in mind when interpreting the results.

Just as with tax credits, a positive value of Π_E, Π_A and Π_D corresponds with exemptions, allowances and deductions benefiting relatively more to lower incomes, and thus enhancing overall progressivity, and consequently overall vertical equity.
The decomposition of gross tax liability progressivity thus takes the form:

$$\Pi_{T_g} = \Pi_R + \frac{e}{1-e-a-d}\Pi_E + \frac{a}{1-e-a-d}\Pi_A + \frac{d}{1-e-a-d}\Pi_D \qquad (11)$$

The explanation above shows clearly that the measures of redistributive effect and progressivity are sensitive to the definition of the base income concept (i.e. *X*). In order to guarantee cross-country comparability, in this paper we use a broad definition for the pre-tax income concept, namely gross income. But it is also possible to use market income (e.g. if one wants to investigate the redistributive effect of taxes and benefits jointly) or taxable income. Changing the income concept will lead to different results (see e.g. Verbist 2002 for a comparison of progressivity of taxes in Belgium with gross income and market income as the base income concept).

4 EUROMOD

4.1 Model and data

As most datasets commonly used to study redistributive outcomes of policies do not include detailed information on taxes, these can be simulated with a microsimulation model. The EU-SILC data, for instance, have a variable for the total amount of personal income taxes and social contributions, but not for either of them separately, let alone that the different tax components can be identified. Moreover, the cross-country comparability is hampered by the different ways in which such information is collected: in some countries taxes are self-reported by the interviewed, in others taken form administrative registers or simulated.

In order to disentangle the effect of different tax components in a cross-country perspective, we use EUROMOD, the multi-country European wide tax-benefit model. Using the information available in the underlying datasets and on the basis of the tax-benefit rules in place, EUROMOD simulates cash benefit entitlements, direct tax, social insurance contribution. Instruments which are not simulated (due to data constraints), as well as market incomes, are taken directly from the input datasets. For further information on EUROMOD, see Sutherland and Figari (2013).

EUROMOD is a static model in the sense that the arithmetic simulation of taxes and benefits abstract from potential behavioural reactions of individuals. As such, EUROMOD is of value in terms of assessing the first order effects of tax-benefit policies and in providing detailed information on each component of the simulated tax-benefit systems usually not available in the underlying datasets.

The tax-benefit systems simulated in this paper refer to 2008. The simulations of 2008 policy systems are performed on EU-SILC data in all countries but the UK where the Family Resource Survey is used because more appropriate for microsimulation purposes. If the policy year does not match the income reference period, monetary values have been updated (e.g. from 2007 to 2008) according to the appropriate price and income indices. See EUROMOD Country Reports for more details.

4.2 Personal Income Taxes in EUROMOD

Gross income components are taken directly from the dataset or, where necessary, are imputed from net income (see Immervoll and O'Donoghue, 2001). Gross income includes all gross cash benefit payments, gross income from work (salaries, wages, self-employment income), property income, other cash market income and occupational pension income. To arrive at disposable or net income (N) we subtract social insurance contributions (T_{SIC})[6], personal income taxes (T_{PIT}) and other taxes (T_{OTH}) from gross income (X):

$$N = X - T_{PIT} - T_{OTH} - T_{SIC}$$

In Verbist and Figari (2014) we investigated the redistributive and progressivity effect of these three types of taxes. Here we focus on personal income taxes. In most countries, the personal income tax (PIT) schedule is a complex of different components, such as the rate structure and various tax advantages, that are all simulated in EUROMOD. The OECD distinguishes the following types of tax advantages (see e.g. OECD 2010): exemptions are amounts excluded from the tax base (e.g. child benefits in most European countries); allowances are fixed amounts subtracted from pre-tax income (e.g. for old age in some countries) while deductions are income-dependent amounts subtracted from pre-tax income (e.g. for professional expenses); tax credits are amounts deducted from tax liability and are in some cases refundable (or non-wastable), i.e. if the tax credit exceeds tax liability, the amount of the excess is paid to the taxpayer. The first three types of measures make up the difference between pre-tax income and the tax base, on which the rate schedule is applied. In Table 1 we present the main characteristics of the rate schedule as it is simulated in EUROMOD for the 2008 policy system. In most countries, a limited number of bands is in place (between two and five), with Luxembourg as a notable exception with 17 bands. Compared to 10 years ago, this entails in most countries a decrease in number of bands and top rates. Top rates vary between a 15% and 52%. As is shown in Table 1, some countries apply a zero tax band, whereas others do not. This illustrates that it is not always easy to demarcate the various tax components in the PIT system: some countries grant tax credits that fulfil a similar role as the zero tax band (e.g. the basic tax credit in Belgium), or a tax allowance (e.g. in the United Kingdom). In section 5.3 we explore ways of dealing with this issue.

[6] Whenever it is relevant the social insurance contributions are deducted from personal income tax.

Table 1: Basic characteristics of personal income tax schedules in EU-15, 2008.

	Number of bands	Lowest tax rate	Highest tax rate	Basic tax credit	Basic tax allowance
Austria	4	0	50	no	No
Belgium	5	25	50	yes	No
Denmark[1]	2	5.48	15	no	Yes
Finland[1]	4	6.5	31.5	no	yes
France	5	0	40	no	No
Germany [2]	-	14	45	no	Yes
Greece	5	0	40	no	No
Ireland	2	20	41	yes	No
Italy	5	23	43	no	No
Luxembourg	17	0	38	no	No
Netherlands	4	2.45	52	yes	No
Portugal	7	10.5	42	yes	No
Spain	4	15.66	27.13	yes	Yes
Sweden[1]	3	0	25	no	Yes
UK	2	20	40	no	Yes

Notes: [1] For the Scandinavian countries, these tax rates do not include local taxes. These local taxes are proportional, and the tax rate varies according to locality. In EUROMOD average local tax rates are applied.

[2] The tax schedule is not based on tax bands, but on a polynomial.

When EUROMOD allows it, we also include local and regional taxes. For the Scandinavian countries these local taxes are proportional, and the tax rate varies according to locality/region. In EUROMOD an average local tax rate is applied for Denmark (24.81%), Finland (18.55%) and Sweden (31.5%). In the case of Italy and Spain the distinct regional tax rates are used in the simulations for the regional taxes.

4.3 Some assumptions and caveats

We assume full tax compliance and 100% of benefit take-up and our results can be interpreted as measuring the intended redistributive effects of the different components embedded in the tax-benefit systems.[7]

Based on the literature (e.g. Piketty and Saez 2007) we rely on plausible and simple assumptions about the incidence of taxes that need to be taken into account in the interpretation of the results. First, we do take into account the effect of taxes paid on benefits. Second, we consider the pre-tax income distribution as given without considering the impact of behavioural decisions or macro-economic aspects which can be affected by the tax-benefit system in place in each country. Third, as our analysis is static, we look at the redistributive impact of taxes at a given point in time;

[7] However, given the incidence of the shadow economy in Italy, gross self-employed income has been calibrated in order to obtain an aggregate amount corresponding to that reported in fiscal data (Ceriani, Fiorio and Gigliarano, 2013).

this is relevant as these taxes affect disposable income of households, and thus their living standards. We do not adopt a life-cycle perspective although it is important to recognise that income taxes appear less progressive from a lifetime perspective (Bengtsson, Bertil and Waldenström, 2012).

5 Progressivity of personal income taxes in the EU

Personal income taxes are in most countries the most important contributor to the redistributive effect of taxes in the EU-15. Therefore, we will go into more depth how this comes about. We have already pointed out that the PIT system is a complex of various measures (exemptions, allowances etc.). In this section we apply the decomposition explained in section 3 and study how these various components contribute to PIT progressivity. As we have seen, there is a wide variety among countries in the composition of the tax base, in the kind of tax advantages that are granted (allowances, deductions and credits) and the structure of the rate schedule. So progressivity in the EU will result from different instruments. Note that we call an instrument progressive when its Kakwani is higher than 0.10, regressive when it is lower than -0.10 and proportional when the Kakwani is between -0.10 and 0.10.

5.1 Level and progressivity of the PIT components

Taxable income (i.e. the income on which the rate structure is applied) is between 62% (France) and 87% (Denmark) of gross income (derived as 100% minus the average rate of exemptions, allowances and deductions). The gap between taxable and gross income follows in general mainly from deductions. The only exceptions are Italy, where exemptions are more important, and Ireland, the Netherlands and the UK that use allowances of some substance. Deductions are very important (+20%) in France, Portugal and Spain; and important (+10%) in Austria, Belgium, Finland, Germany, Greece, Luxembourg and Sweden. Most of these deductions are earnings-related or are social insurance contributions. Only in Germany, deductions are mainly related to old age and pensions, whereas in the Netherlands the mortgage interest deductions have most weight. Exemptions are important in Ireland, Italy, Luxembourg and the United Kingdom. Credits have some weight in Belgium, Ireland and Spain, but are small in other countries.

There is again a wide variety among countries when we look at the structure of the tax components: some are pro-poor, whereas others are regressive or rather proportional. In most countries exemptions are pro-poor. Some countries even have a very high value of the Kakwani index for exemptions. This relates in general to the fact that some social benefits are exempt; the more these benefits are concentrated among the lower income groups, the more pro-poor their exemption of taxation is. The highest

Kakwani indices are found in those countries where exemptions include mainly benefits for unemployment or minimum income support, as is the case in Ireland and the United Kingdom. In Austria, Belgium, Germany, Luxembourg and the Netherlands exemptions consist mainly of family related benefits, more specifically child benefits. In the Netherlands the taxable part of imputed rent is included as a negative exemption, and is an important component which probably explains the high value of the Kakwani.

Table 3: Average rate as a proportion of gross income and Kakwani indices of PIT components (Exemptions E, Deductions D, Allowances A, Rate schedule R, Credits K), in the EU-15 countries, 2008.

	Average tax rate				Kakwani indices				
	Exemptions (e)	*Deductions (d)*	*Allowances (a)*	*Credits (k)*	*Exemptions (e)*	*Deductions (d)*	*Allowances (a)*	*Rate schedule (r(y))*	*Credits (k)*
Austria	0.061	0.126	0.005	0.011	0.464	-0.030	0.173	0.206	0.279
Belgium	0.061	0.187	0.000	0.092	0.201	-0.048	.	0.078	0.297
Denmark	0.044	0.082	0.000	0.000	-0.060	-0.143	.	0.101	.
Finland	0.092	0.124	0.000	0.012	0.025	0.332	.	0.072	-0.019
France	0.073	0.304	0.000	0.017	0.634	0.072	.	0.306	-0.374
Germany	0.048	0.150	0.000	0.000	0.771	0.244	.	0.205	.
Greece	0.093	0.119	0.000	0.003	0.082	-0.011	.	0.357	-0.181
Ireland	0.100	0.016	0.103	0.110	0.519	-0.215	-0.107	0.099	0.106
Italy	0.104	0.083	0.000	0.060	0.010	-0.022	.	0.052	0.327
Luxembourg	0.105	0.172	0.000	-0.003	0.120	0.056	.	0.281	-0.312
Netherlands	0.008	0.077	0.074	0.008	2.857	-0.146	0.271	0.256	0.247
Portugal	0.054	0.319	0.000	0.024	0.367	0.241	.	0.131	0.151
Spain	0.033	0.232	0.000	0.091	0.065	0.255	.	0.048	0.095
Sweden	0.079	0.102	0.000	0.015	0.188	0.190	.	0.041	-0.439
United Kingdom	0.130	0.023	0.244	0.000	0.665	-0.198	0.214	0.056	-0.064

Notes: Income are equivalised using the modified OECD equivalence scale.
Source: Authors' analysis based on EUROMOD

Deductions are pro-poor in Finland, Germany, Portugal, Spain and Sweden. In Germany, deductions are aimed at pensioners, who situated relatively more in the lower part of the distribution. In the other countries, deductions are mainly earnings related or social insurance contributions. Deductions are pro-rich in Denmark, Ireland, the Netherlands and the UK. In Ireland and the UK these are (private) pension contributions, which are clearly concentrated at the upper end of the distribution. In the Netherlands, this is mainly the mortgage interest tax relief.

Allowances are pro-poor in all countries where they are used, except in Ireland.

The rate schedule is everywhere progressive. Here we have some interesting results. One might assume that a large number of tax bands would lead to a more progressive tax system: the more tax bands, the more the tax rate increases with income. But apparently there is no relationship between the number of tax bands and rate progressivity: countries with the largest number of tax bands are not necessarily the most progressive in their rate structure, and vice versa (cf. Table 1; e.g. Belgium, which has 5 tax bands and a low value for rate progressivity, whereas Sweden has

only 3 tax bands but the highest value of Π_R). Something similar applies for the upper tariff: Austria, Belgium and the Netherlands have the highest top rates, but their Π_R are not that high compared to other countries with lower top rates like the Nordics. Here the role of pre-tax income inequality, the composition of taxable income and the role of joint or individual taxation become apparent. This also shows how important the characteristics of the underlying income distribution are. The rate schedule is most progressive in France and Greece; in France this also includes the effect of the application of the 'quotient familial'.

Credits are pro-poor in Austria, Belgium, Ireland, Italy, the Netherlands and Portugal. These credits are mainly family policy related and lump sum. Credits are pro-rich in France, Greece and Luxembourg.

5.2 Contribution to progressivity of the PIT components

The structure and weight of the different PIT components are brought together in Figure 2, where we show the contribution of each component to total PIT progressivity. What strikes immediately is that the rate structure is the most important factor in most countries. Furthermore, there is a strong effect from exemptions and/or allowances in France, Ireland and the UK, from deductions in Portugal and Spain, and from credits in Belgium, Ireland, Italy and Spain, as well as in France but then in a negative way. In 10 of the 15 countries the rate schedule accounts for the majority of total progressivity. In Austria, Denmark, France, Greece, Luxembourg and the Netherlands more than 80% of progressivity comes from the rate structure. These are in general the countries with the highest Π_R^K. In 3 countries progressivity results mainly from the composition of the tax base (i.e. the joint effect of exemptions, deductions and allowances): this is the case for Portugal, the UK and Sweden. In Belgium and Spain, we find a mixture of the rate structure, credits and exemptions.

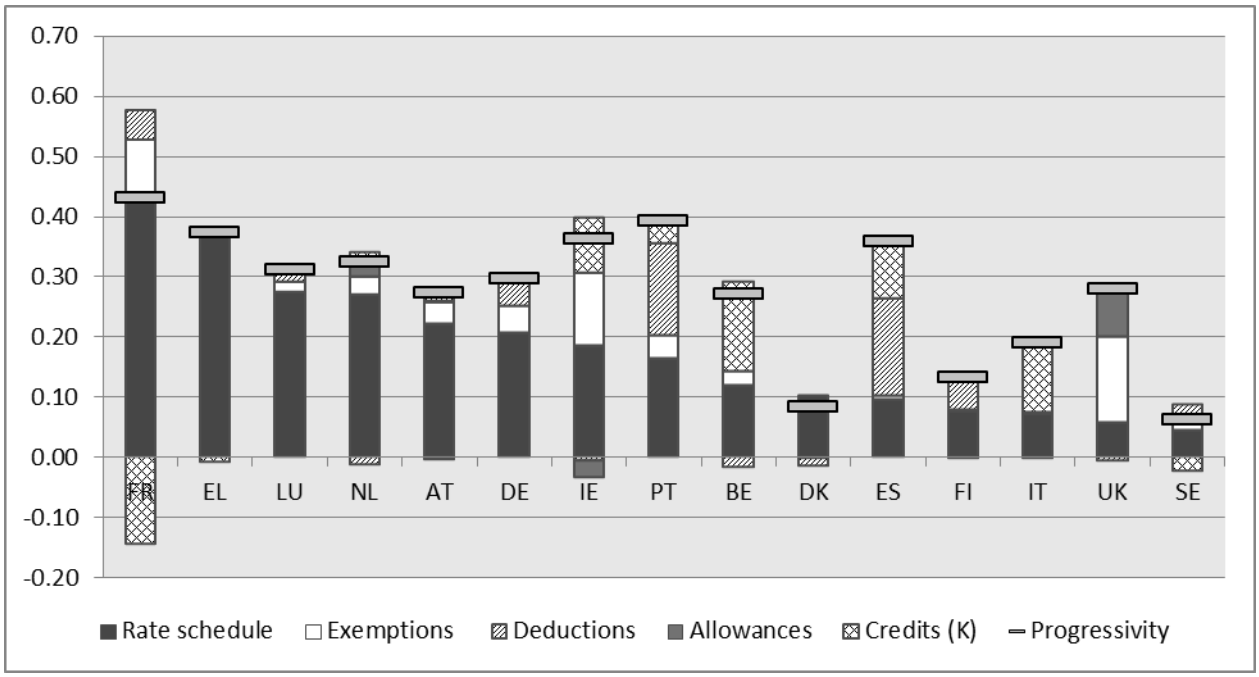
We can thus distinguish three groups of countries:

1) rate structure countries: Austria, Denmark, Finland, France, Germany, Greece, Luxembourg and the Netherlands;
2) tax base composition countries:, Portugal, Sweden and UK;
3) mixed structure countries: Belgium, Ireland, Italy and Spain.

Compared to 1998, this grouping of countries has somewhat changed (see Verbist 1998): Italy, Spain and Sweden were rate structure countries in 1998, Ireland was a tax base country, while Austria was in the group of mixed structure. We can compare this further with the typology in Wagstaff and van Doorslaer (2001), though we have to be careful: the databases are not the same, and the income concept is also quite different. In Wagstaff and van Doorslaer, taxable income is used and not gross income; exemptions E are not taken into account (as the data were not available in the administrative OECD dataset). Their analysis refers to the mid-late 1980s and most

countries have embarked on rather substantial tax reforms towards the end of the eighties. However, bearing these caveats in mind, we try to draw some conclusions about the evolution of the PIT systems over the longer term. As a broad pattern we see that the rate structure was already the major source for progressivity in the mid-eighties, and apparently this pattern has been reinforced in the countries of the EU-15 in the mid-late 1990s (see Verbist, 2004) and late 2000s.

Figure 2: Contribution of the various PIT components to PIT progressivity, 2008.



Notes: Income are equivalised using the modified OECD equivalence scale. Source: Authors' analysis based on EUROMOD

5.3 The effect of the zero band rate

What is common in most countries is that part of income is not taxed; countries, however, apply a wide variety of instruments to achieve this. Some countries have a zero band rate, others have a basic tax allowance or a basic tax credit. In order to make this visible, we try to isolate the contribution of this zero-taxed part to overall progressivity.

We make this comparison for a selection of countries that represent the different ways of operationalizing this zero-taxed part (cf. Table 1):

- Ireland, which has a basic tax credit;
- Italy, which has no zero-taxed part;
- Sweden, which combines a zero tax band with a basic allowance; and
- the United Kingdom which has a basic allowance.

We have applied two approaches to enhance comparability across countries when it comes to analysing the effect of the zero-taxed part. In a first approach, we identify the zero-taxed part and then integrate this is in the rate structure as a kind of zero band. By doing this, we make the rate effect comparable across countries. The rate effect now increases considerably as is illustrated by the much larger contribution of the rate effect to total PIT progressivity (second panel of Table 4). For e.g. Ireland, the effect of credits even becomes negative, while the contribution of the rate effect becomes overpowering. This gives a first indication of the strong progressivity effect of the basic tax credit in Ireland. In Sweden we see a similar movement, but then related to allowances, the effect of which drops considerably while the rate effect now contributes more than 100% to total tax progressivity. A similar though somewhat less pronounced shift occurs in the United Kingdom.

Table 4: Contribution to PIT progressivity in the EU-15 countries (as a % of total PIT progressivity), 2008.

	Baseline			Integrating zero-taxed part in rate effect			Isolating zero-taxed part			
	Exemptions + Deductions + Allowances	*Rate effect*	*Credits*	*Exemptions + Deductions + Allowances*	*Rate effect*	*Credits*	*Exemptions + Deductions + Allowances*	*Zero-taxed part*	*Residual Rate effect*	*Credits*
Ireland	24.3%	50.5%	25.1%	15.3%	122.8%	-38.0%	24.3%	63.1%	50.5%	-38.0%
Italy	-0.7%	37.4%	63.3%	-0.7%	37.4%	63.3%	-0.7%	-	37.4%	63.3%
Sweden	69.3%	68.1%	-37.4%	23.8%	113.6%	-37.4%	28.6%	-2.1%	110.9%	-37.4%
UK	80.0%	20.0%	-	34.8%	65.2%	-	46.5%	25.9%	27.5%	-

Notes: Income are equivalised using the modified OECD equivalence scale.
Source: Authors' analysis based on EUROMOD

The second approach to show the effect of the zero-taxed part is to isolate this from whichever instrument it is integrated in, notable the allowance, the zero band rate or the credit; for countries where it its integrated in the rate structure, this means splitting the rate effect in a zero rate effect and what we call a residual rate effect (see right-hand panel of Table 4). In Ireland and the United Kingdom, the zero-taxed part and the rate effect have a more or less similar weight in terms of contribution to progressivity, while for Sweden the residual rate effect brings about all the effect.

5.4 Increasing the top rate

Finally, we want to study in somewhat more detail the role of the top tariffs on progressivity. We already showed that, even though they are often used as a face-value indicator for progressivity, there is certainly no one-to-one relationship between the top tariff and PIT progressivity. We illustrate this further by simulating an increase in the top tariffs with 5 percentage points in the EU-15 countries. As already mentioned top rates range from 25% to 52% (see Table 1), which might be one of the determinants of differential outcomes across countries. Also, the share of taxpayers that falls under the top tariff is of course relevant.

Table 5: Kakwani indices of personal income taxes after increasing top tariffs in personal income tax with 5 percentage points, 2008.

	Kakwani index				Share of taxpayers with taxable income at top rate
	Baseline	*After increase top tariff*	*Absolute change wrt baseline*	*% change wrt to baseline*	
Austria	0..2739	0.2801	0.0062	2.3%	8.9%
Belgium	0.2722	0.2786	0.0064	2.3%	16.7%
Denmark	0.0846	0.0956	0.0110	13.0%	20.0%
Finland	0.1336	0.1374	0.0038	2.8%	3.4%
France	0.4317	0.4319	0.0002	0.0%	3.6%
Germany	0.2965	0.2982	0.0017	0.6%	0.3%
Greece	0.3726	0.3750	0.0024	0.6%	1.5%
Ireland	0.3638	0.3716	0.0078	2.2%	28.2%
Italy	0.1905	0.1934	0.0029	1.5%	1.7%
Luxembourg	0.3116	0.3237	0.0121	3.9%	45.9%
Netherlands	0.3250	0.3324	0.0074	2.3%	9.6%
Portugal	0.3917	0.3933	0.0016	0.4%	1.9%
Spain	0.3592	0.3617	0.0025	0.7%	2.8%
Sweden	0.0634	0.0679	0.0045	7.1%	5.0%
UK	0.2797	0.2912	0.0115	4.1%	9.2%

Notes: Income are equivalised using the modified OECD equivalence scale.
Source: Authors' analysis based on EUROMOD.

As expected, progressivity goes up in all countries, but the impact varies widely across countries (see Table 5). The strongest increase in relative terms occurs in Denmark and Sweden, both countries that currently have a relatively low top rate (15% and 25% respectively). Also in Luxembourg and the UK, countries with a rather average top rate, the rise is relatively important in absolute terms. The impact is very small, if not to say negligible, in the Southern European countries and France. Changes are in general larger in countries where more tax payers are affected by the top tariff, but also here there is no clear cut pattern. Overall this analysis strengthens the point that the value of top tariffs are not the only drivers of progressivity, and that other factors are important to consider too.

6 Conclusions

Summarising, the following observations and conclusions can be drawn on the basis of our EUROMOD-research on the redistributive and progressivity effect of personal income taxes in the EU-15. As expected, there is a wide variation in the EU-15 in the redistributive efforts through personal income taxes on household income. If we concentrate on PIT progressivity, we find that most tax exemptions and tax

allowances enhance progressivity. The evidence on tax deductions and tax credits is much more mixed. The rate structure always contributes positively to the progressivity of the PIT system, but there is a wide variety among countries in the importance of this instrument. For some countries (e.g. Greece, Luxembourg, Denmark) it is almost the sole source of progressivity, whereas in other countries its relative contribution to overall progressivity amounts only to less than one third (e.g. Spain and the United Kingdom.

Almost all countries have an instrument to tax part of taxable income at a zero rate: either there is a zero band rate, or there is a kind of basic allowance or tax credit. Our analysis for a selection of countries has shown that this zero-taxed part offers a considerable contribution to overall progressivity, but the impact is far from uniform across countries. We plan to extend this analysis for other countries.

Simulating an increase in top tax tariffs, provides further insight into the role of these tariffs in progressivity of taxes: also here the impact differs across countries. Overall this analysis strengthens the point that the value of top tariffs are not the only drivers of progressivity, and that other factors are important to consider too.

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