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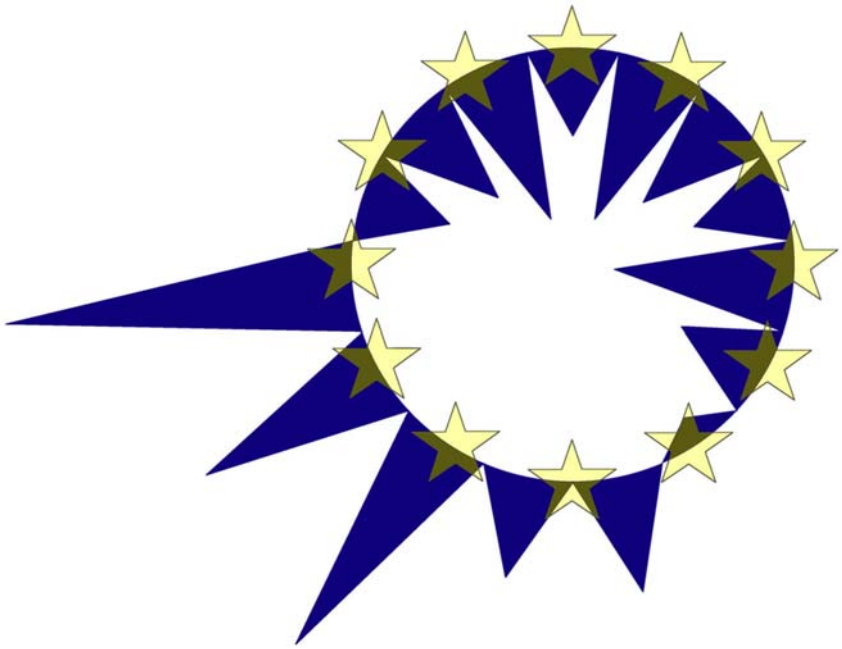

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REDISTRIBUTIVE EFFECT AND PROGRESSIVITY OF TAXES: AN INTERNATIONAL COMPARISON ACROSS THE EU USING EUROMOD

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Redistributive effect and progressivity of taxes
An International Comparison across the EU using EUROMOD

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Abstract

This paper gives an international comparison of the redistributive effect of personal income taxes in the 15 countries of the EU, using the European tax-benefit model EUROMOD. We focus on the effect of personal income taxes, social insurance contributions and other direct taxes. We present the contribution of progressivity and average tax rate to the reduction of income inequality, as well as the weight of the various types of tax concessions (i.e. exemptions, deductions, allowances and credits). There appears to be a wide variety among countries in the level of inequality reduction as well as in the instruments used to achieve this reduction. Personal income taxes are in all countries the most important source for inequality reduction, which is to a large extent, though not solely, due to the progressive rate schedule. Countries with a high degree of pre-tax inequality do not systematically redistribute more through their taxes; the results indicate rather the opposite.

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

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EUROMOD relies on micro-data from 12 different sources for fifteen countries. These are the European Community Household Panel (ECHP) User Data Base made available by Eurostat; the Austrian version of the ECHP made available by the Interdisciplinary Centre for Comparative Research in Social Sciences; the Panel Survey on Belgian Households (PSBH) made available by the University of Liège and the University of Antwerp; the Income Distribution Survey made available by Statistics Finland; the Enquête sur les Budgets Familiaux (EBF) made available by INSEE; the public use version of the German Socio Economic Panel Study (GSOEP) made available by the German Institute for Economic Research (DIW), Berlin; the Living in Ireland Survey made available by the Economic and Social Research Institute; the Survey of Household Income and Wealth (SHIW95) made available by the Bank of Italy; the Socio-Economic Panel for Luxembourg (PSELL-2) made available by CEPS/INSTEAD; the Socio-Economic Panel Survey (SEP) made available by Statistics Netherlands through the mediation of the Netherlands Organisation for Scientific Research - Scientific Statistical Agency; the Income Distribution Survey made available by Statistics Sweden; and the Family Expenditure Survey (FES) made available by the UK Office for National Statistics (ONS) through the Data Archive. Material from the FES is Crown Copy right and is used by permission. Neither the ONS nor the Data Archive bear any responsibility for the analysis or interpretation of the data reported here. An equivalent disclaimer applies for all other data sources and their respective providers cited in this acknowledgement.

1 Introduction

The relative welfare position of households will be modified by income taxes if these are not proportional. This impact of taxes on the income and welfare distribution is called the redistributive effect of 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 on the tax level, measured by the average tax rate. In this paper we use the microsimulation model EUROMOD to compare the redistributive effect of social security contributions and income taxes in the countries of the EU-15 (i.e. those countries that formed the European Union before 1st May 2004). How do these taxes relate to one another with respect to inequality reduction, progressivity and tax level? Is there a relationship between pre-tax income inequality and the extent of redistribution through taxes? How do the various measures of the tax system (e.g. the rate structure, tax allowances, deductions and credits) contribute to progressivity, and consequently to the redistributive effect?

Our analysis is confined to personal income taxes, social security contributions and other direct taxes on income. This means that an important part of the distributional process is not included, namely social benefits and transfers in kind. For an analysis of the joint effect of taxes and social benefits using EUROMOD, we refer to Immervoll et al. (2004). Another limitation of our analysis is that we have not taken account of potential changes in household behaviour (e.g. labour supply responses) and in macro-economic aggregates (e.g. inflation, economic growth), which affect the pre-tax income distribution. As our analysis is static, we do not adopt a life-cycle perspective. Nevertheless, it is interesting to look at the redistributive impact of taxes on income inequality at a given point in time, as these taxes affect disposable income of households, and thus their income security.

International comparisons of the redistributive effect of taxes are up until now relatively rare; we present an overview of the literature in section 2. Next, we discuss the microsimulation model EUROMOD, together with an overview of the content and characteristics of the various tax instruments that are used in each country. In section 3 we present the measures we use for analysing the redistributive effect and progressivity of taxes. Special attention will be given to the decomposition measures for progressivity over the different tax instruments. Next, we apply these measures for each EU-country using EUROMOD. We first look at the total of taxes, and then in section 6 we focus on personal income taxes. The last section brings the conclusions together.

2 Background: what do we know from previous research?

There are few studies that present an international comparison of the redistributive effect of taxes. Wagstaff et al. (1999a)[2] have compared twelve OECD countries; the

[2] Berglas (1971) presents results for UK, France, US, West-Germany and Japan; Kakwani (1977a) compares Australia, Canada, UK and US, based on official data; Zandvakili (1994) compares 8 LIS-countries by using the measures from the generalised entropy family; Atkinson et al. (1995) for a

results for Belgium are calculated in Verbist (2002). The results are derived from either survey or administrative data on a representative sample of the population. The data sources used are not all from the same year (see table 1). Also the sampling unit, and as a consequence the unit of analysis, is not identical for all surveys: for most countries the unit of analysis is the household or the family, for Switzerland it is the tax unit. Another difference lies in the way tax data are obtained: for most countries actual tax payments are provided through the questionnaire or from the tax authority's tax files, for some countries tax data are estimated with a microsimulation model (i.e. for Belgium, Italy, Germany and the US). The income concept used is gross income defined along the lines of the LIS (cf. Smeeding et al., 1985). The income taxes included are all personal income taxes, irrespective of the level of government at which they are levied and are calculated net of any tax credits. Social insurance contributions are excluded, as are any taxes on capital gains and on imputed income from owner occupancy. In our calculations with EUROMOD we will use a wider scope of taxes and include social insurance contributions and other direct taxes. Both income and income tax payments are equivalised using a parametric equivalence scale e_i [3] in each country. The main results for thirteen countries are presented in table 1 and figure 1.

Table 1: Decomposition of redistributive effect over vertical, horizontal and reranking contributions for 13 OECD countries, equivalent incomes.

Country (year)	G_X	G_N	*RE*	*RE as % of* G_X	*t*	Π_T^K
Belgium (1992)	0.2980	0.2335	0.0645	21.6	0.2040	0.2465
Denmark (1987)	0.3023	0.2703	0.0320	10.6	0.2966	0.0938
Finland (1990)	0.2685	0.2253	0.0432	16.1	0.2188	0.1644
France (1989)	0.3219	0.3065	0.0154	4.8	0.0620	0.2717
Germany (1988)	0.2591	0.2312	0.0279	10.8	0.1108	0.2433
Ireland (1987)	0.3870	0.3418	0.0452	11.7	0.1540	0.2685
Italy (1991)	0.3248	0.3009	0.0239	7.4	0.1354	0.1554
Netherlands (1992)	0.2846	0.2517	0.0329	11.6	0.1487	0.1977
Spain (1990)	0.4083	0.3694	0.0389	9.5	0.1397	0.2545
Sweden (1990)	0.3004	0.2608	0.0396	13.2	0.3270	0.0891
Switzerland (1992)	0.2716	0.2541	0.0174	6.4	0.1210	0.1528
UK (1993)	0.4121	0.3768	0.0352	8.5	0.1421	0.2278
US (1987)	0.4049	0.3673	0.0376	9.3	0.1370	0.2371

Notes: *RE* is the difference between pre-tax (G_X) and post-tax Gini (G_N), *t* is the average tax rate, Π_T^K is the Kakwani index of progressivity computed on the assumption that all households face the same tax schedule (see Wagstaff et al. 1999a).
Sources: for Belgium Verbist (2002); for other countries Wagstaff et al. (1999a)

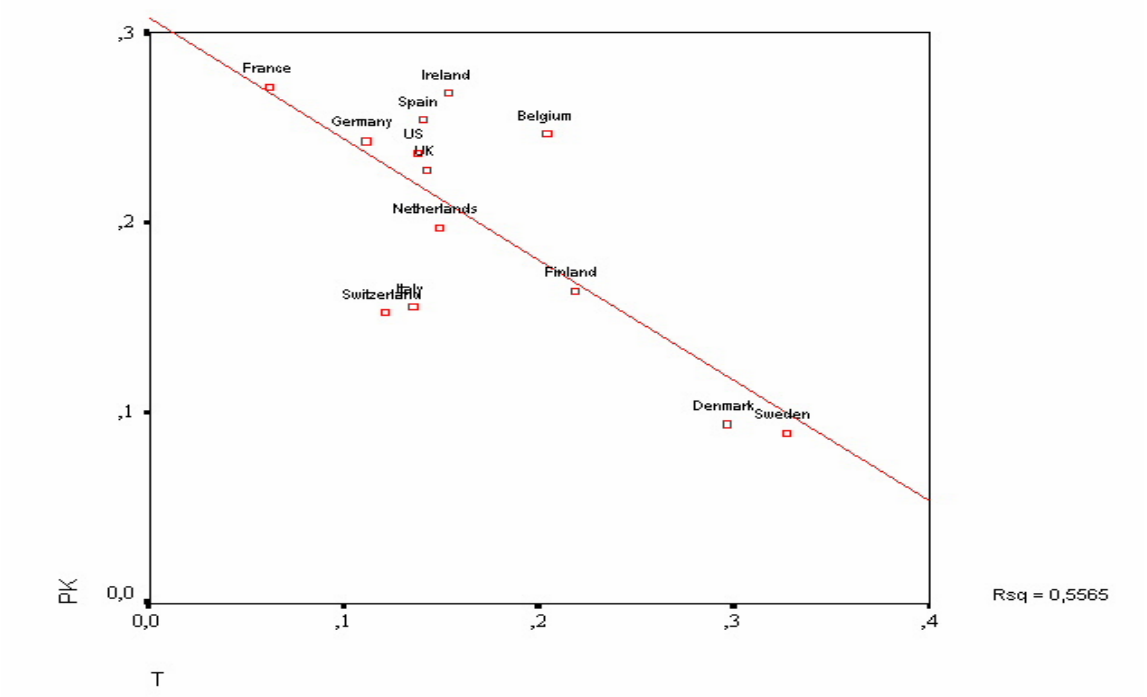
We can see a large variation in redistributive effect and in the mix of *t* and $\Pi_{T_0}^K$ across countries. Apparently there is no positive link between pre-tax inequality and the extent of redistribution: it is not the case that countries with high pre-tax inequality systematically redistribute more (in order to compensate more for this higher pre-tax inequality, or less as they may not be interested in more inequality). The Pearson's rank correlation between G_X and *RE* is 0.1647 and not significantly different from

number of LIS-countries; Wagstaff and van Doorslaer provide the more recent results, focussing on the financing of health care (2001, Wagstaff et al. 1999a & 1999b, van Doorslaer et al. 1999).

[3] A parametric equivalence scale is a set of scales with a common functional form and for which parametric variations change the scale rate relativities for households of different types. The equivalence scale e_i for a household *i*, is here specified as $e_i = (n_A + \eta n_K)^\theta$, with n_A= number of adults; n_K = number of children; parameters η and θ, with $\eta = \theta = 0.5$.

zero. Figure 1, however, suggests a kind of trade-off between progressivity and tax level. The correlation coefficient between t and Π_0^K is –0.75, which points in this direction (significant at the 0.005 level). It can be argued that a government chooses a low tax level with a high degree of progressivity: when the overall tax burden is mild, then it is not so difficult to put more of this burden on the broadest shoulders. France and Germany appear to have chosen this path. According to Loizides (1988)[4] Greece has also opted for a high degree of progressivity (Kakwani of 0.3558) with a low average tax level (t=0.078). But when the tax level is high, then it seems difficult to avoid that everybody pays his share, such that the average tax rate increases less with income level. The Scandinavian countries and especially Denmark and Sweden combine the highest level of taxes with the lowest degree of progressivity. Most other countries take up a position somewhere in between.

Figure 1: Regression of average tax rate (T) and progressivity (PK) of 13 OECD countries (based on data in table 1)



Similar results are found on the basis of the OECD data published in 1990, based on administrative tax records (see OECD (1990) for the data, and Verbist (2002) for the calculations). An international comparison of the degree of progressivity and its building stones is provided by Wagstaff and van Doorslaer (2001) who have used these OECD-data to calculate the progressivity of PIT in 17 OECD-countries. Countries exhibit a wide variety in the use they make of the different instruments determining progressivity. Wagstaff and van Doorslaer distinguish four groups of countries:

[4] The figures of Loizides are not entirely comparable with those in table 2. He uses data from tax statistics, thus having only taxable income from tax units; income data are not corrected for family size; his figures refer to 1978.

1) *rate structure countries*, where progressivity follows mainly from the pure rate effect. This group includes Australia, France, Italy, the Netherlands, Norway and Spain;
2) *allowance countries*, where progressivity is mainly attributable to the existence of allowances, i.e. Ireland, the UK and the US;
3) *credit countries*, for which tax credits are the dominant source of progressivity. Only Denmark belongs to this group;
4) *mixed structure countries*, who use a mixture of the different instruments. These countries are Belgium, Canada, Finland, Sweden and Germany.

In the following sections we will calculate the redistributive effect of total taxes using EUROMOD. EUROMOD has the advantage that it is designed especially for this kind of international comparative research. Moreover, it works with databases of a more recent period than the other studies. It will also give us the opportunity to test if the trade-off hypothesis between progressivity and tax burden holds.

3 EUROMOD and the transition from gross to net income

EUROMOD is a tax-benefit model for the 15 countries of the European Union (for more information, see Immervoll et al., 1999; Sutherland 2001). EUROMOD is a static empirical microsimulation model. 'Static' means that the model simulates the tax-benefit system at one particular moment in time; it is not build to simulate life-cycle incomes for individuals, nor does it, by default, include behavioural reactions to simulated policy changes. The model covers a major part of the different national personal income tax and social benefits systems. It calculates taxes and benefits for a representative set of micro-data. These national datasets are collected at various points in time between 1993 and 1998, but have all been adjusted to 1998 prices and incomes (for an overview of the various data sources, see appendix 1). Policy measures in the model used here also refer to 1998.

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 (see also appendix 3). To arrive at disposable or net income (N) we subtract personal income taxes (T_{PIT}), other taxes (T_{OTH}) and social insurance contributions (T_{SIC}) from gross income (X):

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

As we have already mentioned we only look at part of the redistribution process. Cash benefits are not included here in the calculations, as we focus on the tax system. They are however simulated in EUROMOD (for an analysis of the redistributive effect of taxes and cash benefits together using EUROMOD, see Immervoll et al., 2004). Collective goods and services, such as education, are not taken into account, though they also have an important redistributive impact. Moreover, not all taxes could be included; we had to limit ourselves to those that are modelled in EUROMOD, i.e. direct taxes at the individual or the household level. So we do not look at taxes on

goods and services, nor at corporate income taxes or employer social contributions. We study the following three types of taxes (T = total taxes):

- personal income taxes T_{pit} (at the national level);
- social insurance contributions T_{sic} (excluding employer contributions);
- other income taxes T_{oth} (for most countries this is a small category).

The content of these three types will be discussed in more detail in the following paragraphs.

3.1 Social insurance contributions (except employer contributions)

In all countries mandatory social insurance contributions (SIC) are levied on labour income from employees and self-employed as well as on some social benefits (Table 2). In Germany the self-employed pay only voluntary contributions. In four countries SIC on labour income are the only contributions that are levied (Ireland, Italy, Portugal and UK).

In all other countries recipients of either pensions or unemployment allowances or sickness and disability benefits also pay contributions, though in most cases the rate is lower than on income from work (for more on this see Verbist, 2004). In Denmark and Luxembourg, social assistance recipients pay contributions as well. France is the only country that levies social contributions on family benefits and capital income.

Table 2: Basis for levying social insurance contributions in the EU-15, EUROMOD, 1998

SIC on	Employee income	Self-employment income	Pensions	Unemployment allowances	Other income
Austria	x	x	x		
Belgium	x	x	x		x (²)
Denmark	x	x		x	x (²)(³)
Finland	x	x	x	x	
France	x	x	x	x	x (⁴)
Germany	x	(¹)	x		
Greece	x	x	x		
Ireland	x	x			
Italy	x	x			
Luxembourg	x	x	x	x	x (³)
Netherlands	x	x	x	x	x (²)
Portugal	x	x			
Spain	x	x		x	
Sweden	x	x		x	
UK	x	x			

(¹) Only voluntary contributions; (²) on sickness & disability benefits;
(³) On social assistance; (⁴) on family benefits, capital income

3.2 Components of the Personal Income Tax Systems in the EU

The personal income tax (PIT) schedule is a complex of different instruments, such as the rate structure and various tax advantages. Final tax liability is determined by different factors: pre-tax income (*X*), tax exempt (categories of) income (*E*), tax deductions (*D(X)*) and tax allowances (*A*) that can be applied on pre-tax income, the rate schedule (*r(Y)*) and tax credits (*K*). Pre-tax income *X* includes all income components before tax, and thus determines to a great extent tax liabilities. Taxable income *Y* must be distinguished from pre-tax income. Some income components are part of pre-tax income, but do not have to be declared to the tax authorities, and thus

are not included in the concept of taxable income; we call this 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 here defined as a fixed amount subtracted from pre-tax income. They can be thought of as zero-rate tax bands. 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. So taxable income $Y = X - E - D(X) - A$. 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_{pit} by reducing gross tax liability T_g with total tax credits *K*, which may itself be a function of *X*: $T_{pit} = T_g - K(X)$.

We present here an overview of the different tax components of personal income tax systems in the EU-15 (Table 3). In practice, it can be sometimes arbitrary to label an income component as either an exemption, a deduction or an allowance. This distinction is however not too important. What is relevant is to see how taxable income *Y* is arrived at.

It is useful to distinguish market income from social benefits with the latter divided into seven (policy) fields: family policy related components (FP), education (ED), old age (OA), minimum income (MI), disability & invalidity (DI), housing (HO), other social benefits (OS). In the first category we distinguish measures relating to earnings (ER), capital income (CI), real estate (RE), and private provisions and transfers (PP).

3.2.1 Income exempt from PIT

Exemptions include in almost all countries child and family benefits. Greece is the only country in which these benefits are taxable. Also social assistance and minimum income provisions are in most countries tax exempt. The countries that include social assistance benefits in their taxable income are Denmark, Greece, Luxembourg, Netherlands and Spain. Study allowances and housing benefits are in general also excluded from taxable income. Many countries also exclude benefits for disability and invalidity from taxation. In four countries unemployment benefits are partly or entirely tax exempt, namely in Austria, Germany, Ireland and Portugal.

Pensions are in all countries part of taxable income, though as we will see, specific tax advantages available to the elderly can significantly reduce their tax burden (sometimes to zero).

3.2.2 Imputed taxable income

For some countries we had to introduce a category of imputed taxable income. This is done as some income components are part of taxable income, but not of gross income. The best example here is imputed values of real estate property (Belgium, Italy and the Netherlands). They are no part of standard disposable income, and hence not of gross income, but in some countries they have to be included to calculate taxes. In our calculations these income components are included in the category of exemptions.

3.2.3 Deductions

In most countries social insurance contributions are deducted before taxes are calculated. This is however not the case in Ireland, the Netherlands and the UK, and only partially in France and Germany.

The majority of deductions are granted to market income: most countries provide the deduction of work-related expenditures, or try to stimulate the acquisition of real estate. Work-related expenses are not deductible in Denmark, Greece, Ireland (which has provided a tax allowance, though, for this aim), Spain (which uses a tax credit in this respect) and the UK. Stimulating the acquisition of real estate is mainly done through the application of mortgage interest deductions, as is the case in Belgium, Denmark, Greece and the Netherlands. In some countries maintenance payments are also deductible (Belgium, Denmark, Germany, the Netherlands and Sweden).

Deductions of the policy-related category are related to old age or to family policy. Old age deductions are very prominent in Germany, and exist in Finland, France, Ireland, Luxembourg, Netherlands, Portugal, Sweden and the UK. Family related deductions are provided in Austria, Belgium, France and Luxembourg.

Table 3: Overview of exemptions, deductions, allowances and credits in the personal income tax systems in the EU-15, EUROMOD, 1998.

	EXEMPTIONS	*IMPUTED TAXABLE INCOME*	*DEDUCTIONS*	*ALLOWANCES*	*CREDITS*
Austria	**FP**: Child benefits; Pregnancy benefit; Maternity allowance; Care benefits; **ED**: Study allowances; **MI**: Social assistance; **OA**: Private pension benefit payments; **OS**: Unemployment benefits; **HO**: Housing benefits; **CI**: Investment Income; **PP**: Private transfers received,	-	**SIC;** **ER**: Cost of earnings and limited; expenditures; Part of 'other earnings'	**DI**: disability**;** **ER**: Self-assessment income; agricultural workers	**FP**: General; Child tax; Lone parent; single earners; **OA**: pensioner; **ER**: Commuters'; income tax reduction; wage earners; progression adjustment ***Neg.***: Preferential tax of other earnings
Belgium	**FP**: Child benefit, Birth/adoption allocation; **ED**: Study allowances; **MI:** Minimum income; **MI** & **OA**: Minimum income for old persons; **DI**: Allocation for handicapped people; **PP**: 20% of maintenance payments received.	Imputed rent; 40% of property income	**FP**: Marital quotient (pos/neg); **PP**: Maintenance paid (80%); **SIC;** **ER**: Professional expenses; **RE**: Mortgage interest; dwelling allowances;	-	**FP**: Basic (for single/ spouses); Family credits (for children, handicapped, lone parents); **OA & OS**: Replacement income tax credit; Zero tax for low replacement incomes.
Denmark	**FP**: Child benefit; Family allowances; Day care subsidies; **ED**: Study allowances; **HO**: Housing benefits; **DI**: Part of disability pensions;	Lump sum income	**PP**: alimony received for children**;** **SIC**; **RE**: mortgage interest;	-	-
Finland	**FP**: Child benefits; Child day care payments; Home care benefits; **MI**: Social assistance; **DI**: Military injury compensation **HO**: Housing benefits; **CI**: Part of investment Income; **PP**: Maintenance payments received; **ER**: Part of self-employment income	-	**OA**: pension deduction; **SIC**; **ER**: work-related expenses; travel expenses; Income losses; for sailors; **RE**: mortgage interest	-	**DI**: Disability; **PP**: Child maintenance; **CI**: Deficit capital compensation (including mortgage interest)

	EXEMPTIONS	*IMPUTED TAXABLE INCOME*	*DEDUCTIONS*	*ALLOWANCES*	*CREDITS*
France	**FP:** Family benefits; Lone parent benefit; **MI**: Minimum income; Minimum pension; Social aid; **OA**: Social benefit for dependent elderly; **DI**: Allocation for handicapped people; Invalidity pension; War pension; **CI**: Investment income; Property income; **PP**: Maintenance payments received.	-	**FP**: Personal deduction; **OA**: Pensions deductions; **SIC**: Partly; **ER**: Professional expenses. .	-	**ER**: Low incomes; various types (imputed)
Germany	**FP**: Child benefits; **ED**: Study allowances; **MI**: Social assistance; **OA**: Nursing home insurance premia received; **OS**: Unemployment allowances **HO**: Housing benefits	-	**OA**: Civil servant pensions; Old age; Non-earnings part of non-civil servant pensions **CI**: Investment income; **PP**: Maintenance payments **ER**: Expenditures; Professional expenses;	**FP**: Children; Lone parents	-
Greece	**ED**: Study allowances; **HO**: Housing benefits;	Lump sum income	**PP** : Medical expenses; private education expenditure ; **SIC** ; **RE** : Mortgage interest; Rent.	-	**FP**: Children; Household expenditure; **OA**: private pension contributions
Ireland	**FP:** Child benefits; Maternity contributory benefits; Orphan's contributory benefits; Carer's non-contributory benefits; Family Income Supplement; **ED**: Study allowances; **MI**: social minimum; **DI**: Invalidity and disability contributory benefits; **OS**: most of unemployment benefits; **HO**: Housing benefits; **PP**: Maintenance payments received;	-	**OA**: Pension contributions	**FP**: Lone parent; Single/married; widowed; **OA**: Age; **ER**: Employee	**PP**: permanent health insurance relief **RE**: Mortgage interest relief

	EXEMPTIONS	*IMPUTED TAXABLE INCOME*	*DEDUCTIONS*	*ALLOWANCES*	*CREDITS*
Italy	**FP**: Family allowances; **MI**: Social pension; **DI**: War pension; Disability benefits; **OS**: Social security benefits from local authorities; **CI**: 15% of property income; **PP**: Maintenance payments received;	Imputed cadastral values	**SIC**: Employee; **ER**: Expenditures deductions; **RE**: Owner occupied house deduction	-	**FP**: Dependent spouse; Children; Lone parents; Other dependants; **PP**: Insurance; **ER**: Work-related expenses; **RE**: Mortgage interest
Luxembourg	**FP**: Child benefits; Pre-, postnatal and birth allowances; Maternity payments; Orphan allowance; Care benefits; **ED**: Study, education and school allowances; **DI**: Seriously disabled persons benefits; Permanent accident benefit; **OS**: sickness replacement salary/wage; other benefits from the Fonds National de Solidarité; Other public benefits; **HO**: Housing benefits;	-	**FP**: lone parents; child & family care; **OA**: pensioners; **CI**: property income; LUX investment income + related costs **SIC** **ER**: wage-earners; 'professional' couples; expenditures; disabled (employees); farmers; agricultural salaried workers; accessory income	-	**FP**: Children; **MI**: Tax adjustment for low incomes **Neg**.: Additional unemployment insurance tax
Netherlands	**FP**: Child benefits; **ED**: Study allowances; **HO**: Housing benefits; **PP**: Maintenance payments received for children;	Use of car from employer; imputed income from owner occupied house	**OA**: pension contributions; **CI**: amounts in special savings accounts **PP**: part of maintenance payments; **ER**: Professional expenses; Self-employment income; **RE**: mortgage interest	**FP**: basic tax free amounts; single parent; **OA**: Old age; **CI**: Investment income	-
Portugal	**FP**: Child benefits; Family benefits; **ED**: Study allowances; **MI**: Social assistance; Income supplement to ensure minimum income; **OS**: Unemployment benefits; **HO**: Housing benefits; **CI**: investment income; property income; **PP**: Maintenance payments;	Lump sum income	**OA**: for pension income; **SIC** **ER**: for (self-)employment income; **RE**: Housing debt;	-	**FP**: For tax unit composition

	EXEMPTIONS	*IMPUTED TAXABLE INCOME*	*DEDUCTIONS*	*ALLOWANCES*	*CREDITS*
Spain	**FP**: Child benefit	-	**CI**: for Employment income; Part of investment income; **SIC**	-	**FP**: Children; dependent parent; **OA**: elderly inactive; **ER**: employment income; **RE**: rents; mortgage
Sweden	**FP**: Child benefits; **ED**: University/Study grants; Educational benefits; **MI:** Social assistance; **OA**: Non-taxable pension; **OS**: Sick benefit self-employed; Residual tax free benefits; **HO**: Housing benefits; **CI**: Investment income; part of self-employment income **PP**: Maintenance payments;	-	**OA**: Pension contributions; **PP**: Periodic maintenance payments; **SIC** **ER**: Basic/special deduction; Work-related travelling; New started company	-	**CI**: Reduction on capital;
UK	**FP**: Child benefit; Family Credit; Attendance allowance; **ED**: Study allowances; Training allowance **MI**: Income Support; **DI**: Disability & incapacity allowances; **HO**: Housing benefits; **CI**: Part of investment income; **PP**: Maintenance payments received;	-	**OA**: Private pension contributions	**FP**: Personal; **OA**: Age-related personal	**FP**: Married persons; Lone parents **OA**: Age-related married person; **RE**: Mortgage intrest tax relief (refundable).

FP = Family Policy related; **ED** = Education; **MI**= Minimum Income; **OA** = Old Age; **DI** = Disability & Invalidity; **OS** = Other Social benefits; **HO** = Housing; **CI** = Capital Income; **PP** = Private Provisions & Transfers; **SIC** = Social Insurance Contributions; **ER** = Earnings Related; **RE** = Real Estate; **Neg**. = Negative

3.2.4 Allowances in PIT:

Allowances are not used very much. The only three countries that have allowances of some substance are Ireland, the Netherlands and the UK and they use them mainly for old age and family policy. Many countries however have a zero rate band in the tax schedule (e.g. Greece, Sweden); even though this is not labelled in the tax law as an allowance, it can be considered as one. This illustrates again that it is not always evident to categorise the different tax measures.

3.2.5 Tax Credits in PIT:

Tax credits are frequently used in the framework of family policy and old age provisions. Austria, Belgium, Greece, Spain and UK have tax credits in both these fields; Italy, Luxembourg and Portugal have only family related provisions. Some countries also use tax credits for the benefit of earners (Austria, France, Italy and Spain) and as a mortgage interest relief (Finland, Ireland, Italy, Spain and UK). In some countries tax credits are refundable (or non-wastable), i.e. if the tax credit exceeds tax liability, the amount of the excess is paid to the taxpayer (e.g. family credit in the UK). This fits in a tendency in some countries to administer benefit payments through the tax system.

Sometimes special taxes are levied in the framework of personal income taxes; these are treated as negative tax credits. This is the case in Austria with a preferential tax on other earnings and in Luxembourg with the additional unemployment insurance tax.

3.2.6 Rate structure of PIT:

Table 4: Overview of the rate structure in the personal income tax systems in the EU-15, EUROMOD, 1998.

	Number of bands	Lowest tariff	Highest tariff
Austria	5	10	50
Belgium	7	25	55
Denmark[1]	4	0	29
Finland[1]	7	0	38
France	6	0	54
Germany [2]	-	19	53
Greece	6	0	45
Ireland	2	24	46
Italy	5	18.5	45.5
Luxembourg	18	0	46
Netherlands	3	7.1	60.0
Portugal	4	15	40
Spain	9	0	56
Sweden[1]	2	0	25
UK	3	20	40

[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 an average local tax rate is applied for Denmark (32.4%) and Finland (17.5%); for Sweden the distinct local rates are used.
[2] The tax schedule is not based on tax bands, but on a polynomial.

In table 4 we present the structure of the rate schedule as it is integrated in EUROMOD 1998. These are only the rates that apply in the national personal income tax systems. This explains the low values for the highest tariffs in the Scandinavian

countries. As becomes apparent, some countries apply a zero tax band, whereas others do not. Here it becomes again apparent 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).

3.3 Other taxes

Other taxes are those direct taxes on household income that are not part of the national personal income tax system. Broadly, two groups of 'other taxes' can be distinguished: local taxes (Denmark, Finland, France, Sweden, UK) and taxes on income from real estate and financial assets (Austria, Belgium, Finland, France, Italy, Portugal, Sweden). The coverage of local taxes in EUROMOD, however, is not universal. Sometime, these taxes exist, but because of a lack of data they are not covered.

As we have already mentioned, local taxes are very important in the Scandinavian countries, whereas the weight of 'other taxes' in most countries is relatively small.

Table 5: Other taxes on income in the EU-15, EUROMOD, 1998

Country	*Other taxes*
Austria	Withholding tax on capital income; church tax
Belgium	Property tax
Denmark	Local tax
Finland	Local tax; Wealth tax; Church tax; Tax on Capital income; Tax from deposit interest
France	Capital income taxes; Local and regional taxes
Germany	Solidarity surplus tax
Greece	-
Ireland	-
Italy	Taxes on financial assets (dividends, bonds, deposits)
Luxembourg	-
Netherlands	-
Portugal	Capital income
Spain	-
Sweden	Local; Real estate; Investment; Wealth
UK	Local council tax

4 Measuring the redistributive 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. In general, 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 taken in tax increases with income (i.e. the average tax rate increases with income). The tax system is called proportional when the average rate is constant, and it is said to be regressive when the average rate decreases with rising income (i.e. when the lower income individuals bear a relatively higher part of the tax burden). When measuring the redistributive effect of taxes, we (implicitly) compare the existing tax system with a proportional tax that yields the same revenue

as this actual tax system, so the given total amount of income does not change. This (hypothetical) proportional tax is distributionally neutral, as it preserves the relative pre-tax income differences[5]. The measurement of the redistributive effect and progressivity in the Lorenz curve framework was initiated by Musgrave et al. (1948) and Kakwani (1977a and b). In this section we present the most important tools used to measure the redistributive impact of tax instruments[6]. Most measures are designed for evaluating the effect of taxes, but mutatis mutandis they can also be applied to social benefits (see Duclos (1993), Verbist (2002)).

4.1 Measurement of progressivity and redistributive effect of taxes

A very popular index of progressivity is the one proposed by Kakwani (1977a) which measures the departure from proportionality as the difference between the concentration coefficient of taxes and the Gini of pre-tax income:

(1) $$\Pi_T^K = C_T - G_X$$

For measuring the redistributive effect we will use 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:

(2) $$\Pi^{RS} = G_X - C_{X-T}$$

There is a close link between the measures of progressivity and those of redistributive effect (Kakwani, 1977a). 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)*:

(3) $$\Pi^{RS} = \frac{t}{1-t}\Pi_T^K$$

Up until now we have assumed that the tax system does not produce changes in the rank order of the income units, i.e. that it makes no difference whether income units are ranked in ascending order of their pre-tax or their post-tax income. But due to differences in tax treatment of income units it is possible that some of them swap positions in the income ranking. Reranking can be measured as the difference between the concentration coefficient of net income, C_N, and the Gini coefficient, G_N (Atkinson (1980), Plotnick (1981)). The Reynolds-Smolensky index is then an indicator of vertical equity *VE*, i.e. it measures the total reduction of inequality that would occur if there were no reranking of income units[7]. The index $D = G_N - C_N$ measures how much of this equalising effect is 'undone' by reranking. Thus, the total redistributive effect is the result of a vertical equity (VE) and a reranking effect (RR):

(4) $$RE = G_X - G_N = VE - RR = \Pi^{RS} - D$$

[5] This applies only within the framework of scale-invariant inequality measures, which are used here.
[6] More details on the derivation of these formulae can be found in appendix 2.
[7] Atkinson (1980) and Plotnick (1981) consider reranking as a measure of horizontal inequity of the tax system. Some authors also distinguish "pure horizontal inequity", i.e. the unequal treatment of equals that does not automatically results in reranking (see e.g. Lambert et al., 1993). As the empirical implementation is problematic (e.g. how to define "equals", see also Wagstaff et al, 1999a)), we did not follow this approach

4.2 Decomposition of tax progressivity

As progressivity is one of the important determinants of the redistributive effect, we analyse it in more detail. Progressivity can be decomposed over the different factors that build up a tax system.

4.2.1 Decomposition of Progressivity of Total Taxes

In all countries we consider here there are different types of taxes. Progressivity of total taxes results from the progressivity characteristics of these different individual taxes. Kakwani (1977a) showed that progressivity of total taxes can also be measured as the weighted sum of the Kakwani indices of these individual taxes:

$$(5) \qquad \Pi_T^K = \sum_i \frac{t_i}{t} \Pi_{T_i}^K$$

4.2.2 Decomposition of Progressivity of Personal Income Taxes

The personal income tax schedule is a complex of various measures (see tables 3 and 4). 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 (cf. section 2):

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

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:

$$(6) \qquad \Pi_{T_{PIT}}^K = \frac{t_g}{t_{pit}} \Pi_{T_g}^K + \frac{k}{t_{pit}} \Pi_K^K$$

Π_{Tg}^K is the Kakwani index of gross tax liabilities. Π_K^K shows the degree of disproportionality of tax credits K relative to the distribution of pre-tax income, or $\Pi_K^K = G_X - C_K$. 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'[8]:

[8] 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.

(7) $$\Pi_{Tg}^{K} = \left(C_{Tg} - C_Y\right) + \left(C_Y - G_X\right)$$

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[9]:

(8) $$\Pi_{R}^{K} = C_{T_g} - C_Y$$

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:

(9) $$C_Y - G_X = \frac{e}{1-e-a-d}\Pi_{E}^{K} + \frac{a}{1-e-a-d}\Pi_{A}^{K} + \frac{d}{1-e-a-d}\Pi_{D}^{K}$$

with
- *e* as the average rate of exempt income and $\Pi_{E}^{K} = G_X - C_E$ measuring the disproportionality of exempt income;
- *a* as the average rate of allowances and $\Pi_{A}^{K} = G_X - C_A$ measuring the disproportionality of allowances;
- *d* as the average rate of deductions, and $\Pi_{D}^{K} = G_X - C_D$, measuring the disproportionality of deductions.

Just as with tax credits, a positive value of Π_{E}^{K}, Π_{A}^{K} and Π_{D}^{K} 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:

(10) $$\Pi_{T_g}^{K} = \Pi_{R}^{K} + \frac{e}{1-e-a-d}\Pi_{E}^{K} + \frac{a}{1-e-a-d}\Pi_{A}^{K} + \frac{d}{1-e-a-d}\Pi_{D}^{K}$$

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 this paper we use a broad definition for the base 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 other 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).

4.3 Equivalence scale

The household is considered as the relevant unit of analysis as most people live in family groups and households pool resources. We use an equivalence scale to take account of household composition. We only look at the distribution between

[9] For some countries the rate effect we will measure here includes also other elements. For Austria and Germany it also captures the effect that unemployment benefits are tax exempt. 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. For the UK the effect of the special tax rate for investment income is also included in the rate effect, and in Ireland it also includes the effect of the marginal relief. These remarks have to be born in mind when interpreting the results.

households. This implies that we assume that within households resources are distributed equally over the household members, which means that all household members attain the same welfare level. This is a (debatable but) standard assumption (see a.o. Coulter et al., 1992; Cowell and Mercader-Prats, 1999).

Income (components) are corrected for differences in household size and composition with the modified OECD-scale. According to this equivalence scale the first adult has a value 1, every other adult counts for 0.5 and each child for 0.3. We analyse inequality of equivalent household income weighted for the number of individuals. This means that we attribute equivalent household income to every individual household member, so that in fact measurement is performed on the individual equivalent household income distribution. Cowell (1984) argues that this is the best approach as "presumably social welfare depends on the well-being of individual persons, regardless of the units in which they happen to live, the alliances they form or whether or not they live at home".

5 The redistributive effect of taxes in the EU

We will first compare the different components of taxes in the EU. We look at the transition from gross to net income as it is modelled in EUROMOD. This means that we analyse the effect of taxes on income inequality.

5.1 Redistributive effect of total taxes

Using formulae (4) and (3) we can calculate for each country the effect on income inequality of total taxes. Taxes reduce income inequality in all countries, though unsurprisingly not to the same extent (table 6).

Table 6: Redistributive effect (RE) of total taxes in EU countries, EUROMOD, 1998, equivalised incomes.

	G_X	G_N	*RE*	*RE as % of* G_X	*VE*	Π_T^K	*t*
Austria	0.3133	0.2526	0.0607	19.4	0.0639	0.1689	0.2745
Belgium	0.3146	0.2408	0.0737	23.4	0.0780	0.2330	0.2509
Denmark	0.3010	0.2411	0.0599	19.9	0.0625	0.0985	0.3881
Finland	0.2893	0.2329	0.0563	19.5	0.0597	0.1411	0.2972
France	0.3170	0.2847	0.0323	10.2	0.0345	0.1320	0.2071
Germany	0.3331	0.2760	0.0571	17.2	0.0664	0.1684	0.2827
Greece	0.3748	0.3417	0.0331	8.8	0.0353	0.1492	0.1913
Ireland	0.3753	0.3202	0.0551	14.7	0.0568	0.2676	0.1750
Italy	0.3779	0.3411	0.0368	9.8	0.0390	0.1219	0.2426
Luxembourg	0.3183	0.2566	0.0617	19.4	0.0630	0.2398	0.2081
Netherlands	0.2955	0.2496	0.0459	15.5	0.0484	0.1198	0.2877
Portugal	0.4044	0.3561	0.0483	12.0	0.0499	0.2098	0.1920
Spain	0.3689	0.3311	0.0398	10.3	0.0398	0.1792	0.1817
Sweden	0.2984	0.2662	0.0323	10.8	0.0401	0.0891	0.3103
UK	0.3590	0.3133	0.0457	12.7	0.0474	0.1884	0.2009

Source: EUROMOD

We can distinguish three groups in their redistributive efforts through taxes:

High RE: Austria, Belgium, Denmark, Finland, Germany, Luxembourg
Moderate RE: Ireland, Netherlands, Portugal, UK
Low RE: France, Greece, Italy, Spain, Sweden

It is not obvious to draw a line in these results. It is not the case that all Scandinavian countries have a high *RE*: Sweden is situated in the group with a low *RE*. Maybe the strongest line is that almost all the Southern European countries have a low *RE*, with the exception of Portugal that is found in the moderate group. In this last group we also find the two English-speaking countries, UK and Ireland. It is remarkable that also according to EUROMOD Belgium attains the highest degree of inequality reduction, both in absolute and relative terms.

For most countries *RE* is broadly the same as vertical equity (*VE)*; the only exceptions are Germany and Sweden where inequality reduction is more strongly counteracted through reranking. Thus, as vertical equity is by far the most important factor, we will look more closely at the building stones of vertical equity, i.e. progressivity and tax level, measured respectively by the Kakwani index and the average tax rate.

5.2 Average tax rates

The average rate of total taxes results of course from the total of the three tax types (see table 7). The average tax rate is very high in Scandinavia, Germany and the Netherlands. In the Scandinavian countries this follows from the high level of local taxes. In Germany, the high tax level is due to mainly PIT (tax rate of 0.1453) and SIC (0.1294), whereas in the Netherlands SIC are more predominant (0.1746). The average tax rate is also high in Austria, Belgium and Italy, following for two thirds from PIT in these last two countries, thus scoring in fact the highest average PIT rates.

Table 7: Weight of taxes as a % of gross income, and the proportion of the three tax types in total taxes in the EU-15 countries, EUROMOD, 1998, equivalised incomes.

	Total taxes	*Personal Income Taxes*		*Social Insurance Contributions*		*Other taxes*	
	average rate t	*average rate*	*as % of t*	*average rate*	*as % of t*	*average rate*	*as % of t*
Austria	0.2745	0.1490	*54.3*	0.1247	*45.4*	0.0008	*0.3*
Belgium	0.2509	0.1677	*66.8*	0.0831	*33.1*	0.0002	*0.1*
Denmark	0.3881	0.0808	*20.8*	0.0844	*21.7*	0.2228	*57.4*
Finland	0.2972	0.0816	*27.5*	0.0604	*20.3*	0.1552	*52.2*
France	0.2071	0.0359	*17.3*	0.1472	*71.1*	0.0240	*11.6*
Germany	0.2827	0.1453	*51.4*	0.1294	*45.8*	0.0080	*2.8*
Greece	0.1913	0.1096	*57.3*	0.0817	*42.7*	-	-
Ireland	0.1750	0.1435	*82.0*	0.0315	*18.0*	-	-
Italy	0.2426	0.1591	*65.6*	0.0660	*27.2*	0.0175	*7.2*
Luxembourg	0.2081	0.1270	*61.0*	0.0812	*39.0*	-	-
Netherlands	0.2877	0.1131	*39.3*	0.1746	*60.7*	-	-
Portugal	0.1920	0.1050	*54.7*	0.0813	*42.3*	0.0057	*3.0*
Spain	0.1817	0.1396	*76.8*	0.0421	*23.2*	-	-
Sweden	0.3103	0.0246	*7.9*	0.0430	*13.9*	0.2427	*78.2*
UK	0.2009	0.1336	*66.5*	0.0452	*22.5*	0.0220	*11.0*

Source: EUROMOD

The highest SIC-rates are found in Austria, France, Germany and the Netherlands, ranging from 12.5% to 17.5% of gross income. Ireland, Spain, Sweden, UK have the lowest SIC-rates (between 3.2% and 4.5% of gross income).

For most countries, personal income taxes are the most important tax type. This is not the case for the Scandinavian countries and for France and the Netherlands. For these last two countries, social insurance contributions have the biggest weight (resp. 71.1% and 60.7% of total taxes), whereas for other countries this proportion varies between 14% (Sweden) and 46% (Germany). In Denmark, Finland and Sweden other taxes, which are mainly local taxes, are the most important tax type (ranging from 52% to 78% of total taxes). In the UK, France and Italy, 'other taxes' have some weight (more than 5% of total taxes), but in all other countries these taxes are relatively small or non-existent.

5.3 Progressivity of the three tax categories

The tax types do not only differ in weight, but there is also quite some diversity in structure. In this section we compare progressivity of the three tax types over the EU-15. The Kakwani indices of total taxes range from 0.0891 in Sweden to 0.2676 in Ireland. This general figure results from the progressivity characteristics of the three different tax types, which can be disentangled with formula (5).

Table 8: Kakwani indices of total taxes and the three tax types in the EU-15, 1998.

	Total taxes	*Personal Income Taxes*	*Social Insurance Contributions*	*Other taxes*
Austria	0.1689	0.2961	0.0172	0.1274
Belgium	0.2330	0.2797	0.1398	-0.2613
Denmark	0.0985	0.1831	0.0855	0.0727
Finland	0.1411	0.2784	0.1004	0.0848
France	0.1320	0.4401	0.0713	0.0441
Germany	0.1684	0.2842	0.0313	0.2842
Greece	0.1492	0.2928	-0.0436	-
Ireland	0.2676	0.2917	0.1575	-
Italy	0.1219	0.1562	0.0444	0.1033
Luxembourg	0.2398	0.3907	0.0037	-
Netherlands	0.1198	0.3268	-0.0143	-
Portugal	0.2098	0.3250	0.0558	0.2852
Spain	0.1792	0.2622	-0.0963	-
Sweden	0.0891	0.4774	0.0388	0.0587
UK	0.1884	0.2594	0.1248	-0.1121

Source: EUROMOD

We find a wide variety in Kakwani indices for tax types and countries. One fact is clear: PIT is in all countries the most progressive tax type. PIT is very progressive in Sweden, France and Luxembourg, with Kakwani indices of resp. 0.4771, 0.4401 and 0.3907. Progressivity of PIT is rather low in Italy (0.1562) and Denmark (0.1831). In section 5 we will analyse these results in more detail.

Social insurance contributions are in most countries proportional. Exceptions are Ireland (0.1575), Belgium (0.1398) and UK (0.1248). Most countries levy social contributions as a fixed percentage of income. Ireland and the UK apply lower and upper boundaries for these contributions; apparently the effect of the lower boundary is strongest as contributions in those contributions tend rather towards progressivity. There is an additional SIC rate for high incomes in Finland, whereas in Belgium the lowest pensions do not pay SIC; these factors probably explain why SIC in both these countries also incline towards progressivity. Spain also applies lower and upper bounds for the calculation SIC, but contrary to the Anglo-Saxon countries the effect

of the upper bound appears to be stronger, as SIC in Spain incline towards regressivity.

Other taxes are progressive in Germany, Austria, Italy and Portugal. In Germany 'other taxes' consist of the solidarity surplus tax, which is a surcharge on PIT, so it has the same value of Kakwani as personal income taxes. For the other three countries this category includes mainly taxes on capital income or financial assets; as these taxes are relatively more present among higher incomes, 'other taxes' have a progressive structure. Other taxes are regressive in Belgium (regional tax on property) and UK (local council tax). In the other countries, other taxes are proportional.

5.4 Contribution to total tax progressivity

Using formula (5) we can also calculate the contribution of each tax type to overall progressivity. The contribution to overall progressivity depends on the features of the individual instruments. For personal income taxes we will discuss the effect of the various income tax components into more detail in section 6. The effect of social insurance contributions will depend on the structure of the system (e.g. the existence of lower and upper bounds), but also on the structure of the underlying income distribution (e.g. the weight of low- and high-income groups). We expect that a lower bound will make social insurance contributions more progressive, whereas a ceiling will probably lead to regressivity. In countries where there is both a ceiling and a floor, the final effect will depend on the level of the SIC boundaries and on the weight of high and low income groups[10]. As the base income concept here is gross income, the degree of progressivity of social insurance contributions also depends on the weight of the income components on which SIC are levied. For the interpretation of the results we also have to bear in mind that there is a considerable difference in logic between personal income taxes and social insurance contributions. In general, personal income taxes are levied to fulfil the government revenue requirements for a specific time period (mostly a year, and can thus be considered as redistributive in a specific period), whereas social insurance contributions are part of a social insurance system, and thus redistribute over the life-cycle rather than between income groups in any given period.

Personal income taxes deliver in each country a positive contribution. The fact that in all countries PIT have the highest Kakwani, combined with the fact that in many countries their average tax rate is the highest of the three types (in 10 of the 15 countries) leads to PIT delivering the highest contribution to overall progressivity of total taxes (more than 80% in 11 countries, even up to 112% in Greece and Spain). The notable exceptions are the Scandinavian countries and France.

For the Scandinavian countries, local taxes deliver a very important contribution to overall progressivity, which follows mainly from their high average other tax rate, not so much from their progressivity as they all have a relatively low Kakwani for their local taxes.

[10] It also important to note here that the degree of progressivity also depends on the measure used. We work here within the standard Gin framework. Using for instance inequality measures with other inequality preferences, will lead to different results (see Immervoll, 2004).

Table 9: Decomposition of progressivity of total taxes over the three tax types: (progressivity of total taxes = 100%), EU-15, 1998.

	Personal Income Taxes		*Social Insurance Contributions*		*Other taxes*	
	Contribution	*as %*	Contribution	*as %*	Contribution	*as %*
Austria	0.1607	*95.2*	0.0078	*4.6*	0.0004	*0.2*
Belgium	0.1869	*80.2*	0.0463	*19.9*	-0.0002	*-0.1*
Denmark	0.0381	*38.7*	0.0186	*18.9*	0.0417	*42.4*
Finland	0.0765	*54.2*	0.0204	*14.4*	0.0443	*31.4*
France	0.0762	*57.7*	0.0507	*38.4*	0.0051	*3.9*
Germany	0.1461	*86.7*	0.0143	*8.5*	0.0080	*4.8*
Greece	0.1678	*112.5*	-0.0186	*-12.5*	-	-
Ireland	0.2393	*89.4*	0.0283	*10.6*	-	-
Italy	0.1024	*84.0*	0.0121	*9.9*	0.0074	*6.1*
Luxembourg	0.2384	*99.4*	0.0014	*0.6*	-	-
Netherlands	0.1285	*107.2*	-0.0086	*-7.2*	-	-
Portugal	0.1778	*84.7*	0.0236	*11.3*	0.0084	*4.0*
Spain	0.2015	*112.4*	-0.0233	*-12.4*	-	-
Sweden	0.0379	*42.5*	0.0054	*6.0*	0.0459	*51.5*
UK	0.1726	*91.6*	0.0281	*14.9*	-0.0123	*-6.5*

Source: EUROMOD

SIC are very important in France (mainly due to the high tax rate). But also in Belgium and Denmark they give an important positive contribution to inequality reduction. In Greece and Spain the impact is clearly negative, following from the negative Kakwani index; this means that total progressivity, and thus the redistributive effect, would be bigger if there were no social insurance contributions.

As we have already mentioned local taxes are important in the Scandinavian countries, and this is also reflected in the large share of 'other taxes'. In other countries this tax type has only a small impact. It is still around 6% in Italy and UK. In Italy other taxes enhance equality, whereas in the UK they are anti-equalising. This last result is remarkable; despite the council tax benefit, which is designed to provide relief for the lowest income groups, the local council tax in the UK is regressive.

5.5 Is there a trade-off between tax progressivity and tax level?

In this section we will deal with two issues. On the one hand we want to know if there is a relationship between initial inequality and redistributive efforts. On the other hand, we will test here on the basis of the EUROMOD-data the trade-off hypothesis formulated in section 2. It would not be illogical to have a correlation between pre-tax income inequality and the redistributive effect of taxes. This correlation can be positive: countries with a high pre-tax income inequality may tend to put more effort in redistribution. If market forces lead to relatively big inequalities, this may be a reason for the government to interfere more strongly and correct this distribution. But also the opposite stand can be defended: an initially unequal distribution and the social choice to redistribute rather little can be based on the same underlying factors, such as a strong emphasis on individual responsibility and a big confidence in the market. The results presented in section 3 indicated a positive relationship, though it was not significant. With EUROMOD we find that the sign of the correlation coefficient favours the second supposition, namely that countries with a high level of pre-tax inequality redistribute rather less. However, also this correlation is not significant. There is also no significant correlation between G_X and Π_T^K. But there is quite a strong correlation between initial inequality and the average tax rate. This can be seen as an indication in favour of the second supposition.

The hypothesis of a trade-off between progressivity and tax level seems to rest on firmer ground. Just as in section 2 we find a significantly negative correlation between these two variables. This negative correlation applies both for total taxes as for personal income taxes. However, the classification of countries according to the trade-off hypothesis is not the same. For total taxes we can broadly identify a group of "low progressivity – high tax rate" countries (with the Scandinavian countries, the Netherlands and Italy), and a group of "high progressivity – low tax rate" countries (with Ireland, Luxembourg, Portugal, the UK and Spain) (see table 6). Austria and Germany occupy a position in between and Belgium again combines a high degree of progressivity with a moderate tax rate. Greece and France have a combination of low progressivity with a low tax level.

Table 10: Correlation between inequality, redistributive effect, progressivity and tax level, EU-15, EUROMOD, 1998.

Variables	Pearson rank correlation coefficient	(t-values)	
$G_X - RE$	-0.3129	(-1.188)	
$G_X - t$	-0.7294	(-3.845)	**
$G_X - \Pi_T^K$	0.4198	(1.668)	
$t - \Pi_T^K$	-0.6486	(-3.073)	**
$t_{PIT} - \Pi_{T_{PIT}}^K$	-0.6255	(-2.890)	*
$t_{SIC} - \Pi_{T_{SIC}}^K$	-0.0769	(-0.278)	

* Significant at the 0.01 level; ** significant at the 0.005 level

For personal income taxes solely the correlation coefficient is –0.6255 and significantly different from zero at the 0.01 level. The "low-progressivity – high tax rate" group for PIT include Italy, the UK, Spain, Belgium and Germany, whereas Sweden, France, Portugal, Greece and the Netherlands belong to the "high progressivity – low tax rate" countries. Denmark and Finland have a low score on both variables, while the other countries take up a position somewhere in the middle. The trade-off hypothesis does not hold for social insurance contributions: there is no systematic relation between the average SIC rate and SIC progressivity.

6 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 sections we apply the decomposition explained in section 4 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.

6.1 Proportion of the components in gross income

Taxable income (i.e. the income on which the rate structure is applied) is between 53% (France) and 91% (Spain) of gross income. The gap between taxable and gross income follows in general mainly from deductions. The only exceptions are Finland and Italy, where exemptions are more important and Ireland, the Netherlands and the UK that use allowances of some substance. These allowances relate mainly to the field of family policy in these three countries (cf. table 3). Deductions are very important (+20%) in Austria, France, Germany, Luxembourg and Portugal; and important (+10%) in Belgium, Denmark, Greece, the Netherlands 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 Finland, France, Ireland, Italy, Sweden and UK. In France and Italy exemptions are mainly related to capital income. In the other countries exemptions consist mainly of social benefits. Credits have some weight in Belgium (chiefly the basic tax credit in the field of family policy), but are very small in other countries.

Table 11: Average rate of the tax components as a proportion of gross income, EU-15, 1998.

	Exemptions (e)	*Deductions (d)*	*Allowances (a)*	*Taxable income (y)*	*Credits (k)*
Austria	0.0619	0.2293	0.0003	0.7085	0.0429
Belgium	0.0745	0.1880	-	0.7375	0.0803
Denmark	0.0413	0.1337	-	0.8250	-
Finland	0.1285	0.0796	-	0.7919	0.0054
France	0.1381	0.3262	-	0.5357	0.0201
Germany	0.0382	0.2313	0.0074	0.7231	-
Greece	-0.0016	0.1386	-	0.8630	0.0083
Ireland	0.1034	0.0182	0.2452	0.6332	0.0043
Italy	0.1612	0.0756	-	0.7632	0.0401
Luxembourg	0.0559	0.2227	-	0.7214	0.0083
Netherlands	-0.0098	0.1330	0.2091	0.6677	-
Portugal	0.0690	0.3402	-	0.5908	0.0186
Spain	0.0014	0.0836	-	0.9150	0.0217
Sweden	0.1504	0.1270	-	0.7226	0.0000
UK	0.1161	0.0147	0.2622	0.6070	0.0114

Source: EUROMOD

6.2 Progressivity structure of the PIT components: Kakwani indices

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. In Austria, Belgium, Germany and Luxembourg exemptions consist mainly of family related benefits, more specifically child benefits. 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 UK. Exemptions are most progressive in Spain, which is not surprising as it consists of a means-tested benefit. The more benefits are concentrated among the lower income groups, the more pro-poor their exemption of taxation is. The negative values of the Kakwani indices of exemptions come from the so-called negative exemptions (i.e. the imputed taxable income components). This is the case in Greece, the Netherlands and in Italy. The most striking result here is the

score of –1.80 for the Netherlands. This means that imputed rent is situated relatively more at the lower end of the income distribution and that adding its value to taxable income has a negative effect on progressivity.

Table 12: Kakwani indices of PIT components (Exemptions E, Deductions D, Allowances A, Rate schedule R, Credits K, Personal Income Taxes T), EU-15, 1998.

	Π_E^K	Π_D^K	Π_A^K	Π_R^K	Π_K^K	$\Pi_{T_{pit}}^K$
Austria	0.4417	0.0034	0.3088	0.1088	0.3630	0.2961
Belgium	0.3019	-0.0002	-	0.0665	0.2847	0.2797
Denmark	0.5751	-0.0619	-	0.1644	-	0.1831
Finland	0.0587	0.0381	-	0.2497	-0.0307	0.2784
France	0.1590	-0.0276	-	0.3389	-0.2258	0.4401
Germany	0.5478	0.2681	0.1252	0.1703	-	0.2842
Greece	-0.2456	0.0977	-	0.2437	0.1778	0.2928
Ireland	0.5992	-0.2485	0.2281	0.1096	-0.1861	0.2917
Italy	-0.0586	-0.0235	-	0.0709	0.3404	0.1562
Luxembourg	0.4138	0.1392	-	0.2728	0.3062	0.3907
Netherlands	-1.8009	-0.0745	0.2620	0.2330	-	0.3268
Portugal	0.2204	0.2174	-	0.0905	0.2312	0.3250
Spain	1.1462	0.0717	-	0.2078	0.0808	0.2622
Sweden	0.0991	0.1864	-	0.4240	-0.2783	0.4774
UK	0.6876	-0.2378	0.1700	0.0343	0.0704	0.2594

Source: EUROMOD

Deductions are pro-poor in Germany, Luxembourg, Portugal and Sweden. In Germany, deductions are aimed at pensioners, who situated relatively more in the lower part of the distribution. In the other three countries, deductions are mainly earnings related or social insurance contributions. Deductions are pro-rich in Ireland and UK. In both countries these are (private) pension contributions, which are clearly concentrated at the upper end of the distribution.

Allowances are pro-poor in all countries where they are used

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 4; e.g. Spain, which has 9 tax bands and an average value for rate progressivity, whereas Sweden has only 2 tax bands but the highest value of Π_R^K). Something similar applies for the upper tariff: Belgium, Spain and the Netherlands have the highest top rates, but their Π_R^K are not that high compared to other countries. 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 underlying income distribution are. The rate schedule is most progressive in France and Sweden; in France this also includes the effect of the application of the ‘quotient familial’.

Credits are pro-poor in Austria, Belgium, Greece, Italy, Luxembourg and Portugal. These credits are mainly family policy related and lump sum; in Luxembourg the effect follows from the tax adjustment for low incomes. Credits are pro-rich in France,

Ireland and Sweden. In Sweden the tax credit is granted for capital income and in Ireland mainly for mortgage interest relief.

6.3 Contribution to progressivity of the PIT components

The structure and weight of the different PIT components are brought together in table 13, where we express the contribution of each component as a percentage of 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 allowances in Ireland and the UK, from deductions in Germany and Portugal and from credits in Austria, Belgium and Italy, 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 Denmark, Finland, France, Greece, Spain and Sweden more than 85% of progressivity comes from the rate structure. These are in general the countries with the highest Π_R^K. In Luxembourg, which also has a high Π_R^K, the rate schedule accounts for 74%. In the Netherlands, Germany and Italy the rate structure is the most important determinant, but also other components have a considerable effect (allowances in the Netherlands, deductions in Germany and credits in Italy). 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 Ireland, the UK and Portugal. In Belgium and Austria, we find a mixture of the rate structure, credits and exemptions.

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

We can compare this 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. A first conclusion is that most countries are still in the same group. According to Loizides (1988) in Greece the rate structure was the main determinant of progressivity, and this turns out to be still the case. A second observation is that Finland, Germany and Sweden have shifted from the mixed structure group to the rate structure category. For Finland and Sweden we have to qualify this observation: in our calculations local taxes are a separate category, and thus not included in the analysis of personal income taxes, whereas they are included in Wagstaff and van Doorslaer. A last observation is that the tax reform in Denmark has also leaded this country into the rate structure group. We cannot say anything about the evolution of Austria, Luxembourg and Portugal, as they were not in the Wagstaff and van Doorslaer study. 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.

Table 13: Contribution of the various PIT components to PIT progressivity (between brackets: contribution as a % of PIT progressivity) in the EU-15, 1998.

	Exemptions	Deductions	Allowances	Rate schedule	Credits (K)	Π_T^K
Austria	0.0497	0.0014	0.0001	0.1402	0.1046	0.2961
	(16.8)	(0.5)	(0.1)	(47.3)	(35.3)	(100.0)
Belgium	0.0451	-0.0001	-	0.0984	0.1334	0.2797
	(16.1)	(-0.0)		(35.2)	(48.7)	(100.0)
Denmark	0.0288	-0.0100	-	0.1644	-	0.1831
	(15.7)	(-5.5)		(89.8)		(100.0)
Finland	0.0101	0.0041	-	0.2662	-0.0020	0.2784
	(3.7)	(1.5)		(95.6)	(-0.7)	(100.0)
France	0.0640	-0.0262	-	0.5289	-0.1266	0.4401
	(14.5)	(-6.0)		(120.2)	(-28.8)	(100.0)
Germany	0.0289	0.0837	0.0013	0.1703	-	0.2842
	(5.2)	(29.5)	(0.4)	(59.9)		(100.0)
Greece	0.0005	0.0169	-	0.2621	0.0134	0.2928
	(0.2)	(5.8)		(89.5)	(4.6)	(100.0)
Ireland	0.1008	-0.0074	0.0910	0.1129	-0.0056	0.2917
	(34.5)	(-2.5)	(31.2)	(38.7)	(-1.9)	(100.0)
Italy	-0.0155	-0.0029	-	0.0887	0.0859	0.1562
	(-9.9)	(-1.9)		(56.8)	(55.0)	(100.0)
Luxembourg	0.0341	0.0458	-	0.2907	0.0201	0.3907
	(8.7)	(11.7)		(74.4)	(5.1)	(100.0)
Netherlands	0.0265	-0.0148	0.0821	0.2330	-	0.3268
	(8.1)	(-4.5)	(25.1)	(71.3)		(100.0)
Portugal	0.0303	0.1473	-	0.1065	0.0409	0.3250
	(9.3)	(45.3)		(32.8)	(12.6)	(100.0)
Spain	0.0020	0.0076	-	0.2401	0.0125	0.2622
	(0.8)	(2.9)		(91.6)	(4.8)	(100.0)
Sweden	0.0206	0.0328	-	0.4241	-0.0001	0.4774
	(4.3)	(6.9)		(88.8)	(0.0)	(100.0)
UK	0.1427	-0.0062	0.0797	0.0372	0.0060	0.2594
	(55.0)	(-2.4)	(30.7)	(14.4)	(2.3)	(100.0)

Source: EUROMOD

7 Conclusions

Summarising, the following observations and conclusions can be drawn on the basis of our EUROMOD-research on the redistributive effect of taxes in the EU-15.

1. As expected, there is a wide variation in the EU-15 in the redistributive efforts through taxes on household income. France, Greece, Italy, Spain and Sweden have a low degree of inequality reduction through taxes (about 10% of pre-tax income inequality), whereas Austria, Belgium, Denmark, Finland, Germany and Luxembourg have a redistributive effect that is relatively high (around 20% of pre-tax inequality).
2. Countries with a high degree of pre-tax income inequality do not redistribute systematically more through their taxes. The results suggest rather the opposite: countries with a high pre-tax inequality level tend to redistribute rather less. We deduce this from the finding that the correlation between inequality before taxes and the average tax rate is negative and significantly different from zero. This supports the supposition that an initially unequal distribution and the social choice to redistribute rather little is probably based on the same underlying factors, such as a strong emphasis on individual responsibility and a big confidence in the market.
3. A mixture of personal income taxes (PIT), social insurance contributions (SIC) and other taxes is used to achieve tax progressivity. However, PIT are the most important source of progressivity and hence income inequality reduction. The only exceptions are Denmark and Sweden, where progressivity arises from a mixture of the three tax types, with a preponderance of local taxes.
4. All PIT systems exhibit a progressive structure. This broadly applies also for SIC and other taxes, but there are some exceptions. SIC are regressive in Greece, the Netherlands and Spain, whereas other taxes are pro-rich in Belgium and the UK.
5. There is a trade-off between progressivity and the average tax rate, and this is true for total taxes as well as for personal income taxes. Apparently, a government puts more burden on the broadest shoulders, if the tax weight is rather mild. But when the tax level is high, it appears to be more difficult to avoid that everybody pays its share of taxes, such that the tax rate increase less with income level.
6. If we concentrate on PIT progressivity, we find that broadly all tax exemptions and tax allowances enhance progressivity. The only exception is Italy, where exemptions are pro-rich. The evidence on tax deductions and tax credits is mixed: tax deductions have a noticeable inequality reducing effect in Denmark and France and an inequality enhancing impact in Germany, Greece, Portugal and Sweden. Tax credits have a considerable pro-poor impact in Austria, Belgium, Italy and the Netherlands, and are pro-rich in France.
7. The rate structure always contributes positively to the progressivity of the PIT system, so there is a wide variety among countries in the importance of this instrument. For some countries (e.g. France and Spain) it is almost the sole source of progressivity, whereas in other countries its relative contribution to overall progressivity amounts only to 14% or 33% (resp. the UK and Portugal).
8. As was shown in previous research, the rate structure was in general already the major source for progressivity in the mid eighties. Apparently, this pattern has been reinforced in the EU-15 in the mid-late 1990s.

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Appendix 1: EUROMOD datasets

Country	Base Dataset for EUROMOD	Date of collection	Reference time period for incomes
Austria	Austrian version of European Community Household Panel (W5)	1999	annual 1998
Belgium	Panel Survey on Belgian Households (W6)	1999	annual 1998
Denmark	European Community Household Panel (W2)	1995	annual 1994
Finland	Income distribution survey	1998	annual 1998
France	Budget de Famille	1994/5	annual 1993/4
Germany	German Socio-Economic Panel (W15)	1998	annual 1997
Greece	European Community Household Panel (W2)	1995	annual 1995
Ireland	Living in Ireland Survey (W1)	1994	month in 1994
Italy	Survey of Households Income and Wealth	1996	annual 1995
Luxembourg	PSELL-2 (W5)	1999	annual 1998
Netherlands	Sociaal-economisch panelonderzoek (W3)	1996	annual 1995
Portugal	European Community Household Panel (W3)	1996	annual 1995
Spain	European Community Household Panel (W3)	1996	annual 1995
Sweden	Income distribution survey	1997	annual 1997
UK	Family Expenditure Survey	1995/6	month in 1995/6

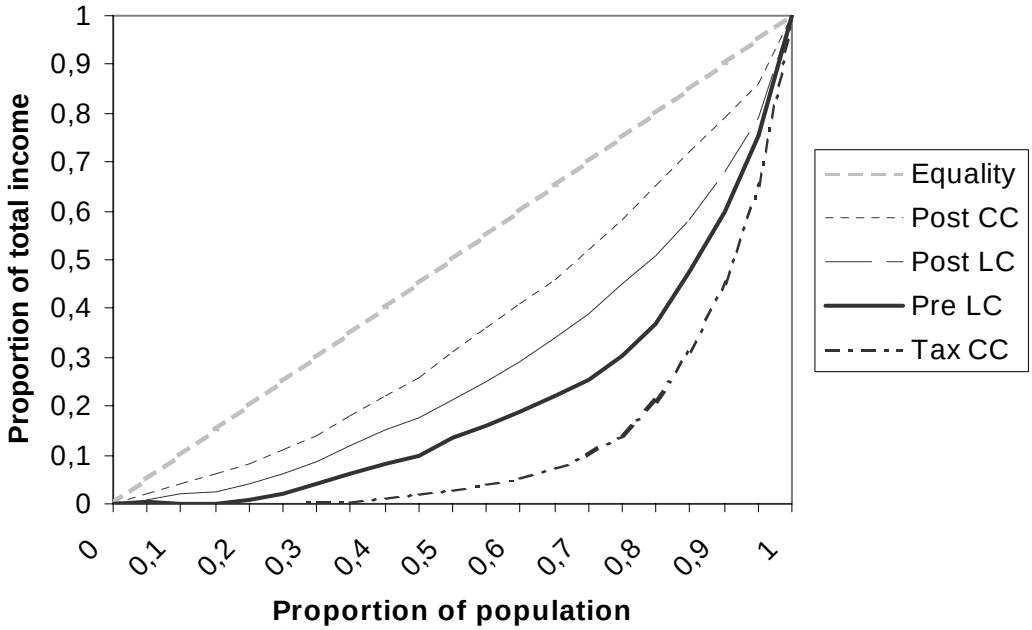
Source: Sutherland, 2001

APPENDIX 2: Measuring the redistributive effect of taxes

A.1 Lorenz and concentration curves

The indices used in this paper for measuring the effect of taxes are based on the Lorenz curve. Income units are ranked in ascending order of their pre-tax income *x*. Plotting the cumulative proportion of pre-tax income received against the cumulative proportion of income units yields the *Lorenz curve of pre-tax income* (figure A.1). The redistributive effect of taxes, i.e. the reduction of inequality following from taxation, can be represented by the shift of the pre-tax to the post-tax income Lorenz-curve. In order to draw the *post-tax income Lorenz-curve* income units are ranked in ascending order of their post-tax income *x-t(x)* (with *t(x)* representing taxes). Plotting the cumulative proportion of post-tax income received against the cumulative proportion of income units yields the *Lorenz curve of post-tax income*. If the post-tax Lorenz curve lies closer to the 45° line than the pre-tax curve (as is the case in figure A.1), then inequality is reduced because of taxes. Plotting the post-tax income shares against the cumulative proportion of income units ordered according to their *pre-tax* income, yields the *concentration curve for post-tax income*. The post-tax income Lorenz and concentration curves differ from each other in the way income units are ranked. Both curves coincide when income units do not change ranks because of taxes. But when the ranking of income units is changed by the tax system, then both curves are distinct. Reranking of income units occurs in real-world income taxes, e.g. because of differential treatment.

Figure A.1: Lorenz curves for pre-tax (Pre LC) and post-tax (Post LC) income and concentration curves for post-tax income (Post CC) and taxes (Tax CC)



Tax liability of an income unit with pre-tax income *x* is represented by *t(x)*. The *average tax rate t* is the proportion of tax in pre-tax income, or $t = t(x)/x$. A tax system is called *progressive* when the proportion of income taken in tax increases with income (Kakwani (1984). This means that the average tax rate should increase with income and that the tax system is 'pro-poor' (Blackorby & Donaldson (1984); Lambert (1985)). The tax system is said to be *proportional* when the average tax rate is constant, and *regressive* when *t* decreases with rising income. The concentration curve for taxes plots the tax shares against the

cumulative proportion of income units ordered according to their pre-tax income. When the income tax is progressive, we see an inward shift from the pre- to the post-tax Lorenz curve. This shift measures the amount of redistribution following from the income tax compared to a distributionally neutral equal-yield taxation. Hence, it measures the redistributive effect of a progressive as against a proportional tax raising the same revenue (therefore also known as the equal-yield flat-tax) (Lambert, 2001). Thus, if we want to measure the redistributive effect of taxation, we compare the pre- and post-tax Lorenz curve; if we are interested in progressivity, we look at the tax concentration curve in relation to the pre-tax Lorenz curve.

A.2 Measurement of the effects of taxation

We focus in this paragraph on the most widely used indices for the measurement of the effect of taxation. These indices reveal on the one hand the progressivity characteristics of a tax system and on the other hand its redistributive effects[11].

Progressivity as departure from proportionality

A very popular index of progressivity is the one proposed by Kakwani (1977a) which measures the departure from proportionality as the difference between the concentration coefficient of taxes and the Gini of pre-tax income:

(1) $\Pi_T^K = C_T - G_X$

The Gini index G_X can be derived from the area between the Lorenz curve L_X and the 45° line of perfect equality; analogously, this can be done for the concentration curve of taxes, thus producing a concentration coefficient C_T. 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.

Redistributive effect

The redistributive effect looks at the shift from pre-tax to post-tax income. When there is no reranking, the post-tax Lorenz curve equals the post-tax income concentration curve. For measuring the redistributive effect we use 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:

(A.1) $\Pi^{RS} = G_X - C_{X-T}$

There is a close link between the measures of progressivity and those of redistributive effect (Kakwani, 1977a). 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)*:

(A.2) $\Pi^{RS} = \frac{t}{1-t}\Pi_T^K$

Up until now we have assumed that the tax system does not produce changes in the rank order of the income units, i.e. that it makes no difference whether income units are ranked in ascending order of their pre-tax or their post-tax income. But due to differences in tax treatment of income units it is possible that some of them swap positions in the income ranking (see also Lambert 1993, 1994a and 1994b). This is captured by the difference between the concentration curve and the Lorenz curve of the post-tax income distribution *N*. Consequently, reranking can be measured as the difference between the corresponding concentration coefficient, C_N, and the Gini coefficient, G_N (Atkinson (1980), Plotnick (1981)). The Reynolds-Smolensky index is then an indicator of vertical equity *VE*, i.e. it measures the total reduction of inequality that would occur if there were no reranking of income units. The

[11] 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).

index $D = G_N - C_N$ measures how much of this equalising effect is 'undone' by reranking. Thus, the total redistributive effect is the result of a vertical equity and a reranking effect:

(A.3) $RE = G_X - G_N = (G_X - C_N) - (G_N - C_N) = VE - RR = \Pi^{RS} - D$

A.3 Decomposition of Progressivity of Taxes

Decomposition of Progressivity of Total Taxes

In most countries there are different types of taxes. Progressivity of total taxes results from the progressivity characteristics of these individual taxes. To measure the contribution of each type, we decompose the Kakwani index of total taxes. Kakwani (1977a) showed that the concentration coefficient of the total tax function $T(x)$ can be written as the sum of the concentration coefficients of n individual taxes (or, analogously, tax components, cf. infra) T_i:

(A.4) $$C_T = \sum_{i=1}^{n} \frac{t_i}{t} C_{T_i} ,$$

where C_{Ti} is the concentration coefficient of the ith tax, and t_i the average tax rate (i.e. T_i/X). Using this relationship the Kakwani index of total taxes can be written as:

(A.5) $$\Pi_T^K = C_T - G_X = \sum_{i=1}^{n} \frac{t_i}{t} C_{T_i} - \sum_{i=1}^{n} \frac{t_i}{t} G_X = \sum_i \frac{t_i}{t} \Pi_{T_i}^K$$

Decomposition of Progressivity of Personal Income Taxes

The personal income tax schedule T_{pit} is shorthand for a complex, real world income tax schedule. This summary representation obscures the effect of the different components of the tax system separately, such as the rate structure and various tax advantages (see figure 1). The effect of these different components can be measured by using decomposition formulae that make clear how the rate structure and these 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.

Final tax liability is determined by different factors: the tax base (or 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 tax base 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; I call this total tax exempt income 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 transition from pre-tax income X to taxable income Y can thus 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 then $N = X - [r(X - E - A - D(X)) - K] = X - T_{pit}$

Progressivity of net tax liabilities (or shortly 'net progressivity') results from the effect of gross tax liabilities minus that of tax credits. Using formula (A.5), we find that the concentration coefficient of net tax liabilities, C_T, is the weighted average of the different concentration coefficients of gross tax liabilities T_g and total tax credits K. The average tax

rate is $t = t_G - k$, 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:

$$C_T = \frac{t_g}{t} C_{T_g} - \frac{k}{t} C_K$$

Starting from formula (A.1) we arrive at the following decomposition of the Kakwani index of net tax liability:

(A.6)
$$\begin{aligned} \Pi_T^K &= \frac{t_g}{t} C_{Tg} - \frac{k}{t} C_K - \frac{t_g - k}{t} G_X = \frac{t_g}{t}(C_{T_g} - G_X) + \frac{k}{t}(G_X - C_K) \\ &= \frac{t_g}{t} \Pi_{T_g}^K + \frac{k}{t} \Pi_K^K \end{aligned}$$

Π_{Tg}^K is the Kakwani index of gross tax liabilities, measured as the area between the concentration curve of gross tax liabilities and the Lorenz curve of pre-tax income. Π_K^K shows the degree of disproportionality of tax credits K relative to the distribution of pre-tax income, or $\Pi_K^K = G_X - C_K$. A positive Kakwani index of tax credits indicates that the tax credit goes disproportionately 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 I call 'direct progressivity', and on the other hand from the effect of the tax base structure, which is 'indirect progressivity':

(A.7) $$\Pi_{T_g}^K = (C_{Tg} - C_Y) + (C_Y - G_X)$$

The first term of this formula measures *direct progressivity*, which follows from the progressive tax rate schedule applied on taxable income, and is measured by the difference between the concentration curves of gross tax liabilities and taxable income. We call this the pure rate effect, which is represented by the index:

(A.8) $$\Pi_R^K = C_{Tg} - C_Y$$

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 (A.6) we can write:

(A.9) $$C_Y - G_X = \frac{e + a + d}{1 - e - a - d}(G_X - C_{E+A+D})$$

Using (A.5) in this formula we can write the measure of indirect progressivity as the weighted sum of the disproportionality of exemptions, allowances and deductions:

(A.10)
$$\begin{aligned} C_Y - G_X &= \frac{1}{1 - e - a - d}\left[e(G_X - C_E) + a(G_X - C_A) + d(G_X - C_D)\right] \\ &= \frac{e}{1 - e - a - d} \Pi_E^K + \frac{a}{1 - e - a - d} \Pi_A^K + \frac{d}{1 - e - a - d} \Pi_D^K \end{aligned}$$

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

Just as with tax credits, a positive value of Π_E^K, Π_A^K and Π_D^K corresponds with exemptions, allowances and deductions benefiting relatively more to lower incomes, and thus enhancing overall progressivity, and consequently overall vertical equity.

APPENDIX 3: Definition of income concepts for each country

For each country we have defined the following income concepts:

- **gross or pre-tax income** (X), which 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
- **total taxes** ($T = T_{pit} + T_{sic} + T_{oth}$)
- (net) **personal income tax liability** (T_{pit})
- **other direct taxes** (T_{oth})
- **social insurance contributions** (T_{sic})
- **net or disposable income** ($N = X - T$), which corresponds to the EUROMOD standard definition of Household Disposable Income (HDI) (see e.g. Sutherland, 2001)
- **exemptions** (E), which also include imputed taxable income components (see section 2.2.1)
- **allowances** (A)
- **deductions** (D)
- **taxable income** (Y), which corresponds to $X – E – A – D$
- **gross tax liability** (T_g)
- **credits** (K)

For the various income concepts we list in this appendix the income components that are included. Income components in *italic* have a value zero. For each country we also present a table which summarises the average values of the income concepts. In general, the income concepts are listed in the columns, whereas the variables are written in the rows. In the first column you find the variable name as it is programmed in EUROMOD. The next 5 or 6 columns indicate which variables are included in the resp. income concepts: e.g. if the variable has a value 1 in the second column, it means that it is entirely part of gross income X; if it has a weight 0.2, only 20% is part of the income concept. The last two columns give the average values of the variables. In the last but one column we find the average household amount ("mean"), whereas the last column presents the average equivalised household amount weighted for the number of individuals in the household ("mean equiv.") (cf. section 2.3). In principle, the sum of the corresponding weighted variables should give the average total amount of the income concept ("sum" and "sum equiv.") This will however not always be the case for allowances (A), deductions (D) and taxable income (Y). It is sometimes possible that the value of A and/or D exceeds Y. We have corrected in such a way that Y is nowhere below zero, and that A and/or D are reduced such that $X = Y – E – A – D$.

AUSTRIA

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = self-employed contributions to disability insurance + employee health insurance contributions + self-employed health insurance contributions + employee contributions to pensions insurance + self-employed contributions to pensions insurance + employee contributions to unemployment insurance + employee contributions to housing subsidy + employee compulsory union contributions

T_{oth} = withholding tax on capital income + *churchtax* + *other personal taxes and contributions* + *wealth or national property tax* + *sub-national (local or regional) taxes*

Net income (N) N = X - T

Exemptions (E)

- *maternity payment*; maternity allowance supplement; pregnancy benefit; child benefits; child birth benefit; *addition to child benefit for disabled children*; provincial family bonus; small children benefit; child care benefit; caring benefit
- study allowances
- social assistance
- 37.5% of private pension benefit payments
- unemployment benefits; unemployment payments
- housing benefits (housing benefits)
- investment income (taxed as part of 'other taxes', i.e. withholding tax on capital income)
- *maintenance payments*; private transfers received

Allowances (A)

- *for disability*
- for self-assessment income
- for agricultural workers (at_it_agriworker_tfa)

Deductions (D)

- for single earners
- cost of earnings; part of 'other earnings'; limited expenditures
- SIC (self-employed contributions to disability insurance; self-employed health insurance contributions; self-employed contributions to pensions insurance; employee SIC)
- *Church tax*
- *Charitable donations*
- *Exceptional costs*

Taxable income (Y)

Y = X – E – A – D (correction of Y, D, A for negative values of Y)

Gross tax liability (T_g)

= application of rate schedule before tax credits

Credits (K)

- general; child tax credit; lone parents; Single earners
- pensioners
- Commuters; income tax reduction; wage earners; progression adjustment
- Preferential tax of other earnings is a negative tax credit (as it increases taxes)

Net personal income tax liability (T_{pit})

= national income tax (is sometimes negative. Some tax credits are refundable in Austria)

BELGIUM

Gross Income (X)

Remark: investment income is part of gross and net income, but not always of taxable income, (only when it is beneficial for the taxpayer)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = employee contributions to healthcare and sickness insurance + employee contributions to unemployment insurance + employee contributions to pension insurance + self-employed social insurance contributions + health insurance and solidarity contributions paid by pensioners
T_{oth} = *sub-national (local or regional) taxes* + *other personal taxes and contributions* + wealth or national property tax

Net income (N) N = X - T

Exemptions (E)

- child benefit; birth/adoption allocation
- study allowances
- minimum income (minimex)
- minimum income for old persons
- allocation for handicapped persons
- 20% of maintenance payments received
- other (*housing benefits*; *irregular lump sum benefits*; *other regular primary income*; other private transfers received; *other regular cash payments*)

Remark: 1) imputed rent is imputed taxable income
2) property income is taxable for 140%, so 40% of property income is imputed taxable income

Allowances (A)

none

Deductions (D)

- SIC
- cost of earning income deduction
- Real Estate Deductions: mortgage interest + dwelling allowance + additional dwelling allowance
- Deductible Expenses: maintenance payments (80%)
- marital quotient: the part that is deducted from one spouse is a negative figure and thus becomes a positive deduction, where as the part that is added to the income of the other spouse is positive and increases taxable income (and thus a negative deduction)

Taxable income (Y)

$Y = X – E – A – D$

Gross tax liability (T_g)

application of rate schedule on taxable income of both spouses

Credits (K)

- basic exemption (single/spouse) + family tax credit
- replacement income credit
- zero tax for some low replacement incomes;

Net personal income tax liability (T_{pit})

= national income tax

DENMARK

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = own contribution to supplementary pension scheme + general own social contribution + temporary own pension contribution + voluntary unemployment insurance contribution

T_{oth} = *other personal taxes and contributions* + *wealth or national property tax* + local income tax

Net income (N) N = X - T

Exemptions (E)

- child benefits (incl. 'ordinary', extra', 'special' and 'multichildren' benefit); family allowance; day care subsidy
- study allowances
- housing benefits
- part of disability pension (invalidity amount plus augmentation plus special benefit for disabled with substantial earnings)
- *other private transfers received*

remark: lump sum income is imputed taxable income

Allowances (A)

none

Deductions (D)

- alimony received for children
- *maintenance payments*
- Social insurance contributions (=T_{sic})
- *pension contributions*
- mortgage interest

Remark: the other two 'deductions' (transfer deduction & capital transfer deduction) are not considered as deductions, but as part of the tax rate structure. They can be seen as building stones of a progressive rate structure (see also 'Gross tax liability').

Taxable income (Y) Y = X – E – A – D

Gross tax liability (T_g)

= bottom national income tax + middle national income tax + top national income tax
the rate structure can be seen as consisting of 4 tax bands:

Tax bands in DK/year	Tax rate	%
0 – 31400	0%	
31 400 – 139 000	8%	= 8
139 000 – 251 200	14%	= 8 + 6
251 200 +	29%	= 8 + 6 + 15

The income concept for each % is not entirely the same (the 6%-income-concept has 2 extra deductions compared to the 8%-income-concept (i.e. *maintenance payments* & voluntary unemployment insurance contribution), whereas the 15%-income-concept differs from the 6%-income-concept in the sense that it does not include investment income.
The boundaries of the tax bands can differ for tax units for two reasons (see country report):

1) the upper limit of the first band can be 22500 Dk for children
2) unused parts of taxfree amounts can be transferred between spouses

Credits (K)

none

Net personal income tax liability (T_{pit})

= bottom national income tax + middle national income tax + top national income tax

FINLAND

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = employee social contributions + employee sickness contributions + self-employed contributions to pensions insurance

T_{oth} =*coOTHTAX* + wealth or national property tax + local non-capital income taxation + church non-capital income taxation + capital taxation + *real estate taxation* + deposit interest income tax

Net income (N) N = X - T

Exemptions (E)

- child benefit; lone parent child benefit; child day care benefit, child home care non-means-tested payment; child home care additional means-tested benefit; ex-child home care subsidy
- social assistance benefits
- military injury compensation
- housing benefit; pensioners housing benefit; student housing benefit
- part of investment income
- property income
- maintenance payments received
- part of self-employment income
- *pension from abroad*
- other (other regular primary income; irregular lump sum benefits; other private transfers received; other regular cash payments)

Allowances (A)

none

Deductions (D)

- deduction for pension income
- natural deductions (priority) = deduction for professional expenses (= standard deduction for employees + deduction for sailors, for travel expenses etc.)
- part of employee social contributions (= employee social contributions for occupational pensions + employee social contributions for unemployment)
- state tax deductions for sailors
- for income losses
- Other deductions (*fisotded*)

Taxable income (Y)

Y = X – E – A – D

Gross tax liability (T_g)

application of rate schedule on taxable income of both spouses

Credits (K)

- child maintenance tax credit
- disability tax credit
- f*i_it_temp_house* (everywhere zero)
- Deficit capital compensation tax credit

Net personal income tax liability (T_{pit})

= national income tax

FRANCE

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = all employee social insurance contributions
T_{oth} = sub-national (local or regional) taxes + *other personal taxes and contributions* + *wealth or national property tax* + capital income tax

Net income (N) N = X - T

Exemptions (E)

- family benefits (allocation familial; family benefit for young children; fr_sben_ars; alloc. de rentrée scolaire; family benefit for many children; social benefit for special education; social benefit for parental education; support for child care; lone parent benefit; social benefit for lone parents)
- minimum income; minimum pension; social aid
- social benefit for dependent elderly
- allowance for handicapped persons (means tested); invalidity pension; war pension
- investment income
- maintenance payments received
- property income
- other (irregular lump sum benefits; *other regular primary income*; other private transfers received)

Allowances (A)

none

Deductions (D)

- personal deduction
- for pensions
- for professional expenses
- part of SIC: general employee social insurance contributions; *css contribution on unemployment and on pensions*; special contribution on unemployment income for pensions; contribution on pension income for sickness;
- part of csg-contributions on employment income, on unemployment income, on pensions and *on other income*

Taxable income (Y)

Y = X – E – A – D (correction Y, D and A, if Y<0)

Gross tax liability (T_g)

Includes both application of the rate schedule as the advantage of the Family Quotient.

Credits (K)

- Tax rebate (décoté);
- Tax credit (imputed):,
- Tax credit for those who pay less than 400 FF (tax is reduced to zero)

Net personal income tax liability (T_{pit})

= national income tax

GERMANY

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} =employee health social insurance contributions + employee social insurance contributions for disability + employee contributions to pensions insurance + employee contributions to unemployment insurance

T_{oth} = *sub-national (local or regional) taxes + other personal taxes and contributions + wealth or national property tax* + solidarity surplus tax

Net income (N) N = X - T

Exemptions (E)

- child benefit; federal child raising benefit; provincial child raising benefit; post natal benefit for non-earning mothers;
- study allowances
- social assistance
- nursing home insurance premia received
- unemployment allowances
- housing benefits; direct housing support
- Other (*other regular primary income; irregular lump sum benefits; other regular cash payments*)

Allowances (A)

- child tax allowance (compared with child benefit via optimization)
- lone Parent tax allowance

Deductions (D)

- Deduction on Civil Servant Pensions; for old age; non-earnings part of non-civil-servant pensions;
- Part of old age and Widow/Orphan pensions
- Expenditure Deductions (which includes also deduction of part of social insurance contributions)
- Old Age Deductions
- Part of maintenance payments
- Deduction for earned wages
- Deduction *from* investment income

Taxable income (Y)

Y = X – E – A – D

Gross tax liability (T_g)

Credits (K)

none

Net personal income tax liability (T_{pit})

national income tax

GREECE

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = civil servants social contribution + ika employee contributions + farmer's sic + ika pensioner contributions + self-employed contributions

T_{oth} = *other personal taxes and contributions + wealth or national property tax + sub-national (local or regional) taxes*

Net income (N) N = X - T

Exemptions (E)

- Housing benefits
- Study allowances
- *other private transfers received*

remark: lump sum income is imputed taxable income

Allowances (A)

none

Deductions (D)

- Social Insurance contributions (T_{sic})
- Mortgage interest payments
- Medical expenses deduction
- Private education expenditure deduction
- Rent deduction

Taxable income (Y)

Gross tax liability (T_g)

= taxes after application of the rate schedule

Credits (K)

- Household expenditure
- Private pension contributions
- Children

Net personal income tax liability (T_{pit})

= national income tax

IRELAND

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = general employee social insurance contributions

T_{oth} = *other personal taxes and contributions + wealth or national property tax + sub-national (local or regional) taxes*

Net income (N) N = X - T

Exemptions (E)

- Housing benefits
- Study allowances
- Maintenance payments received
- Carer's non-contributory benefits
- Child benefits
- Short Term Disabled Contributory Benefits
- Family Income Supplement
- Long Term Invalidity Contributory Benefits
- Unemployed (Non-)contributory Benefits
- Maternity Contributory Benefits
- Orphan's Contributory Benefits
- Social Minimum non-contributory benefits
- *Unemployment supplement*
- other (*irregular lump sum benefits*; *other regular cash payments*, deserted wives' non-contributory benefits)

Allowances (A)

- Age
- Lone parent
- Single/married
- Widowed
- Employee

Deductions (D)

- Pension contributions
- *Imputed Self-Employment Deduction*

Taxable income (Y)

Y = X – E – A – D

Gross tax liability (T_g)

Credits (K)

- mortgage interest relief
- permanent health insurance relief

Net personal income tax liability (T_{pit})

= national income tax

ITALY

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = general employee social insurance contributions = employee contribution + executive additional contribution + self-employment contribution

T_{oth} = *sub-national (local or regional) taxes + other personal taxes and contributions + wealth or national property tax* + deposit tax + tax on government bonds + tax on other bonds + tax on dividends

Net income (N) N = X - T

Exemptions (E)

- *Housing benefits*
- Maintenance payments received
- *Maternity payments*
- 15% of property income
- Family allowances (1 adult + no children; 1 adult + children; 2 adults + no children; 2 adults + children)
- Social security benefits from national administrations; from regional administrations; from provincial administrations; from municipal administrations; from local health centre; from other local P.A.; from other private institutions.
- Social pension and War pension
- State disability non contributory pension; INAIL Disability non-contributory pension
- *Other* (*irregular lump sum benefits; other regular cash payments; other regular primary income*)
- Tax evasion (correction for underreporting)
- investment income is no part of Y, and thus part of E. It is however taxed separately and the corresponding taxes are in T_{oth}

remark: Imputed cadastral values is imputed taxable income (taxable rental income; land-imputed cadastral value; main residence-imputed cadastral value; other buildings -imputed cadastral value)

Allowances (A)

none

Deductions (D)

- General employee social insurance contributions (T_{sic})
- House deduction
- Other expenditures deductible from taxable income (imputed)

Taxable income (Y)

$Y = X – E – A – D$

Gross tax liability (T_g)

Credits (K)

including:

- Work-related expenses for employees (earnings tax credit)
- Work-related expenses for pensioners (earnings tax credit + pension tax credit)
- Work-related expenses for self-employed (self-employment earnings tax credit)
- Tax credit for dependent spouse
- For dependent children
- For lone parents
- Other dependents
- Insurance tax credit + mortgage interest tax credit + other tax credits (imputed)

Net personal income tax liability (T_{pit})

= national and local income tax (IRPEF) + tax on productive activities of self-employed

LUXEMBOURG

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = self-employed contributions to disability insurance + employee health social insurance contributions + self-employed health insurance contributions + employee contributions to pensions insurance + self-employed contributions to pensions insurance + self-employed (non-farmers) family benefits contribution

T_{oth} = *sub-national (local or regional) taxes + other personal taxes and contributions + wealth or national property tax*

Net income (N) N = X - T

Exemptions (E)

- Study allowances, Education allowance, School allowance
- Child benefit; handicapped child benefit; orphan allowance
- Pre-, postnatal and birth allowances; maternity allowances
- Housing benefits
- Seriously Disabled Persons; Permanent Accident Benefit
- Care benefits
- Other benefits from the Fonds national de Solidarité; other Public Benefits
- Sickness Replacement Salary/Wage (is part of current employment income in Euromod)
- other (*irregular lump sum benefits*; other private transfers received)

Allowances (A)

None

Deductions (D)

- social insurance contributions (=T_{sic})
- wage-earners
- 'professional' couples
- agricultural salaried workers
- pensioners
- disabled; disabled employees
- farmers
- child care; family care
- exemption for accessory income
- exemption for LUX investment income + related costs
- expenditure deductions
- lone parents
- property income
- low incomes of class 1a. (this deduction appears in EUROMOD for "programming" reasons but it is not a deduction that appears in the law.)
- Adjustment deduction to round incomes to lower 1000

Taxable income (Y) Y = X – E – A – D

Gross tax liability (T_g)

Credits (K)

- Deduction for child care expenditures
- Adjustment of taxable income depending on tax "class" (for lower income families)
- Unemployment additional insurance tax, is an extra surtax (calculated as 2.5% of taxes) and is thus treated as a *negative* tax credit.

Net personal income tax liability (T_{pit})

= national income tax

NETHERLANDS

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = self-employed contributions to disability insurance + employee health social insurance contributions + employee contributions to pensions insurance + employee contributions to unemployment insurance

T_{oth} = *other personal taxes and contributions + wealth or national property tax + sub-national (local or regional) taxes*

Net income (N) N = X - T

Exemptions (E)

- Housing benefits
- Study allowances
- *Maternity payments*
- Child benefits
- Maintenance payments received from ex-spouse for children
- other (*irregular lump sum benefits*; other private transfers received; *other regular cash payments*)

remark: Use of car from employer and Imputed income from owner occupied house is imputed taxable income

Allowances (A)

- Pension deductions
- Basic tax free allowance
- Investment income tax free allowance
- Single parent tax free allowance

Deductions (D)

- Deduction for professional expenses
- Self employment income deduction
- Mortgage interest payment deduction
- SIC: self-employed contributions to disability insurance + employee contributions to unemployment insurance – employer contributions for health insurance (employer contributions for health insurance are added to Y, and thus a negative deduction as they are no part of X)
- Pension contributions
- Maintenance payments (to exspouse for or directly to) children
- Amounts in special savings accounts or received from special arrangements

Taxable income (Y) Y = X – E – A – D

Gross tax liability (T_g)

Credits (K)

none

Net personal income tax liability (T_{pit})

= national income tax

PORTUGAL

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = employee social insurance contributions + self-employed social insurance contributions
T_{oth} = *sub-national (local or regional) taxes + other personal taxes and contributions + wealth or national property tax* + capital income taxes

Net income (N) N = X - T

Exemptions (E)

- Study allowances
- Housing benefit
- Investment income
- Maintenance payments received
- *Maternity payments*
- Property income
- *Private pension benefit payments*
- Child benefits
- Income supplement to ensure minimum income
- Unemployment related benefits
- Family benefits
- Social assistance
- other (irregular lump sum benefits; other regular cash payments: other regular primary income; other private transfers received)
- treated as a *negative* exemption: coLUMPY

remark: Lump sum income is imputed taxable income

Allowances (A)

None

Deductions (D)

- for housing debt
- for employment income
- for self-employment income
- for pension income

Taxable income (Y)

Y = X – E – A – D

Gross tax liability (T_g)

Credits (K)

Net personal income tax liability (T_{pit})

Income Tax

SPAIN

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = Agrarian employment social insurance contribution + Agrarian self employment social insurance contribution + Apprenticeship employee social insurance contribution + General Employee SICs + part-time employee social insurance contribution + Self-Employed SICs + SICs for the unemployed

T_{oth} = *other personal taxes and contributions + wealth or national property tax + sub-national (local or regional) taxes*

Net income (N) N = X - T

Exemptions (E)

- Child Social Assistance
- *other private transfers received*

Allowances (A)

none

Deductions (D)

- Social insurance contributions ($=T_{sic}$)
- Investment income: part of it is taxable, and another part is not.
- Main income tax deduction from employment income
- *Employment income deduction*

Taxable income (Y)

Y = X – E – A – D

remark: income from property is part of taxable income, but not included due to lack of data.

Gross tax liability (T_g)

Credits (K)

- Income Tax Child Tax Credit (National and Regional)
- Income Tax dependent parent Tax Credit 1 (National and Regional)
- Income Tax dependent parent Tax Credit 2 (National and Regional)
- Income Tax dependent elderly person Tax Credit (National and Regional)
- Income Tax rent Tax Credit (National and Regional)
- Employment Income Tax Credit
- Mortgage tax credit

Not included because of lack of data: the regional tax credits; Income Tax medical expenses Tax Credit (National and Regional); Income Tax child care expenditure Tax Credit (National and Regional); Income Tax disabled person Tax Credit (National and Regional)

Net personal income tax liability (T_{pit})

= national income tax

SWEDEN

Gross income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = general pension fee
T_{oth} = sw_it_estate + sw_it_invnet + sw_it_municipal + sw_wealth_taxnet – sw_it_reduction
remark: self-employment SIC are not included in self-employment income

Net income (N) N = X - T

Exemptions (E)

- Investment income
- Maintenance payments received
- Child benefits
- Housing benefits (housing benefits; Housing benefit supplement for pensioners)
- Social assistance
- *other* (*irregular lump sum benefits; other regular cash payments: other regular primary income; other private transfers received*)
- Resid. Tax free educational benefits
- Residual tax free benefits
- University grants; Study grants for high school
- Sick benefit self-employed (is maybe part of self-employment income, not clear)
- Non-taxable pension
- Part of self-employment income.

Allowances (A) *IL*

None

Deductions (D) *IL*

- general pension fee (T_{sic})
- Pension contributions
- Deduction from income tax base
- Deduction for new started company
- Deduction for periodic maintenance payments
- Deduction for travel between home and work'/* over 6000 SEK/year * Business travel

Taxable income (Y)

Y = X – E – A – D

Gross tax liability (T_g)

= national income tax

Credits (K)

= tax reduction on capital + limitation rule

Net personal income tax liability (T_{pit})

= net national income tax

UNITED KINGDOM

Gross Income (X)

Total taxes (T) $T = T_{pit} + T_{sic} + T_{oth}$

T_{sic} = Employee social insurance contributions
T_{oth} = Council Tax - Council Tax Benefit

Net income (N) N = X - T

Exemptions (E)

- Child benefit
- Maintenance payments received
- Income support
- Housing benefits
- Family Credit
- Study allowances
- Disability etc. benefits (disability living allowance (Self Care); DWA; incapacity benefit; industrial injury; mobility allowance (now "disability living allowance (Mobility)"); severe disablement allowance)
- Other (irregular lump sum benefits; other regular cash payments; other private transfers received; attendance allowance; training allowance; Non-taxable Investment Income)

Allowances (A)

- Personal tax-free allowance
- Age-related Personal tax-free allowance (group 1 and group 2)

Deductions (D)

Pension contributions

Taxable income (Y)

Y = X – E – A – D
Remark: special rate applied on investment income is included in the rate structure effect

Gross tax liability (T_g)

Credits (K)

- Married Couple Income Tax Credit
- Age-related Married tax allowance
- Mortgage Interest Income Tax Credit
- Lone parent tax credit

Net personal income tax liability (T_{pit})

= national income tax