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Old age social protection through taxes?

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Abstract

Although there are important links between the pension system and the tax system, both systems are often studied in isolation. In this paper, we study the interaction between the pension and tax system from a social inequality perspective, in the EU-27 countries and the UK. We study whether both systems reinforce each other or whether they operate in opposite directions. We provide a framework in which countries are classified according to the characteristics of their tax-benefit system, departing from the idea that the underlying principle of the welfare state will affect key decisions regarding pension systems and their taxation. In the analysis, we use the European microsimulation tax-benefit model EUROMOD to calculate the tax burden for pensioners and workers. We study how the tax burden differs across the distribution of pre-tax income and use a decomposition to show how taxes on each component influence progressivity of overall taxes and social contributions. We investigate whether any cross-country (dis)similarities can be discerned related to the welfare state types presented in the literature. Our results indicate that almost all countries use the tax system as a social policy tool. The distributive effects, however, differ across countries. There is variation with regards to the extent to which pensioners are taxed into poverty and with regards to the effect on tax progressivity.

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1. Introduction

In this paper, we aim to study the interaction between the pension and the tax system from a social inequality perspective. These systems are in general studied in isolation, but there are important links between both domains, as we will demonstrate in this paper. Depending on the principles on which both systems are built, these systems may reinforce one another from a social inequality perspective, or, on the contrary, operate in opposite directions. We empirically investigate the following questions regarding the way both systems interact: Do pensioners face a similar tax burden as workers, or are there differences overall and across the income distribution? Do governments in Europe use the tax system as a social policy tool when it comes to the elderly, e.g. by treating (minimum) pensions and old-age benefits in a favourable way? To what extent are elderly persons taxed into poverty?

To answer these questions, we first provide a framework in which countries are classified according to the characteristics of their tax-benefit system, departing from the idea that the underlying principle of the welfare state will affect key decisions regarding pension systems and their taxation. In the empirical analysis, we use the European microsimulation tax-benefit model EUROMOD to calculate for the EU-27 countries and the United Kingdom the tax burden for pensioners and workers and to study how the burden differs across the distribution of pre-tax income. We use a decomposition to show how taxes on each component influence progressivity of overall taxes and social contributions. We investigate whether any cross-country (dis)similarities can be discerned related to the welfare state types presented in the literature.

The paper is structured as follows. In section 2, we set up our conceptual framework, starting from the identification of possible links between welfare state types and the characteristics of pension systems in the EU-27 and the United Kingdom, which we then connect to the literature on tax systems and pension-related tax expenditures. In section 3, we introduce the data and the methodology used to determine taxes and contributions paid on employment and retirement income. Section 4 presents our results, while section 5 concludes.

2. Literature review

Income in old age is determined not only by the pension system, but also by the tax system. Yet there is relatively little research that analyses how the interaction between both systems influences outcomes of poverty and inequality in old age. To guide our analysis, we assume that the type of welfare state influences both sides of the tax-benefit system, in distinct but related ways. In this sense, we follow the reasoning of Kammer et al. (2012, p. 458), who "claim that welfare state institutions even affect the redistributive capacity of individual welfare state instruments as well as the emergence of a complementary fiscal policy mix". In other words, even though the objectives of the tax system differ from those of the pension system, our analysis departs from the idea that the underlying principles of the welfare state type influence decisions regarding key elements of both systems. At the very least, this implies that we expect that the characteristics of the tax system do not counteract the effects of the pension system. Table 1 provides an overview of the connection between the key elements of the pension and taxation system. In the following sections, we will explain more in detail how these elements are connected.

Table 1: Key principles of pension and taxation systems

Welfare state principle	Solidarity	Insurance
Goal	Adequate living standards for everyone	Consumption smoothing
Result	Poverty alleviation	Reproducing living standards in old age
Corresponding principle in taxation	Vertical equity	Horizontal equity

2.1. Pension systems

In general, pension systems have two fundamental objectives (Zaidi, 2010). The first is to provide protection against poverty at old age. This can be linked to the solidarity principle, whereby the system aims to guarantee a minimum income to everyone. The second objective is to safeguard, to a certain extent, the living standard a person had during their working life. This can also be understood in terms of consumption smoothing over the lifetime, and is often indicated by replacement rates (income from pensions as a percentage of income from work). The underlying principle here is one of insurance.

The relative importance of each objective differs across countries. In part, it is related to the Beveridge/Bismarck dichotomy of social security systems and the typology of welfare states as proposed by Esping-Andersen (1990) and amended by Ferrera (1996). Esping-Andersen's (1990) typology of

welfare states distinguished three types: conservative, social-democratic and liberal, Ferrera (1996) added the fourth type of Southern or Mediterranean states. Historically, in Beveridgean countries, poverty prevention has been the main objective of the state. To achieve this, the state provides flat-rate, universal benefits (albeit possibly means-tested). In the case of pensions, the responsibility to maintain living standards obtained during working life is left with the individuals. The countries belonging to this group are the Netherlands, Ireland, the United Kingdom, Denmark, Finland and Sweden (Hinrichs & Lynch, 2010). The group of Beveridgean countries can be divided into two welfare state types: the social-democratic or Nordic countries (Denmark, Finland, Sweden) and the liberal countries (the United Kingdom and Ireland) (Fuest et al., 2010). In liberal type welfare states, social security is provided universally, but is means-tested while in Nordic countries it is universal and provides equal benefits to all.

In Bismarckian countries, on the other hand, the social security system is organized around the logic of social insurance (Fuest et al., 2010). This means that benefits are related to contributions made during working life. This implies that contribution-based pension policies, aimed at income maintenance, are at the centre of the pension system (Ebbinghaus, 2021; Hinrichs & Lynch, 2010). In this group, a distinction can be made between conservative and Southern welfare states. According to Fuest et al. (2010), the differences between conservative and southern countries are mainly found in the levels of social spending and of taxes and redistribution. Although there is discussion about their categorization, Central Eastern European (CEE) and Baltic countries are often categorized as being similar to continental and southern welfare states. In a way, they can be seen as relatively smaller (or not yet mature) social insurance states (Fuest et al., 2010).

Since their conception, both Beveridgean and Bismarckian countries have made changes to their pension systems, incorporating contribution-based and minimum protection elements, respectively (Hinrichs & Lynch, 2010). In addition, demographic ageing processes and fiscal budget constraints have led to pension reforms in many countries. More specifically, there has been a shift towards the privatisation and marketisation of pensions (Ebbinghaus, 2015). Due to these changes, pension systems have become more complex and now consist of multiple policies (OECD, 2019). Therefore, the Beveridge/Bismarck dichotomy alone is not sufficient to fully capture the diversity of pension systems. It can be coupled to the OECD (2019) taxonomy, which is a useful instrument to understand the architecture of pension systems. At the same time, we argue that even with increasingly complex pension systems, connections can be made between different types of pensions systems and the underlying principle of the welfare state type a country adheres to.

In the OECD (2019) taxonomy, pension policies are categorized into three tiers. The first tier is public and mandatory and consists of social protection policies, aimed at providing an adequate standard of living (i.e. preventing poverty). These could be basic pensions, targeted plans or minimum pensions.

Their most important characteristic is that they are independent of past earnings, though they can be made dependent by including a residence criterium, or (current) income and/or assets being below a certain threshold or the number of years one contributed during their working life. The second tier comprises all mandatory, earnings-related programs. Within the public second tier pensions, three types of schemes exist. Firstly, in the schemes that follow defined benefit rules (DB), pensions depend on the number of years one contributed, (pensionable) earnings and accrual rates. Pay-as-you-go schemes follow these applied benefit rules. Secondly, in point schemes workers earn pension points based on their earnings, which are converted into a pension income when the worker retires. A third category are defined contribution (DC) plans, whereby contributions flow into an account (either funded (FDC) or notional (NDC)). At the age of retirement, the accumulated contributions and investment returns are converted into a monthly pension. DC schemes can also be organised privately, either as part of the mandatory second tier or as the voluntary third tier. The third tier is made up by voluntary earnings-related provisions, which can be personal or provided by an employer.

Table 2 summarizes the key characteristics of pension systems and their tax treatment. In line with Fuest et al. (2010), we group countries according to the welfare state typology in the following six categories:

1. Nordic: Denmark, Finland, Sweden and the Netherlands[1]
2. Anglo-Saxon: Ireland and the United Kingdom
3. Continental: Austria, Belgium, France, Germany and Luxembourg
4. Baltic: Estonia, Latvia and Lithuania
5. Central Eastern European: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia and Croatia
6. Southern: Cyprus, Greece, Italy, Portugal, Spain and Malta.

In the group of countries based on the insurance-principle (Continental, Baltic, CEE and Southern countries), the most common pension system combines a public earnings-related pension, with DB rules (or a points-based system in some cases). In most countries, this is complemented with some kind of minimum income protection for individuals without the necessary contribution years to qualify for the earnings-related pension; these first tier pension policies often take the form of a social pension (i.e. means-tested) (Goedemé, 2013; Marchal & Siöland, 2019). The exceptions are Austria, Luxembourg, the Czech Republic, Poland, Romania, Slovakia and Croatia. While these countries do have a public earnings-related pension, they do not have specific minimum income protection schemes for the elderly, although pensioners can rely on social assistance (Marchal & Siöland, 2019). In insurance-based countries, contributions and pension benefits are clearly linked, but public pension systems often also

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[1] We categorize the Netherlands here among the Nordic countries because of its Beveridgean-inspired pension system (Hinrichs & Lynch, 2010) and because of similarities between these countries in the design of old-age minimum income schemes, as will be discussed below.

contain additional redistributive elements, such as benefit ceilings (Been, Caminada, Goudswaard, & van Vliet, 2017).

Other countries within the Bismarckian group have a different pension system. Several CEE countries adopted a multi-pillar pension system (or made reforms to this system) before joining the EU (Zaidi, Grech and Fuchs, 2006). Estonia, Bulgaria, Romania and Croatia combine a public earnings-related pension with a private earnings-related pension. The private earnings-related pension is based on DC rules. Compared to DB rules, the link between contributions and pensions is stronger in such DC pension policies. In addition, the individual accounts at the base of DC schemes shift financial risks to the individual, while these risks are shouldered by the state in DB pension policies (Zaidi, Grech, & Fuchs, 2006). Italy, Latvia and Poland have also integrated DC rules into their pension system, in their public earnings-related pensions. In a sense, the insurance-principle is more present in countries with DC policies at the centre of the earnings-related pension policies than in countries with DB rules.

The solidarity principle that is central in the Nordic and Anglo-Saxon countries is also visible in their pension systems. Essentially, in all these countries, the state assumes responsibility for providing a minimum income level, while individuals are responsible for maintaining their living standards in old age through private (occupational) pension schemes (Zaidi, Grech and Fuchs, 2006). Although reforms have been made in several of these countries, in general the public first tier pension policy is the cornerstone of the pension system. The United Kingdom and Ireland provide a social pension (means-tested), in line with the liberal logic of means-tested benefits. The Nordic countries originally provided basic pensions in line with the logic of universal, equal benefits. Nowadays the non-contributory pension policies in the Nordic countries also include (some) means- or income-testing, so that a pure basic pension only remains in the Netherlands, while it is still partially in place in Denmark (Goedemé & Marchal, 2016). Finland and Sweden chose to supplement their basic pension with a public, rather than private, pillar, effectively turning them into Bismarckian countries (Hinrichs & Lynch, 2010). Individuals can, in most countries, supplement their incomes through pensions in the private sector, which is often extensively regulated. In the Netherlands, Denmark and Sweden, participation is quasi mandatory and the coverage is almost universal (Hinrichs and Lynch, 2010; OECD, 2019). Following the logic of individual responsibility to maintain living standards, in Denmark and, to a certain extent Sweden, the private contribution-based policies are fully funded (FDC).

In line with the logic of minimum income protection, in these countries generous first tier pension policies would be expected. Marchal and Siöland (2019) have analysed for different model families whether first tier pension policies provide income levels that exceed the country poverty threshold. Within the group of Beveridgean countries, for an elderly couple minimum pension policies are above the poverty threshold only in Denmark and Ireland. If other benefits are also taken into account, then income levels are sufficient also in the Netherlands, Finland and the United Kingdom. In Sweden, the

income level provided by first tier pension policies is not sufficient to lift the couple nor the individual out of poverty. For both model families, disposable income represents around 75% of the poverty threshold. As these are model family simulations, the outcomes may be different when analysing real-world data. Using micro-data, rather than model family simulations, Figari et al. (2013) have examined the relationship between old-age minimum income protection schemes and poverty. Their results show that Denmark, the Netherlands and the United Kingdom achieve a great deal of poverty reduction, due to their generous minimum pension schemes. They are, however, less successful in supporting pensioners to maintain the living standards they obtained during working life.

In sum, pension systems have two main objectives: to provide an adequate standard of living for the elderly (and thereby alleviating old age poverty) and to smooth consumption over a lifetime. We have discussed that which of the main pension objectives dominates (and therefore which tier dominates) within a country will be closely related to the welfare state design. We have argued that in Beveridgean countries, such as the Nordic and Anglo-Saxon countries, generous minimum income schemes can be expected since the main aim in these types of countries is to prevent poverty. In continental and Southern countries, a Bismarckian logic applies, where benefits (such as pensions) are related more strongly to past contributions. Consequently, we would expect a stronger relative importance of second and third tier benefits in these countries. Similarly, we have argued that the insurance-principle is even more present in countries with defined contributions policies, where the link between contributions and benefits is even stronger.

So far, we have discussed the main objectives of pension systems and linked them to pension system designs and different welfare state typologies. However, when it comes to the (financial) wellbeing of the elderly, one cannot stop at assessing gross pension levels. Another social policy tool has yet to be applied: taxation. In the next section, we discuss the underlying principles of taxation, establish a link between the objectives of pension systems and the principles of the tax system and analyse how this relates to different tax treatments of pension benefits across countries.

2.2. Tax systems

Even though the objectives of taxes and benefits clearly differ, there is also common ground: "tax and benefit policies should be viewed as components of an overarching welfare strategy, … " (Feher & Jousten, 2018, p. 3). Theoretically, elements of the tax system can be linked to the different welfare principles (solidarity and insurance), as we show in Table 1. Taxes are levied by the government to acquire the funds to fulfil its tasks, thereby following the principles of horizontal and vertical equity (Elkins, 2006). Both principles should be respected, but governments may attach different relative importance to them (Feher & Jousten, 2018). Horizontal equity implies that people in similar positions face similar tax burdens, while vertical equity requires that the tax burden is distributed over the entire

population according to ability to pay. While horizontal equity requires an agreement on which individuals are defined as "equals", vertical equity requires decisions with regards to the distributive effect of taxes, which is a matter of social taste and political debate (Musgrave, 1990). In this paper we focus on how these principles are put into practice[2], and how these principles align with the objectives of pension systems.

In countries based on the solidarity principle, the state's main focus is providing an adequate income level to its citizens. In this case, we might expect the vertical equity objective to be relatively more important than the horizontal equity objective. At the very least, it would be natural to expect that the minimum income protection for elderly is adequate also after taxation or to expect that low-income pensioners are taxed less heavily (which may lead to changes in progressivity of taxes on pension income as compared to employment income). In addition, the notion of stronger shoulders carrying more of the burden that is inherent in vertical equity/progressive taxation, is compatible with the solidarity principle. In insurance-based countries, the horizontal equity concern might be relatively more important. If pension systems are seen as an instrument to maintain in old age living standards obtained during working life, then one might aim to treat employees and pensioners with similar incomes in an equal way in the tax system. Just as there are differences in the extent to which the insurance principle is present in the design of the pension system, the horizontal equity might be more important in countries with DC schemes than in countries with DB schemes.

As explained earlier, pension income can originate from different tiers, and each tier is linked to a different objective and hence probably also to a different tax treatment (as is the case in nearly every country in the EU-27 and the United Kingdom, see Barrios et al., 2020). Because of the objectives of the different tiers, the logic of the relative importance of horizontal and vertical equity would apply here as well. We would expect a relatively smaller tax burden on first tier pension policies, so as to make sure that the poverty-alleviating objective is not undone. Again, this would lead to (more) progressive taxes on retirement income as compared to employment income. Second and third tier benefits would be taxed similarly to incomes from work, since these benefits are concerned with reproducing income from work and can therefore be expected to be taxed according to the horizontal equity principles.

Although the main aim of the tax system is to generate revenue, governments also use the tax system to achieve social and economic goals in various policy fields (e.g. education, housing, pensions) through the use of tax expenditures, which may impact on the degree of both vertical and horizontal equity. Tax expenditures related to old-age or pension benefits generate differences in the taxation of (different sources of) pension income and employment income, by reducing the final tax liability for certain individuals or (categories of) households. They can take the form of tax credits, allowances, deductions,

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[2] Typically, the literature on the taxation of pensions considers three stages at which pensions can be taxed: at the time of saving, when investment gains accrue or when benefits are received. In this paper, we will only focus on the taxation that happens at the last stage.

exemptions or preferential tax rates and are part of what is called the hidden welfare state, in the sense that they oftentimes fulfil a social goal but are not categorised as social expenditures. It is for this reason that Poterba (2011) advocates the abolishment of tax expenditures, believing they are untransparent, inefficient and unfair. In contrast, others argue that tax expenditures are in fact a more efficient policy tool, reducing fraud and issues of non-take up and stigma (Adema, 2001; Avram, 2018).

Table 2 includes information on the tax treatment of each tier of the pension system. The information regarding second and third-tier tax expenditures is provided by Barrios et al. (2020), while information on first tier tax expenditures is derived from the underlying documentation of EUROMOD. A first observation is that first tier pension policies are tax exempt in a substantial number of countries. However, first tier benefits are included in taxable income in four out of six of the Beveridgean countries. This appears to suggest that the tax system might be interfering with the goals of the pension system. We return to this question in the analysis, and show that this is not necessarily true. In addition, Barrios et al. (2020) point out that first tier benefits might be part of taxable income, but can be below taxable level. The only country in our set of countries where both second- and third-tier pension benefits are fully taxed is Poland. In Denmark, second-tier pension benefits are also fully taxed, but private pension (third-tier benefits) are tax exempt. In all other countries, tax expenditures affect second-tier or third-tier benefits (or both).

Depending on their design, the existence of tax expenditures related to pension-benefits might go against the ideas of horizontal and vertical equity and the principles underlying the welfare state. There is, however, very little empirical evidence that estimates how these pension-benefit related tax expenditures affect patterns of tax progressivity and tax burdens between pensioners and workers. In addition, there is little information on how the tax expenditures interfere with or enhance the objectives of the pension system. This is especially relevant, because existing research has shown that the redistributive effects of tax expenditures are related to many factors, such as the type of expenditure, but also the characteristics of the tax systems and features of the underlying distributions (Verbist, 2007; Avram, 2018).

Table 2: Key elements of the pension system and their tax treatment in 28 European countries, 2019

Group	Country	First tier		Second tier			Third tier
		Minimum income protection	Tax treatment	Public system	Private system	Tax treatment	Tax treatment
Nordic	Denmark	Basic pension	taxable	FDC	FDC(q)	taxed	taxed
	Finland	Conditional basic pension	taxable	DB		partially taxed	taxed
	Sweden	Conditional basic pension	exempt	DB/NDC + FDC	FDC(q)	partially taxed	taxed
	Netherlands	Basic pension	taxable		DB(q)	partially taxed	taxed
Anglo-Saxon	Ireland	Social pension	taxable			partially taxed	taxed
	UK	Social pension	exempt	DB		partially taxed	taxed
Contin.	Austria	/	/	DB		partially taxed	taxed
	Belgium	Social pension	taxable	DB		partially taxed	taxed
	France	Social pension	exempt	DB + points		partially taxed	taxed
	Germany	Social pension	exempt	Points		partially taxed	partially taxed
	Luxembourg	/	/	DB		partially taxed	partially taxed
Baltic	Estonia	Conditional basic pension	taxable	DB/Points	FDC	partially taxed	partially taxed
	Latvia	Social pension	exempt	DB/NDC + FDC		partially taxed	exempt
	Lithuania	Social pension	exempt	DB/Points		exempt	taxed
CEE	Bulgaria	Social pension	exempt	DB	DC(compulsory)	exempt	exempt
	Czech Rep.	/	/	DB		partially taxed	taxed
	Hungary	Social pension	exempt	DB		partially taxed	exempt
	Poland	/	/	DB/NDC		taxed	exempt
	Romania	/	/	DB	DC(compulsory)	partially taxed	No info
	Slovakia	/	/	points		exempt	taxed
	Slovenia	Social pension	exempt	DB		partially taxed	taxed
	Croatia	/	/	DB	DC(compulsory)	partially taxed	exempt
South.	Cyprus	Conditional basic pension	taxable	DB		partially taxed	taxed
	Greece	Social pension	exempt	DB		taxed +	partially taxed
	Italy	Social pension	exempt	DB + NDC		partially taxed	partially taxed
	Portugal	Social pension	taxable	DB		partially taxed	Exempt
	Spain	Social pension	taxable	DB		partially taxed	Taxed
	Malta	Social pension	exempt	DB		partially taxed	Taxed

Note: Information on minimum income protection concerns only non-contributory benefits and comes from Goedemé (2013) and Marchal and Siöland (2019). Basic pensions are pensions without means- or income-test, conditional basic pensions are pension-tested and social pensions are means- or income-tested. Second tier system from OECD (2019). (q) = quasi mandatory based on collective agreement with a high coverage rate; DB = Defined benefit; DC = Defined contribution FDC = Funded defined contribution; NDC = notional defined contribution. Information on tax treatment of first tier pensions from EUROMOD Country Reports: https://euromod-web.jrc.ec.europa.eu/resources/country-reports/latest. Tax treatment of second and third tier pensions from Barrios et al. (2020).

3. Data and methods

3.1. EUROMOD

In order to compare gross and net income distributions for the EU-27 countries and the United Kingdom, we use the European tax-benefit model EUROMOD model to calculate taxes levied on employment and retirement income. The data used to calculate benefits, taxes and contributions is nationally representative and is based on the EU-SILC data of 2017. The simulations are performed using tax-benefit policies in place in (the middle of) 2019. To adjust the data to reflect the situation in 2019, uprating indices have been applied to adjust monetary amount to the policy year. In addition, we express all monetary values in PPPs to ensure cross-country comparability.

3.2. Definition of income concepts and components

We define pensioners as individuals of 65 years old and over and having received a pension every month during the entire reference period of twelve months. Similarly, workers are defined as individuals between the ages of 18 and 60 that have received income from work during the entire reference period.

We use several income concepts in our analysis. The first is pre-tax income, which captures income from all sources (for example, (self-)employment income, benefits, capital or property income) before the deduction of personal income taxes (PIT) and social insurance contributions (SIC). Similarly, pre-tax pension or employment income captures income from pensions (for the group of old-age individuals) and employment (for employees) before personal income taxes and contributions. Disposable income equals pre-tax income minus personal income taxes and contributions. Taxable income is the income concept on which the tax rate is applied, i.e. after deduction of tax-exempt income components, allowances and deductions. We look at the impact of the total of personal income taxes and social insurance contributions, as well as of each of these components separately.

We distinguish three income components: income from work (or employment income), income from old age or pensions, and income from other sources. First, income from work is defined as gross employee cash or near cash income. Second, income from pensions include both public and private pensions. Lastly, we consider income from all other sources; for pensioners and workers, this component captures all remaining income, for example self-employment, property or investment income. For individuals who are not part of either subgroup, this component can capture income from many different sources. Since we will only consider income from work for the earlier defined group of workers and income from pensions for the earlier defined group of pensioners, income from other sources also includes income from these components (work or pensions) received by individuals that did not work

or receive a pension during the entire reference period of twelve months. Consequently, income from other sources is used in our analysis as a residual.

For pensioners, retirement income can come from each of the different tiers identified in the literature review. We have split up total pension income into three tiers and one "other" category. The first source is first tier retirement income (in countries where it is provided). The second source contains earnings-related pension income. Note that in some cases this might not be entirely accurate, as we include in this variable all pension income that is not specifically identified as a non-contributory benefit or a disability, widow(er)'s pension, early retirement benefit etc. The third source contains private pension income. Finally, a remaining variable ('Other pensions') contains disability pension, survivors' pensions, early retirement benefits etc., which do not fit into the logic of the pension tiers. We show the average contribution of each pension tier to total pre-tax pensions in Table 3. In most countries, second tier pensions are the most important source of pension income, with shares of often more than 90%. The only countries where this is not the case are Denmark (6.2%) and the Netherlands (35.7%). Smaller shares are reported for Cyprus (74.5%) and the United Kingdom (68.5%). In Denmark, the Netherlands, Ireland and Cyprus, first tier pensions make up a considerable part of total pension income; they are even the largest source of pension income in Denmark and the Netherlands. The United Kingdom and Denmark are the only two countries where third tier benefits are quite important (28.4 and 23.3% of total pre-tax pension income, respectively). In most other countries, the third tier is either non-existent (especially in most of the Baltic and CEE countries) or only very small. Note that Table 3 only shows average contributions to total pension incomes. Consequently, it is unclear whether the low average contribution of first and third tier benefit are because of low amounts for the entire old age population or high amounts for only a very small part of the old age population. Finally, in most countries, the category "other pension" is quite small. Luxembourg and Italy are the only countries where these other pensions make up more than 10% of total pre-tax pension income (14 and 11.6%, respectively).

Table 3: Composition of pre-tax pensions of old-age individuals (as % of pre-tax pensions), 28 European countries, 2019

Group	Country	Tier 1	Tier 2	Tier 3	Other pensions
Nordic	Denmark	69.7	6.2	23.3	0.8
	Finland	0.2	91.9	1.4	6.5
	Sweden	0	96.2	3.6	0.2
	Netherlands	64	35.7	0	0.3
Anglo-Saxon	Ireland	12.5	85.7	1.8	0.1
	UK	2.8	68.5	28.4	0.2
Contin.	Austria	0	90.5	0.9	8.6
	Belgium	0	99.4	0.1	0.5
	France	1.5	98.1	0	0.4
	Germany	0.9	89.6	1	8.5
	Luxembourg	0	85.9	0.1	14
Baltic	Estonia	0.8	99	0.2	0
	Latvia	0.1	99.8	0	0.1
	Lithuania	0	96.7	0	3.3
CEE	Bulgaria	0.2	97.3	0	2.4
	Czech Rep.	0	93.4	0.1	6.5
	Hungary	1.4	98.5	0	0.1
	Poland	0	99.3	0	0.7
	Romania	1.4	98.4	0	0.2
	Slovakia	0	93	0	7
	Slovenia	0.5	99.1	0.3	0.1
	Croatia	0	100	0	0
South.	Cyprus	17.7	74.5	1.2	6.7
	Greece	0	98.2	0	1.8
	Italy	0.6	87.8	0	11.6
	Portugal	1.4	92.3	0.3	6
	Spain	2.6	90	1.7	5.8
	Malta	4.6	94.6	0.8	0

Source: EUROMOD, own calculations

3.3 Allocation of income taxes and social insurance contributions to income components

As income from retirement and employment can be combined by an individual or a tax unit, it is not always straightforward to allocate taxes to a specific income source. We have opted for the following strategy to allocate personal income taxes and social contributions to (1) pensions; (2) income from work; (3) other income sources. First, SIC are allocated to the income component on which they are levied, e.g. employee social insurance contributions are entirely allocated to income from work. Second, for PIT we take a proportional approach, i.e. we allocate taxes to an income component according to the share of this income component in taxable income. This means that when income from work makes up 70% of total taxable income, 70% of this tax paid is allocated to this income component. This approach ensures that tax exempt income components, which are part of pre-tax income but not of taxable income, are allocated a tax amount of zero. In Greece, Italy, Lithuania, Netherlands, Romania, Sweden, Slovenia,

Slovakia, UK, we use the same method to allocate social insurance contributions to employment and/or retirement income.

A further complication arises when personal income taxation is not levied on an individual basis. In those countries where joint taxation is applied, we have made some assumptions to divide income over individuals in a joint tax unit. In France, Germany, Poland, Portugal, Luxembourg there is income splitting, meaning that incomes are first summed within the tax unit and then divided by a certain number (in most cases, divided by 2, in France divided by an equivalence scale based on family composition). Taxes are then calculated based on this divided income and multiplied again to obtain total taxes within the tax unit. In this case, we apportion PIT according to the share of the income component in the divided income and allocate taxes to each individual according to the share of their individual income component in the total tax unit income component. In Spain, Ireland and Malta taxes are calculated using pooled tax unit income. Here, we use the share of each income component in pooled household income to calculate taxes paid on the respective income components, and again allocate these taxes to each individual according to the share of their individual income in the total income component of the tax unit. In Belgium, finally, the method to calculate is again slightly different because of the marital quotient. Under certain conditions, the partner with highest income can allocate a part of their income to their partner. As a result, the transferred income is taxed at a lower rate. In the cases where this happens, we calculate how much of the taxes paid by the partner with lowest income can be attributed to the transferred income, by using a proportional approach. We then transfer this amount of taxes back to the individual with highest income, who earned this component. We calculate proportional taxes on employment and retirement income using this adjusted amount of PIT.

3.4 Indicators

To measure to what extent the tax treatment of old age pensions (and their components) is in line with the underlying principles, we use the following indicators. First, we operationalise horizontal equity by comparing the tax burden on old age pensions with that on income from work. Tax expenditures may be one reason why income from work and old age pensions have a different tax burden. But aside from the tax expenditures, differences in the average tax burden between employees and pensioners also depend on the size of the respective income components. Because old age income is generally smaller than employment income, the tax burden for pensioners will generally be lower than the tax burden of the working-age population in countries with progressive taxation. In addition, in many countries pensioners pay less social insurance contributions than the working-age population (or none at all), due to the fact that they have less risks to be insured against (Verbist, 2007). For this reason, we also look at the difference in tax burden between workers and pensioners across income quintiles. Quintiles are constructed on the basis of pre-tax equivalised household income. Incomes (and income components)

are equivalised by dividing them by the modified OECD equivalence scale. The modified OECD scale gives a value of one to the first adult in the household, an additional 0.5 for each additional adult (persons of 14 or older) and 0.3 for each individual younger than 14.

Next, we use two indicators for vertical equity. On the one hand, we focus on the bottom of the income distribution and calculate to that extent pensioners are taxed into poverty. This is the share of old-age individuals that are considered non-poor based on pre-tax income, but that become poor after the deduction of PIT and SIC on component income. On the other hand, we show to what extent taxes on old age income contribute to overall progressivity. A common way to measure the progressivity of taxes is the Kakwani index (Kakwani, 1977; 1984). The index is a measure of how much the tax system deviates from proportionality. A positive Kakwani indicates that the tax is progressive, I.e. pro-poor, while a negative Kakwani points to a regressive tax. A Kakwani that is (close to) zero means that the tax is proportional. The Kakwani can be decomposed, such that it shows the contribution of each tax component to overall progressivity, using the following equation:

$$\prod_T = \sum_i^n \frac{t_i}{t} \prod_{T_i} ,$$

where $\prod_T$ is the Kakwani index for total taxes, t is the average tax rate of total taxes, t_i is the average tax rate of the specific tax component and $\prod_{T_i}$ is the Kakwani index of each specific tax component (Kakwani, 1977; Verbist & Figari, 2014). Both for poverty and progressivity indicators, equivalised incomes are used.

4. Results

We now present our empirical investigation of how the pension and tax system interact with each other from a social inequality perspective for our set of European countries. We do this by first comparing average tax levels between pensioners and workers overall and over income quintiles, as a measure of horizontal equity. Next, we analyse the degree of vertical equity, using two indicators. On the one hand we look at the extent to which pensioners are taxed into poverty, while on the other hand we calculate the contribution of taxes on pension incomes to overall progressivity of the tax system as compared to other income components.

4.1 Horizontal equity characteristics of the taxation of pensions as compared to income from work

To provide a broad picture of how pension benefits are treated differently (or not) from employment income, we start by showing the average tax burden for pensioners and employees in Table 4. We have expressed the amount of taxes and SIC due on employment and retirement income, as a percentage of

the respective pre-tax component income (including possible components that are tax exempt). It is immediately clear that in all countries the total tax burden (PIT and SIC together) is relatively smaller for old-age individuals than for employees, but we see large differences across countries both in terms of the gap in overall tax burden between the two groups, as in the tax burden on pensions across countries. The gap in overall tax burden between workers and pensioners is especially low in Nordic and South-European countries, and much higher in CEE and the Baltics. This is mainly (but not only) due to the lower SIC rate on pensions.

The disaggregation of the total tax burden into the tax burden of PIT and SIC shows that old-age individuals pay less PIT than employees in the majority of countries. The difference in PIT burden between retirement and employment income is in some cases quite substantial, for example in Belgium and Germany. In other countries, such as Austria and Cyprus, the average tax burden is very similar to the average tax burden of PIT on employment income. There are only five countries where personal income taxes on retirement income are relatively larger than taxes on employment income (France, Italy, Luxembourg, Poland, Sweden). In Italy, pensioners with a yearly pension income above 100 000 euros have to pay a solidarity contribution (which we have added in the definition of personal income taxes, though it is simulated as a pension cut in EUROMOD). In addition, personal pensions are taxed through a capital income tax, which further adds to the average tax burden of old-age individuals. In France, though there are several allowances and tax credits aimed at old-age individuals, it appears that tax expenditures geared towards child-related expenses and the *quotient familial* might explain why the tax burden for employees is lower. With regards to the *quotient familial*, it is likely that pensioners will gain less advantage from this than employees, as they generally live in smaller households. Similarly, in Luxembourg other tax expenditures might explain the lower tax burden of employees. Poland is the only country where contributory pension benefits (second tier) are fully taxed, meaning that there are no specific old-age tax expenditures. There are tax expenditures for other sources of income, which explains the higher tax burden for old-age individuals. In Sweden, finally, the results appear to be partially related to the 'Earned income tax credit', which is larger (in absolute terms) on average for the workers than for pensioners.

In most countries, no SIC are due on pension income. Exceptions are the continental countries, Cyprus, Greece and Croatia. With the exception of the Netherlands, in these countries the tax burden of SIC on retirement income is smaller than that on employment income. This is in line with the prevailing logic to use SIC to finance social security systems. In many countries, SIC are levied to insure individuals against the risk of health issues, unemployment and old age (pension contributions). Old-age individuals often only have to pay for certain types of these insurances. For example, pensioners in Croatia, Cyprus and Greece pay SIC at substantially lower rates than workers. The Netherlands is the only country where the average SIC rate for pensioners is higher than the average rate paid by workers (5.1 and 3.6%, respectively). This can, at least partially, be explained by the way health insurance contributions are

levied. While for employees, health insurance contributions are paid by their employer, individuals with pension income have to pay these themselves. Given that southern welfare states are sometimes classified as 'rudimentary' conservative states (Kammer et al., 2012), we might expect that pensioners are liable to SIC in Italy, Portugal, Spain and Malta as well. However, in these countries SIC are more geared toward employment-related risks (for example, in Italy, SIC are insurances against sickness, maternity, redundancy and severance pay, among others). As it can be argued that these risks are no longer relevant for pensioners, it is not illogical that pensioners don't have to pay SIC. Similarly, Central Eastern European and Baltic states are in some ways similar to conservative and Southern welfare states, but smaller in size (Fuest et al., 2010). In this sense, it is perhaps not surprising that SIC are levied on employment income, but not on retirement income. For Nordic and Anglo-Saxon countries, social security is more often financed out of taxes (rather than SIC) (Kammer et al. 2012).

Table 4: Tax burden as % of pre-tax income (i.e. employment income for workers (W), pre-tax pensions for old age (OA)), 28 European countries, 2019

| Group	Country	Total W	Total OA	PIT W	PIT OA	SIC W	SIC OA
Nordic	Denmark	20.3	9.3	9.5	9.3	10.8	0
	Finland	28.5	15.1	18.3	15.1	10.2	0
	Sweden	24.7	19.4	18.1	19.4	6.6	0
	Netherlands	7.8	5.9	4.2	0.7	3.6	5.1
Anglo-Saxon	Ireland	17.2	1.7	13.6	1.7	3.5	0
	UK	18.3	3.6	9	3.6	9.3	0
Continental	Austria	25	15	9.8	9.7	15.3	5.3
	Belgium	31.7	12.5	18.5	10.2	13.2	2.3
	France	23.4	10.1	2.8	3	20.7	7.1
	Germany	30.9	14.2	14.4	4.2	16.5	9.9
	Luxembourg	23.2	16.1	11.4	11.8	11.8	4.3
Baltic	Estonia	15.1	1	11.8	1	3.3	0
	Latvia	24.6	3.8	13.6	3.8	11	0
	Lithuania	37.6	0	15.8	0	21.8	0
CEE	Bulgaria	20.5	0	8.5	0	12	0
	Czech Rep.	19.1	0.1	7.8	0.1	11.3	0
	Hungary	32	0.4	14.3	0.4	17.7	0
	Poland	19.6	7.7	5.9	7.7	13.7	0
	Romania	40.7	0.3	5.7	0.3	35	0
	Slovakia	21.4	0	7.9	0	13.5	0
	Slovenia	31.9	0.7	9.8	0.7	22.1	0
	Croatia	25.1	1.9	4.8	1.6	20.3	0.4
Southern	Cyprus	12.1	3.3	2.2	1.7	9.9	1.6
	Greece	21.3	9.9	5.2	3.6	16.2	6.3
	Italy	21.8	14.7	13.9	14.7	7.9	0
	Portugal	19.6	5.3	8.6	5.3	11	0
	Spain	21	5.8	10.1	5.8	10.9	0
	Malta	16.5	2.7	8.3	2.7	8.2	0

Source: EUROMOD, own calculations

While Table 4 confirms that there are differences in tax rates for pensioners and employees, it does not yet provide evidence that the principle of horizontal equity is violated. The reason is that the average level of pensions is generally smaller than the average level of employment income[3], and when a tax system is progressive in its rate structure, this alone may explain the lower burden on pension. To minimize the effect of differences in income between both groups, we use the distribution of pre-tax equivalised income to determine equals. We show average tax rates for pensioners and employees across

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[3] Table A1 in the appendix shows that in all countries, the average income position of old-age individuals is worse than that of workers (ratio is smaller than 100). At the same time, in all countries the relative position of old-age individuals is better in terms of net income than in terms of pre-tax income. This points out that the tax treatment of pensions has a favourable impact on the income position of pensioners, confirming earlier findings of Verbist (2007).

quintiles of this distribution. This implies that we are comparing the tax burden of old-age individuals and employees with similar pre-tax income levels, after taking household composition into account. This sheds some light on the extent to which the principle of horizontal equity is maintained or violated through the existence of pension-related tax expenditures. By looking at quintiles we are not entirely able to compare equals, as even within the same quintile of the distribution, pensioners can have smaller incomes than employees, leading to smaller tax burdens. Nevertheless, it gives a reasonable approximation.

Figure 1 shows the average tax burden of personal income taxes (proportional taxes as a percentage of pre-tax component income) across the quintiles of the equivalized pre-tax distribution for each country, for workers on the left and old-age individuals on the right. Countries are ordered by welfare state type. In the Nordic and Anglo-Saxon countries, PIT rates across quintiles are quite similar for employees and pensioners. This is also the case for most continental and Southern countries. As expected, in most CEE and Baltic countries, taxes on retirement income are clearly much lower than taxes on employment income, throughout the distribution.

Figure 1: Average PIT rates for workers (left) and pensioners (right), expressed as a % of pre-tax income across quintiles of equivalised pre-tax income, 28 European countries, 2019
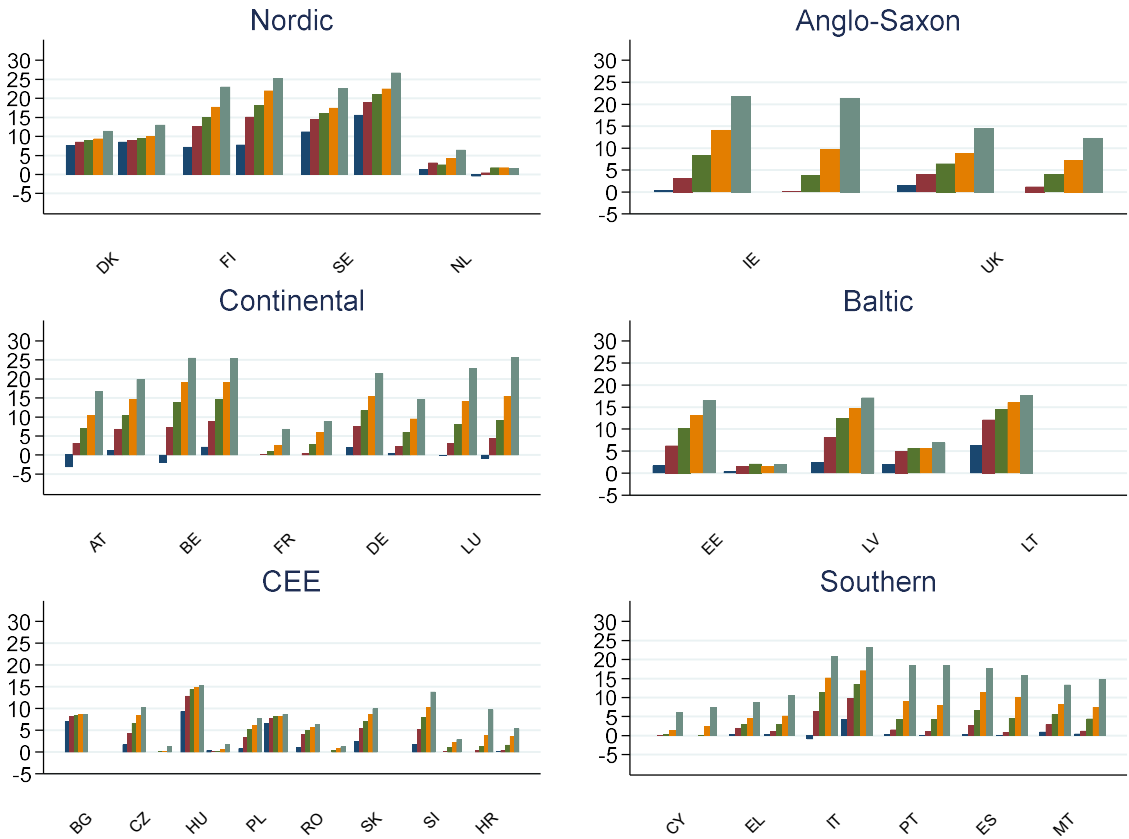
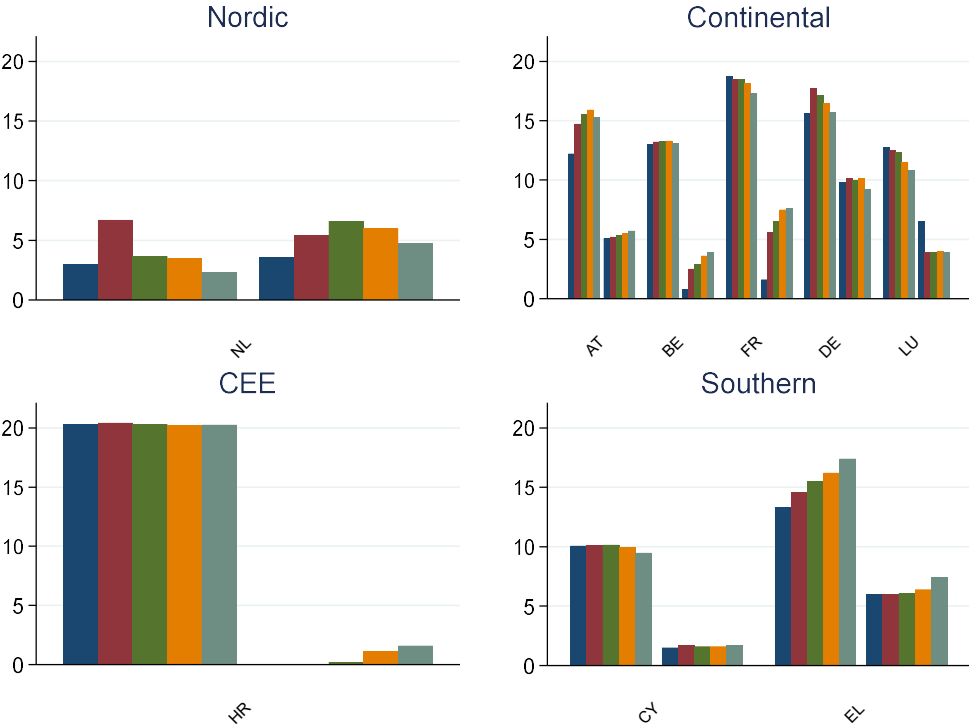

Source: EUROMOD, own calculations

While Table 4 shows that there is wide variation in the overall difference between PIT on employment and on retirement income, Figure 1 adds several interesting insights about the extent to which there is horizontal (in)equity in the tax system. First, it illustrates that the difference in average PIT burden is partially determined by a composition effect (i.e. the position of pensioners in the income distribution) and partially by tax expenditures. In Ireland, for example, the difference in average PIT rate between pensioners (1.7%) and employees (13.6%) is large, yet across quintiles these rates are similar. This indicates that there is a similar treatment of pension and employment income and that the difference in average PIT rate is related to the fact that pensioners are concentrated more in the lower quintiles of the distribution (cf. Table A7 in the Appendix). In other countries, such as Slovenia, the difference in average PIT burden translates into smaller average PIT rates for pensioners in all quintiles. This implies that pension-related tax expenditures induce horizontal inequity between pensioners and employees.

A second insight worth highlighting is that horizontal inequity is often the result of measures to ensure vertical equity (for example, tax expenditures aimed at the lower end of the distribution), both for employees and pensioners. As a result, horizontal equity might be violated especially in the lower quintiles of the distribution and, depending on how tax expenditures for employees and pensioners compare in size, might lead to lower or to higher tax burdens for pensioners as compared to employees. Poland is a nice illustration of this point. In Poland, all retirement income is fully taxed, which results in comparatively high average PIT rates on retirement income over all quintiles. Similarly, in some continental countries, such as Austria and Belgium, across quintiles PIT rates for pensioners are higher than (or equal to) those of employees, despite the existence of pension-related tax expenditures. Moreover in the bottom quintile, employees have negative PIT rates, while the PIT rates of pensioners are positive. In Belgium the effect of substantial pension-related tax expenditures is offset by tax expenditures for professional expenses for employees. As a result, there is horizontal inequity between pensioners and employees, but at the expense of pensioners.

In most countries with DC elements in their second-tier public pensions system (Sweden, Poland, Denmark, Italy), average tax rates across quintiles are quite similar for pensioners and employees (in some cases even higher). In DC schemes the link between contributions and benefits is stronger, linking them to an insurance logic. Consequently, we would expect that the tax systems in countries with DC pension schemes emphasize horizontal equity. The fact that pensioners are treated similarly to workers is in line with this reasoning. Latvia, however, is the only exception. There is a DC element in their pension system, but the average tax rates for pensioners is in all quintiles lower than those for employees. In countries with DB systems, the insurance principle is also at play, so to a certain extent we expect equal treatment. For these countries, the picture is actually mixed: e.g. in Germany average tax rates are lower in all quintiles. In contrast, the tax burden on pensioners in Luxembourg is similar to the burden on workers (and even slightly higher in the four highest quintiles), and slightly lower in the bottom quintile, which is more in line with our expectations.

In sum, these results for PIT only partially follow our expectations. In the group of Beveridgean countries, we expected horizontal equity to be relatively less important. Yet, in the Nordic countries tax rates for retirees are similar to those of employees. In the Anglo-Saxon countries, tax rates for pensioners in the bottom quintiles are lower than those of employees. This could be the result of attaching more importance to vertical equity, which will be explored in the following section. In the group of insurance-based countries, the picture is mixed. In CEE and Baltic countries there is clearly no horizontal equity, in Southern countries (except Italy) tax rates for pensioners are also lower (although the difference is smaller than in CEE countries). Only in continental countries does horizontal equity seem to be present to a greater extent.

Figure 2: Average SIC rates for workers (left) and pensioners (right) across quintiles of equivalised pre-tax income, expressed as % of pre-tax income, 28 European countries, 2019

Source: EUROMOD, own calculations

Figure 2 shows the average level of social contributions for workers and old-age individuals across quintiles, only for those countries where retirement income is liable to SIC. In most countries we find, as one would expect lower SIC rates for pensioners across quintiles. As explained earlier, the exception here is the Netherlands, where SIC rates paid by pensioners are relatively higher than those paid by employees, and this is especially the cases for the higher quintiles.

4.2. Vertical equity

We now turn our attention to how the tax treatment of pensions induces differences in the poverty effects of taxation, on the one hand, and tax progressivity, on the other hand. Both of these measures can be seen as indicators of vertical equity as they are concerned with the tax treatment of unequal individuals (in terms of income) and how ability-to-pay plays a role.

4.2.1. Poverty

We first examine the poverty effect of taxes on pension income. We expect that in solidarity-based systems the taxation of pensions is not distortive to any poverty minimising efforts of the pension system. Secondly, we turn to the tax treatment of the different pension tiers. Here, we expect that within each country, first tier benefits are taxed to a much lesser extent than second and third tier benefits, given that the first tier benefits are aimed at poverty reduction.

To understand how the poverty rates are influenced by taxes on pensions, we introduce the measure of 'taxed into poverty'. The relationship between the poverty effects of the tax system on the one hand (percentage of elderly that are taxed into poverty) and of the pension system on the other hand (pre-tax poverty risk) is summarised in Figure 3. For reasons of comparison, Figure A1 in the Appendix shows poverty rates based on pre-tax and disposable income for employees and workers.

Figure 3 hints at the complex interplay between the characteristics of the pension system (in terms of adequacy of benefits) and the tax system. Pre-tax poverty rates among the elderly (horizontal axis), show a lot of variation between countries. In general, old age pre-tax poverty rates are quite low in the Nordic and Continental countries, where they are usually below 10% (slightly higher in Germany, with 11.2%). In contrast, poverty rates are very high in the Baltic countries, ranging between 38.5% in Lithuania and 51.5% in Estonia, in line with results for 2017/2018 of Ebbinghaus (2021). Within the group of Southern and Eastern European countries, there is more variation. Pre-tax poverty in old-age ranges between 5 and 30% in the Southern countries. Greece and Italy perform quite well, with poverty rates of 5.7 and 4.7%, respectively. On the other end are Cyprus (21.2%) and Malta (29.7%). In the group of CEE countries, Poland and Slovakia stand out because of their comparatively low poverty rates (8.2 and 5.3%, respectively). The highest poverty rate is observed in Bulgaria, which is closer to Baltic countries with its 36.8%. In the remaining CEE countries, poverty rates range between 12 and 23%. Quite notably also is the high rate of pre-tax poverty in Ireland (29.4%), and the lower poverty rate in the UK (which is still higher at 12.7% than that of the worst-performing continental country).

There is less variation across countries in the extent to which pensioners are taxed into poverty. With the exception of Sweden, in all countries less than 5% of old-age individuals are poor after deduction of PIT and SIC on pension income. It appears that the tax system does not counteract in great deal the

poverty-reducing effects of the pension system (small as these poverty-reducing effects may be in certain countries). At the same time, there seems to be an inverse pattern between pre-tax poverty and the share of pensioners that are taxed into poverty, though the pattern is not clear cut. For example, in the Baltic countries and Bulgaria pre-tax pension levels are often inadequate, but the tax system does not further deepen this low income position because of the many tax exemptions on pensions that are in place in these countries. A similar case can be made for most other CEE countries (except for Poland) and Southern countries, though pre-tax poverty rates tend to vary more. Continental countries combine relatively low poverty rates with varying levels of pensioners that are taxed into poverty.

Figure 3: Scatter plot of pre-tax poverty rate and percentage taxed into poverty, pensioners only, 28 European countries, 2019
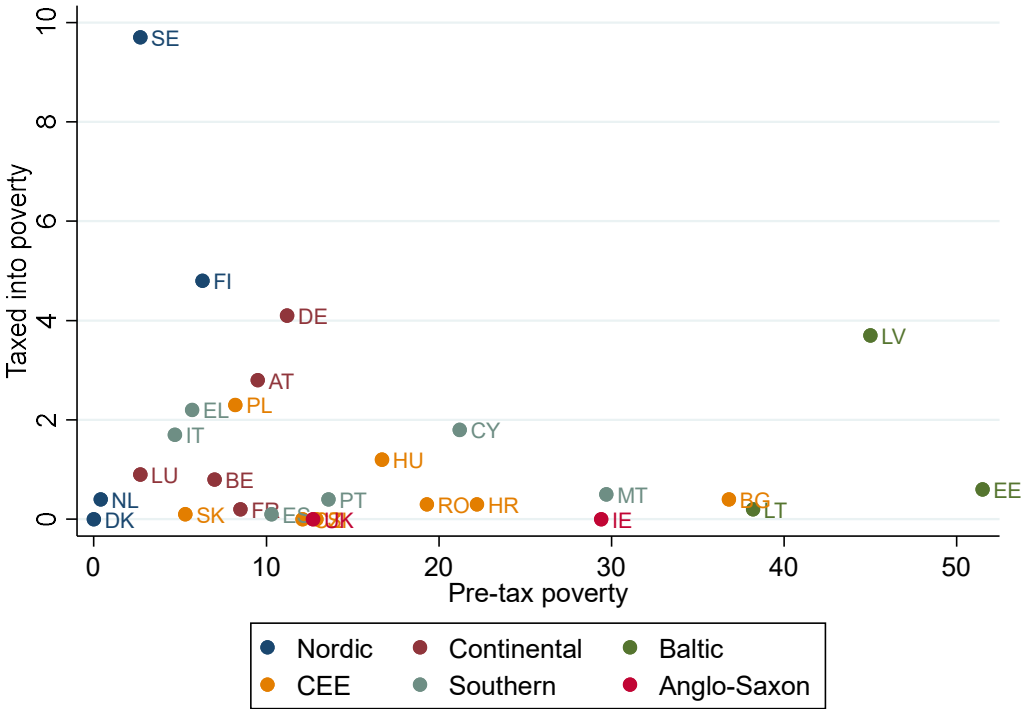
Source: EUROMOD, own calculations
Note: Pre-tax poverty rates are based on equivalised pre-tax income.

A striking finding is the difference in shares of pensioners that are taxed into poverty within Beveridgean countries, more specifically between Sweden and Finland and the other countries. These are all countries where poverty reduction traditionally is at the centre of the pension system. In line with results of Figari et al. (2013), pre-tax poverty rates indicate that especially Denmark and the Netherlands are successful in achieving adequate living standards for pensioners, while Ireland and the UK are less successful. Interestingly, Denmark and the Netherlands are the two countries with (partial) basic pensions. At the

same time, in the UK, Ireland, Denmark and the Netherlands the share of pensioners that is taxed into poverty is (nearly) zero, even though in the Beveridgean countries first tier pension benefits are exempt only in the UK and Sweden. In Sweden and Finland, in contrast, the tax system counteracts to a certain extent the efforts of the pension system to keep pensioners out of poverty. In Sweden, 9.6% of pensioners are taxed into poverty, while in Finland almost 5% of pensioners are poor due to taxes on pension benefits. The result is even more surprising as Sweden is the only Nordic country where first tier pension benefits are tax exempt. Although it might be argued that these numbers are not extremely high, it is striking that the comparatively highest shares of pensioners that are taxed into poverty are found in countries where poverty reduction is one of the central aims of the welfare state.

In what follows, we analyze further to what extent the pensioners that are taxed into poverty could be the result of taxes on minimum pensions, rather than because of taxes on pension benefits from the second or third tier. In the majority of countries first tier pension benefits are tax exempt. Yet, there are still pensioners that are taxed into poverty. This implies that there are individuals with second or third tier benefits that become poor because of taxes on pension income.

4.2.2. Average tax rates over quintiles

In this section we turn to the progressivity of taxes, our second indicator of vertical equity. We first look at average tax rates over quintiles, as presented in Figure 1. In nearly all countries PIT on employment and retirement incomes are progressive (i.e. increase over the distribution), though to various degrees. The only exceptions are the Netherlands, Estonia and Hungary, where PIT on retirement income is not progressive over the full distribution. Especially in the Baltic and CEE countries, progressivity of taxes on retirement income is quite different from progressivity of taxes on employment income. In the Nordic, Anglo-Saxon, continental and several Southern countries, the difference in progressivity appears to be smaller. We return to these differences in progressivity in Section 4.3.3.

We now go into more detail on the average tax rate on pensions in Figure 4, where we show the tax burden on the different pension tiers. We focus here on taxes on pensions that can be linked clearly to one of the pension tiers, meaning that taxes on pensions from the "other pensions' category are not considered (in contrast to Figures 1 and 2). Taxes on the first tier contribute significantly to the total tax burden on pensions only in Denmark. This is unsurprising, since first tier pensions are the most important source of total pre-tax pension income in Denmark. Tax rates are especially high in the first quintiles, with decreasing importance for the next quintiles. This is a consequence of the fact that the higher quintiles rely relatively more on third tier benefits.

Figure 4: Average PIT rates per pension tier across quintiles of equivalised pre-tax income, expressed as % of pre-tax pension income, 28 European countries, 2019
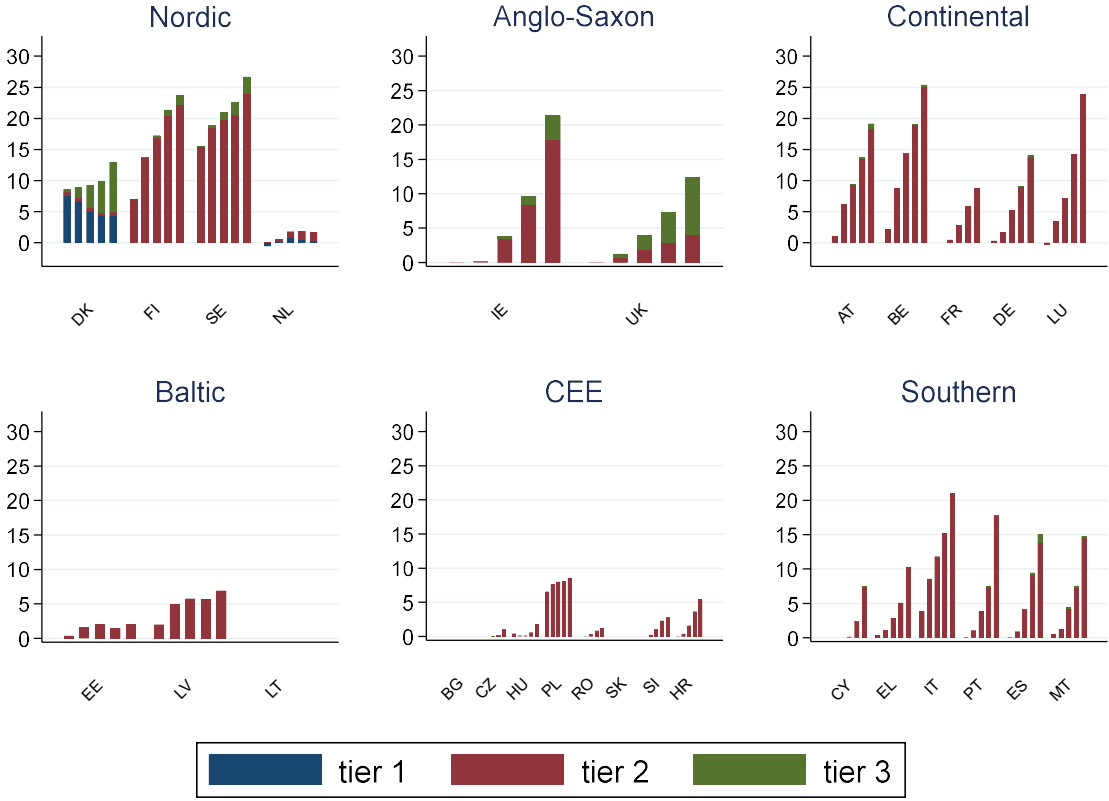
Source: EUROMOD, own calculations

Additionally, Denmark and the Netherlands are the two countries with (close to) zero pre-tax old age poverty. However, as discussed in the previous section, in the Netherlands some poor pensioners are still taxed into poverty as a result of pension taxation, whereas this is not the case in Denmark. The results in Figure 4 show that this is not due to a tax exemption on first tier benefits in Denmark (actually, PIT rates on first tier pensions are very similar in terms of levels across all quintiles in both countries). Consequently, though in Denmark pensions on all tiers are fully taxed, the government still manages to take taxation rules into account when designing the minimum pension scheme. Our earlier reasoning that especially in the countries where the pension system is based on a solidarity principle (and that therefore will have a well-developed first tier), we would expect very low tax rates on first tier benefits does not necessarily hold, since the two countries with a large first tier do levy taxes on this tier. However, Cyprus and Ireland do provide examples of countries where average first tier pensions make up a relatively large part of total pensions (at least compared to many of the other countries), but only very small tax rates on this tier apply. The fact that PIT on pensions of the first tier are not considerable in any of the other countries is in line with the argument from Barrios et al. (2020) that in most countries

pensions from this tier are either tax exempt or below taxable level. It is also simply a consequence of the fact that in these countries, first tier pensions do not make up a large part of the average total pension. Turning to third tier pensions, Denmark and the United Kingdom are the only countries where this tier plays an important part in total pensions. Figure 4 shows clearly that for these two countries the tax rate for this tier is quite high, especially in the higher quintiles. In most other countries, this tier is not (yet) important for current retirees.

Figure 5: Average SIC rates per pension tier across quintiles of equivalised pre-tax income, expressed as % of pre-tax pension income, 28 European countries, 2019
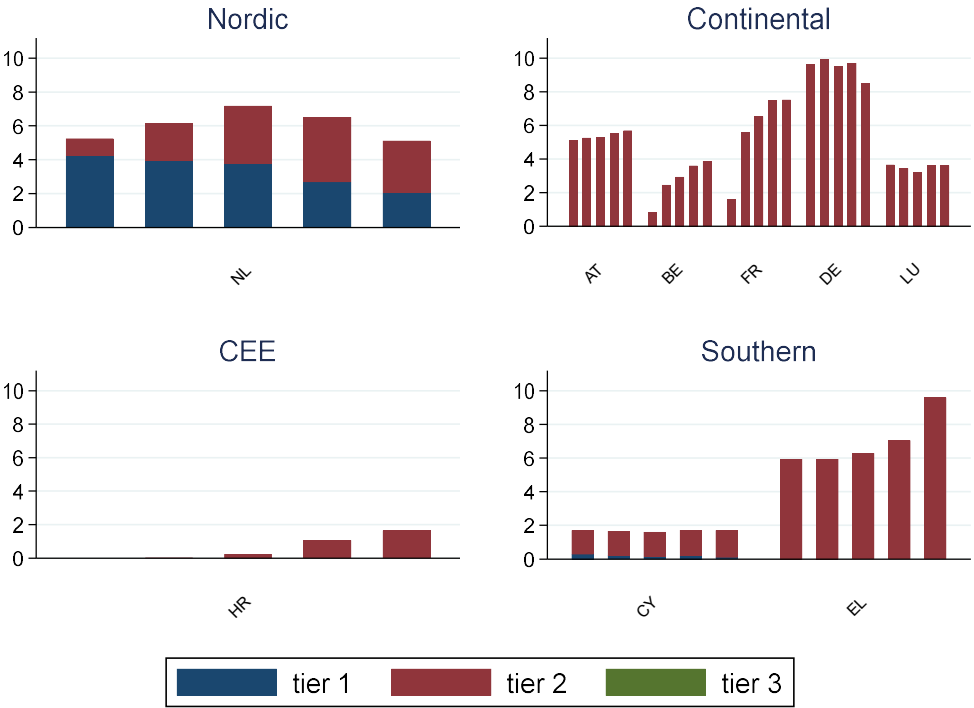

Source: EUROMOD, own calculations

The average SIC rate for each pension tier across quintiles is shown in Figure 5 for those countries where pensioners pay SIC. Two conclusions emerge. Firstly, no country levies SIC on pensions from the third tier. Second, there are only two countries where pensioners pay SIC because of first tier pensions: the Netherlands and Cyprus. In Cyprus, only a very small (nearly negligible) average rate applies. In the Netherlands, the average SIC rate on first tier pensions is regressive, as the average rate decreases with income. In some (solidarity-based) countries, we expected that first tier pensions are taxed at a smaller rate than in insurance-based countries. This is in general the case, but mostly because the first tier is so small (or completely absent) that taxes on these pensions do not contribute to the total tax burden on pensions. In insurance-based countries, the second tier is clearly the most important (which is in line with the insurance logic). In most countries average SIC rates on second tier pensions tend to increase with income (e.g. in Belgium and France) or are the same across quintiles (e.g. in Cyprus).

4.3.3. Decomposing total progressivity

Across countries, there are differences in the overall progressivity of the tax system (taking together PIT and SIC on all income components), as shown by the black dot in Figure 6 and in Table A2 in the Appendix. In line with the results of Verbist & Figari (2014) for the EU-15 in 2008, progressivity of the full tax system is largest in Ireland (Kakwani of 0.297), though the estimate is lower than the one for 2008 (which was 0.320). The countries where the tax system redistributes the least are Denmark (Kakwani of 0.079) and Poland (Kakwani of 0.08). For most countries, our estimates of progressivity are slightly larger than those provided by Verbist & Figari (2014). Table A2 also shows the Kakwani indices for PIT and SIC on employment and retirement income. It becomes immediately clear that both PIT and SIC on employment income are in all countries in our analysis progressive (with the exception of SIC in the Netherlands). The same cannot be said for PIT and SIC on pension income: in eight countries (DK, FI, SE, BE, EE, LT, HU and PL), PIT on retirement income is regressive. In the other countries, taxation on pension income is progressive, but the value of the Kakwani index for pension taxes is almost everywhere smaller than the Kakwani of PIT on employment income (exceptions are the Netherlands, Luxembourg, Cyprus and Portugal). In addition, only in Luxembourg and Croatia are SIC on pension income progressive. In the remaining countries where pension income is liable to SIC (NL, AT, BE, FR, DE, CY and EL), they are regressive.

In Figure 6, we decompose the Kakwani index for total taxes into the progressivity contributions of the different tax types (PIT and SIC) on the different income components on which they are levied (employment, pension from all tiers and all other incomes), where $\prod_T$ is the Kakwani index for total taxes, t is the average tax rate of total taxes, t_i is the average tax rate of the specific tax component and $\prod_{T_i}$ is the Kakwani index of each specific tax component (Kakwani, 1977; Verbist & Figari, 2014). The numbers can be found in Table A3 in the Appendix.

There is cross-country heterogeneity in the way PIT and SIC on employment and retirement income contribute to the overall progressivity of the tax system. The biggest contribution to total progressivity comes from PIT and SIC on employment income. In almost every country (except in Greece and in France) the progressivity of these two taxes accounts for more than half of total progressivity. In nearly all continental and southern countries (with exception of France, Greece and Italy) and the United Kingdom, Finland, Sweden and Estonia, PIT on employment income contributes quite substantially to overall progressivity. In the Baltic and CEE countries, with the exception of Estonia, the contribution of SIC on employment income is similar to the contribution of PIT on employment income, and in some cases even larger (for example, Romania). In some countries, like in Denmark and the Netherlands, the contribution of PIT on income from other sources is also substantial; given the heterogenic character of this component, we do not discuss it further.

In all countries, the contribution of PIT and SIC on retirement income to overall tax progressivity is quite different from the contribution of PIT and SIC on employment income, in the sense that it is much smaller. As the contribution of a specific tax on overall progressivity depends on both the relative size of the tax component and its progressivity, this finding can partially be explained by the relatively smaller size of taxes on retirement income as compared to taxes on employment income (see Table A4 in the Appendix). In addition, whereas taxation on employment income is always progressive, this is not the case for pension income. The regressivity of PIT and/or SIC on retirement income explains the negative contributions to overall tax progressivity in certain countries (e.g. Germany and Greece).

In most countries where PIT and SIC on pensions contribute to overall progressivity (be it positively or negatively), it is mainly due to PIT and/or SIC on second tier pension benefits. This is also shown in Table A5 in the Appendix. In most countries, PIT on second tier benefits contribute positively to the overall Kakwani index. Exceptions are the Nordic countries (without the Netherlands), Belgium, Estonia, Latvia and Poland. Regardless of whether their contribution is positive or negative, in all countries the contribution of taxes on second tier benefits to overall progressivity is limited, which is again partially due to the limited size of PIT on second tier pension benefits (see Table A6 in the Appendix). SIC on second tier pensions contribute negatively to overall progressivity, in a very limited way in nearly every country in which they are levied, except in Luxembourg and Croatia. The negative contribution is a result of the negative Kakwani of SIC on second tier pension benefits. PIT and SIC on first and third tier pension benefits have an impact on overall progressivity in a limited number of countries. Taxes on tier one pensions contribute to total progressivity to a very limited extent only in Denmark and in the Netherlands. In Denmark, the contribution is negative, meaning that the overall effect of these taxes is inequality increasing. In contrast, the contribution of PIT on first tier pensions to total progressivity is slightly positive in the Netherlands, which means that they have a small inequality decreasing effect. SIC on first tier benefits only contribute slightly to total progressivity in the Netherlands and to a lesser extent in Cyprus. Again, these taxes have a negative effect on the index, meaning that they are regressive. Taxes on the third tier have a negligible impact on total progressivity in eight countries. This is a result of the fact that the size of this tier is very small in most countries or non-existent. However, though the contribution is often small, it is everywhere positive as PIT on third tier pensions are progressive. The largest contribution to total progressivity can be observed in Finland and the United Kingdom.

Especially the results regarding the regressive effects of second tier benefits in a select number of countries might appear counterintuitive and even contradictory to the results presented in previous sections. Although PIT on pension income increase across the distribution when considering pensioners alone, the same taxes are regressive when considering the entire population. This finding is related to the position of old-age individuals in the overall distribution of income. For example, in Belgium, the percentage of individuals with (second tier) pensions in the highest quintile is very small, so that even

the richest pensioners (who carry a larger tax burden than poorer pensioners) are located somewhere in the middle of the distribution (see Table A7 in the Appendix). Since we here consider tax progressivity across the entire population, this results in an overall regressive effect. This serves as an important reminder that the underlying characteristics of the income distribution, in this case the position of pensioners, influence outcomes of progressivity of the tax system. While pension benefit related tax expenditures might lower the tax burden of pensioners, this does not necessarily imply that taxes on pension income will have an inequality decreasing effect when the whole income distribution is considered.

Figure 6: Decomposition of progressivity of total taxes over PIT and SIC on different income components, 28 European countries, 2019
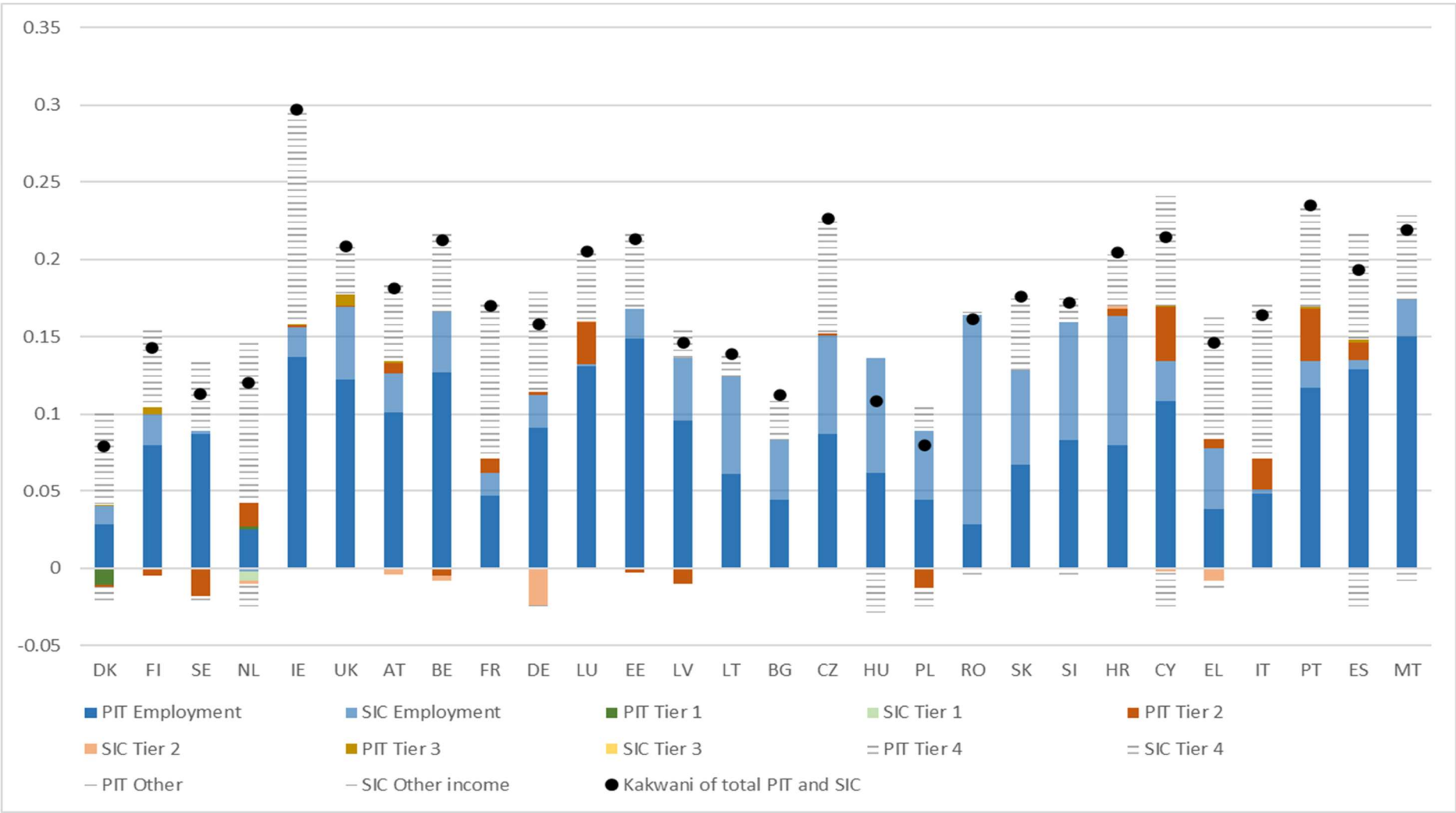
Source: EUROMOD, own calculations
Note: Kakwani index calculated over the entire population, using equivalised incomes and taxes, using the modified OECD scale.

5. Discussion and conclusion

In this paper, we have studied the interaction between the pension system and the tax system across the EU-27 countries and the United Kingdom. Following the work of Kammer et al. (2012) and Feher and Jousten (2018), we have started from the assumption that the underlying principle of the welfare state (solidarity or insurance) would influence key elements of both the pension and the tax system. Very broadly, we assumed that in solidarity-based countries the concern with vertical equity within the tax system would be relatively more important than the horizontal equity concern. In insurance-based countries, we expected that governments would attach relatively more importance to the horizontal equity concern. These hypotheses provided the framework for the empirical analysis, in which we attempted to answer the following questions. Do governments in Europe use the tax system as a social policy tool when it comes to the elderly, e.g. by treating (minimum) pensions and old-age benefits in a favourable way? To what extent are elderly persons taxed into poverty? Do pensioners face a similar tax burden as workers? Are taxes on old-age benefits stronger or weaker pro-poor than those on workers?

Almost all countries clearly use the tax system as a social policy tool for pensioners. From our results on the average burden of PIT and SIC, and on the percentage of pensioners that are taxed into poverty, it might seem that governments use the tax system in a way that is beneficial for pensioners. However, this conclusion should be nuanced, given that both findings are related to the position of pensioners in the income distribution. On average, the rate of PIT and SIC paid by pensioners is lower than that of employees in every country in our analysis. In addition, with the exception of Sweden, in every country less than 5% of pensioners become poor because of PIT and SIC on retirement income. At the same time, pre-tax old-age poverty levels vary across the different countries in our analysis. Because of the relatively worse income position of pensioners compared to workers, it is challenging to determine how much of the difference in tax burden result from pension-related tax expenditures and how much is a consequence of the tax structure.

Figure 7 brings together our results regarding vertical and horizontal equity. On the horizontal axis, we show the average of the difference in PIT rate between pensioners and employees across quintiles. A positive value indicates that, on average, pensioners have higher PIT rates than employees. This measure is positive (or slightly negative) for Poland and for most continental, Southern and Nordic countries. On the other hand, pensioners pay on average less PIT than employees in the Anglo-Saxon, Baltic and CEE countries (without Poland), Germany and the Netherlands. On the vertical axis, we plot the difference in the Kakwani of PIT on pensions and the Kakwani of PIT employment income. In this case, negative values indicate that PIT on pensions are less progressive than PIT on employment income, which is the case for the majority of countries. The only country where it is substantially larger than zero is the Netherlands, while the measure is around zero for Cyprus, Portugal and Luxembourg.

Four groups of countries can be identified. The first group, containing the Anglo-Saxon, Baltic, most of the CEE countries, Germany and Spain have negative measures of both horizontal and vertical equity. In these countries, taxes on retirement income have a lower level and are less progressive than employment income. This is most pronounced in the CEE and Baltic countries, and this is mainly a result of pension related tax expenditures (i.e. pensions being (nearly) tax exempt). The second group, composed of the Nordic countries and nearly all Continental and Southern countries, combines a negative measure of vertical equity with a positive measure of horizontal equity. In these countries, progressivity of PIT on retirement income is smaller than progressivity of PIT on employment income and pensioners pay on average more PIT than employees. The position of Sweden, Denmark and Finland in this group, goes against our expectations, with regards to both the regressive nature of taxes on pensions and the similar tax burdens for employees and pensioners. For the continental and Southern countries, the results regarding horizontal equity follow expectations, given the insurance logic in their pension system. However, it is notable that in some of these countries (e.g. Belgium), the effect of tax expenditures regarding pension benefits (which substantially lower the tax burden of pensioners) are offset by tax expenditures aimed at employees. The third group consists of the Netherlands, where PIT on retirement income is more progressive than PIT on employment income, even when considering the position of pensioners in the distribution. At the same time, pensioners pay on average less PIT than employees. In the final group, composed of Luxembourg, Portugal and Cyprus, both the measure of vertical and horizontal equity is close to zero, implying that employees and pensioners are treated in very similar ways.

Due to the variety of elements that influence the distributive effects of preferential tax treatment of pensions, the effects of using the tax system as a policy tool are heterogenous across countries. Our results highlight, once more, that the position of pensioners in the income distribution is an important driver of the results regarding tax progressivity. In addition, while pension income is granted preferential treatment in nearly all countries, the existence of tax expenditures in other policy fields can (and do) impact the extent to which the principle of horizontal equity between pensioners and employees is maintained or violated.

Figure 7: Scatter plot of measures of vertical inequality and horizontal inequality, 28 European countries, 2019
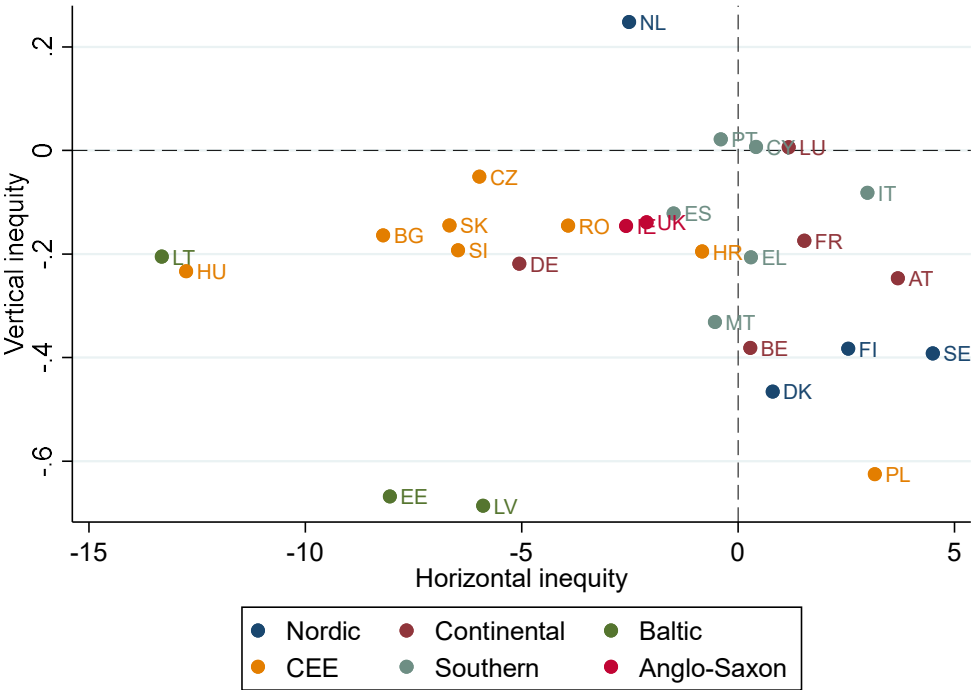
Source: EUROMOD, own calculations

Note: The measure of vertical inequity is the difference in Kakwani index of PIT on pensions and the Kakwani of PIT employment income. Negative values indicate that PIT on retirement income is less progressive than PIT on employment income. The measure of horizontal inequity is the average difference in PIT rates of pensioners and employees across quintiles. Negative values indicate that PIT rates of pensioners are lower than PIT rates of employees.

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Appendix

Table A 1: Average pension income of old-age individuals as a % of average employment income of workers, 28 European countries, 2019

Group	**Country**	Pre-tax	Post-tax
Nordic	Denmark	56.7	64.2
	Finland	47.6	56.5
	Sweden	55	59.2
	Netherlands	56.3	61.9
Anglo-Saxon	Ireland	33.2	42.4
	UK	48.5	60.4
Contin.	Austria	66.7	76
	Belgium	50.5	65.5
	France	61.7	71.4
	Germany	54.1	68.9
	Luxembourg	87.9	95.1
Baltic	Estonia	33.7	40.6
	Latvia	27.9	35.9
	Lithuania	25.7	42.3
CEE	Bulgaria	32.2	40.1
	Czech Rep.	42.4	52.8
	Hungary	49.2	72.9
	Poland	43.9	50.7
	Romania	35.1	59.2
	Slovakia	52.4	67.4
	Slovenia	49.6	74.1
	Croatia	43.8	57.9
South.	Cyprus	64	69.8
	Greece	61.9	72.7
	Italy	78.1	87.5
	Portugal	67.8	79.7
	Spain	72.9	83
	Malta	44.6	53

Source: EUROMOD, own calculations

Note: post-tax distribution is based on pre-tax (pension or employment) income minus proportional taxes

Figure A 1: Pre-tax and disposable income poverty rates for workers (left) and pensioners (right), based on equivalised income, 28 European countries, 2019
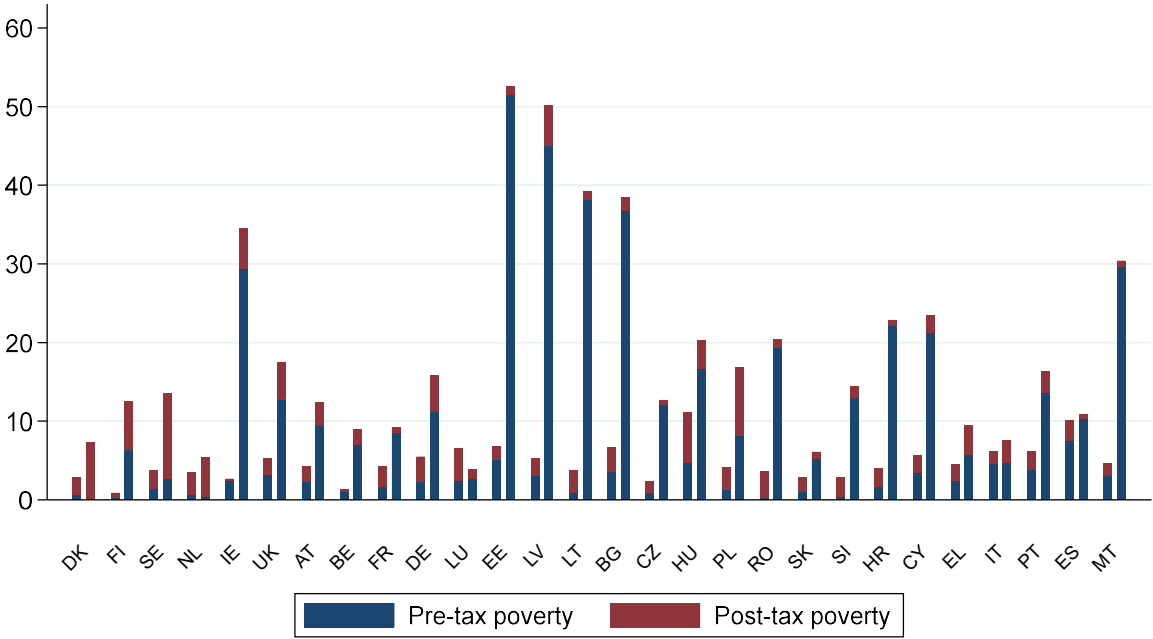
Source: EUROMOD, own calculations

Table A2: Kakwani index of the overall tax system (PIT and SIC combined) and of proportional taxes (PIT) and social contributions (SIC) on employment and retirement income, 28 European countries, 2019

Group	Country	Total taxes	Employment		Retirement	
			PIT	SIC	PIT	SIC
Nordic	Denmark	0.079	0.181	0.082	-0.285	
	Finland	0.143	0.221	0.127	-0.162	
	Sweden	0.113	0.19	0.017	-0.202	
	Netherlands	0.12	0.233	-0.034	0.48	-0.246
Anglo-Saxon	Ireland	0.297	0.297	0.19	0.151	
	UK	0.208	0.32	0.167	0.181	
Contin.	Austria	0.181	0.331	0.083	0.084	-0.136
	Belgium	0.212	0.297	0.15	-0.079	-0.236
	France	0.17	0.467	0.037	0.292	-0.025
	Germany	0.158	0.271	0.071	0.052	-0.415
	Luxembourg	0.205	0.32	0.002	0.326	0.027
Baltic	Estonia	0.213	0.247	0.137	-0.421	
	Latvia	0.146	0.229	0.134	-0.457	
	Lithuania	0.139	0.205	0.167		
CEE	Bulgaria	0.112	0.164	0.113		
	Czech Rep.	0.226	0.308	0.176	0.257	
	Hungary	0.108	0.199	0.193	-0.035	
	Poland	0.08	0.33	0.16	-0.295	
	Romania	0.161	0.21	0.175	0.065	
	Slovakia	0.176	0.258	0.149	0.113	
	Slovenia	0.172	0.31	0.151	0.117	
	Croatia	0.204	0.447	0.148	0.252	0.289
South.	Cyprus	0.214	0.45	0.075	0.457	-0.102
	Greece	0.146	0.342	0.16	0.135	-0.178
	Italy	0.164	0.17	0.025	0.088	
	Portugal	0.235	0.35	0.057	0.372	
	Spain	0.193	0.302	0.033	0.18	
	Malta	0.219	0.344	0.081	0.013	

Source: EUROMOD, own calculations

Table A3: Kakwani of total taxes and contribution of PIT and SIC on employment, retirement and other income to overall progressivity, 28 European countries, 2019

Country	Kakwani total taxes	Employment		Retirement		Other	
		PIT	SIC	PIT	SIC	PIT	SIC
Denmark	0.079	0.028	0.012	-0.011		0.062	-0.011
Finland	0.143	0.08	0.02	-0.01		0.045	0.007
Sweden	0.113	0.087	0.002	-0.018		0.045	-0.003
Netherlands	0.12	0.025	-0.002	0.017	-0.007	0.104	-0.017
Ireland	0.297	0.137	0.019	0.001		0.131	0.008
UK	0.208	0.122	0.047	0.008		0.027	0.005
Austria	0.181	0.101	0.025	0.008	-0.004	0.052	-0.002
Belgium	0.212	0.128	0.039	-0.004	-0.003	0.047	0.005
France	0.17	0.047	0.015	0.01	-0.001	0.095	0.005
Germany	0.158	0.091	0.021	0.002	-0.024	0.065	0.003
Luxembourg	0.205	0.131	0.001	0.028	0.001	0.045	0.001
Estonia	0.213	0.149	0.019	-0.003		0.045	0.004
Latvia	0.146	0.096	0.04	-0.011		0.021	0
Lithuania	0.139	0.061	0.063			0.016	-0.001
Bulgaria	0.112	0.044	0.039			0.011	0.017
Czech Rep.	0.226	0.087	0.064	0		0.058	0.017
Hungary	0.108	0.062	0.074	0		-0.029	0
Poland	0.08	0.044	0.045	-0.013		0.017	-0.013
Romania	0.161	0.028	0.136	0		-0.004	0.002
Slovakia	0.176	0.067	0.061	0		0.015	0.034
Slovenia	0.172	0.083	0.076	0		0.018	-0.005
Croatia	0.204	0.08	0.083	0.005	0.002	0.027	0.006
Cyprus	0.214	0.108	0.026	0.031	-0.002	0.072	-0.022
Greece	0.146	0.038	0.04	0.006	-0.011	0.08	-0.007
Italy	0.164	0.048	0.003	0.013		0.088	0.012
Portugal	0.235	0.117	0.017	0.036		0.059	0.006
Spain	0.193	0.129	0.006	0.014		0.069	-0.025
Malta	0.219	0.15	0.024	0		0.054	-0.009

Source: EUROMOD, own calculations

Note: The contribution of PIT and SIC on employment, retirement and other income is expressed as the respective weighted Kakwani index ($t_i/t \prod T_i$)

Table A4: Total taxes (PIT and SIC) as % of pre-tax income and proportion of each tax type on retirement, employment and other income in total taxes, 28 European countries, 2019

Country	Total taxes	Employment		Retirement		Other	
	Average rate t	PIT	SIC	PIT	SIC	PIT	SIC
		As % of t		As % of t		As % of t	
Denmark	0.377	15.5	14.2	4	0	76.9	-10.5
Finland	0.296	36	16.1	6.3	0	30.2	11.3
Sweden	0.275	46	12.5	8.9	0	27.4	5.2
Netherlands	0.319	10.9	5.8	3.5	2.8	33.9	43.1
Ireland	0.236	46.2	10.2	0.8	0	38.8	4
UK	0.227	38	28.1	4.5	0	26.4	3
Austria	0.272	30.6	30.6	9.2	3.2	13.4	13
Belgium	0.296	42.7	26.1	5.7	1.3	17.5	6.7
France	0.212	10.1	40.9	3.3	4.5	53.4	-12.1
Germany	0.287	33.5	30.2	3.3	5.8	17.6	9.6
Luxembourg	0.247	41	28	8.5	1.9	12.9	7.7
Estonia	0.144	60.4	13.7	0.8	0	21.2	3.9
Latvia	0.215	41.8	29.7	2.3	0	17	9.2
Lithuania	0.285	29.9	37.5	0	0	12.9	19.7
Bulgaria	0.151	27.1	34.9	0	0	13	25
Czech Rep.	0.179	28.3	36.3	0.1	0	18.3	17
Hungary	0.259	31.1	38.6	0	0	20.8	9.5
Poland	0.241	13.4	28.2	4.5	0	40.1	13.8
Romania	0.3	13.3	77.5	0.3	0	3.3	5.6
Slovakia	0.193	25.9	40.7	0	0	5	28.4
Slovenia	0.256	26.7	50.6	0.3	0	7.5	14.9
Croatia	0.194	18	56.3	2.1	0.7	6.7	16.2
Cyprus	0.133	23.9	35.3	6.8	1.9	16.6	15.5
Greece	0.229	11.2	24.8	4.4	6.1	34.5	18.9
Italy	0.259	28.3	12	15	0	30.4	14.4
Portugal	0.201	33.3	29.6	9.7	0	19.5	7.8
Spain	0.186	42.8	17.5	7.5	0	21.4	10.8
Malta	0.151	43.6	29.8	2.5	0	15.7	8.4

Source: EUROMOD, own calculations

Table A5: Contribution of PIT and SIC on each tier of pension income to overall tax progressivity, 28 European countries, 2019

Country	Kakwani total taxes	Tier 1		Tier 2		Tier 3	
		PIT	SIC	PIT	SIC	PIT	SIC
Denmark	0.079	-0.011		-0.001		0.001	
Finland	0.143	0		-0.005		0.004	
Sweden	0.113			-0.018		0	
Netherlands	0.12	0.002	-0.006	0.015	-0.002	0	0
Ireland	0.297	0		0.001		0.001	
UK	0.208			0.001		0.007	
Austria	0.181			0.007	-0.004	0.001	
Belgium	0.212			-0.005	-0.003	0	
France	0.17			0.009	-0.001		
Germany	0.158			0.002	-0.024	0	
Luxembourg	0.205			0.027	0.001	0	
Estonia	0.213			-0.003			
Latvia	0.146			-0.01			
Lithuania	0.139						
Bulgaria	0.112						
Czech Rep.	0.226			0.001		0	
Hungary	0.108			0			
Poland	0.08			-0.013			
Romania	0.161			0			
Slovakia	0.176					0	
Slovenia	0.172			0		0	
Croatia	0.204			0.005	0.002		
Cyprus	0.214	0	-0.001	0.035	-0.001	0.001	
Greece	0.146			0.006	-0.008		
Italy	0.164			0.02		0	
Portugal	0.235			0.034		0.001	
Spain	0.193	0		0.011		0.002	
Malta	0.219			0		0	

Source: EUROMOD, own calculations

Note: The contribution of PIT and SIC on each tier of retirement income is expressed as the respective weighted

Kakwani index ($^{t_i}/_t \prod T_i$)

Table A6: Kakwani indices and proportion of each tax type on retirement income across tiers in total taxes, 28 European countries, 2019

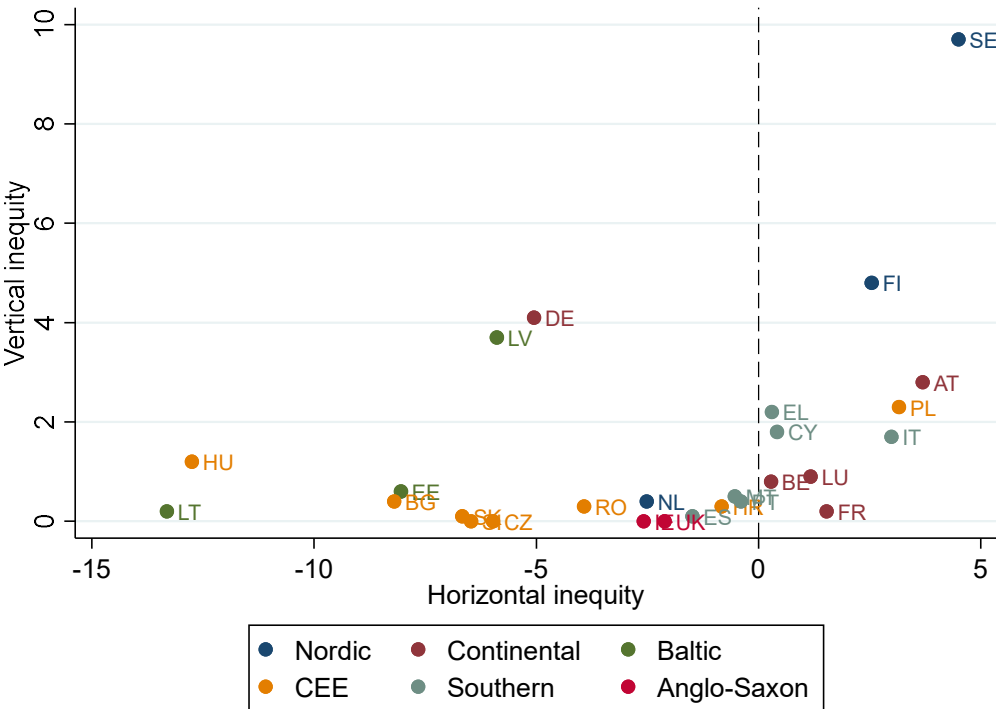| Country	Average tax rates					Kakwani indices					
	Tier 1		Tier 2		Tier 3	Tier 1		Tier 2		Tier 3	
	PIT	SIC	PIT	SIC	PIT	PIT	SIC	PIT	SIC	PIT	SIC
Denmark	2	0	0.2	0	1.7	-0.56		-0.479		0.054	
Finland	0	0	9.6	0	1.2	-0.344		-0.053		0.359	
Sweden	0	0	8.3	0	0.6			-0.219		0.037	
Netherlands	0.6	1.3	2.9	1.7	0	0.398	-0.488	0.498	-0.099	-0.151	-0.262
Ireland	0	0	0.5	0	0.2	-0.478		0.112		0.241	
UK	0	0	1.3	0	3.2			0.05		0.234	
Austria	0	0	8.6	3.4	0.2			0.084	-0.121	0.419	
Belgium	0	0	5.6	1.3	0			-0.081	-0.236	0.404	
France	0	0	3.2	4.4	0			0.289	-0.03		
Germany	0	0	3	5.6	0			0.078	-0.424	0.262	
Luxembourg	0	0	8.1	1.7	0			0.34	0.047	0.037	
Estonia	0	0	0.8	0	0			-0.421			
Latvia	0	0	2.3	0	0			-0.457			
Lithuania	0	0	0	0	0						
Bulgaria	0	0	0	0	0						
Czech Rep.	0	0	0.3	0	0.1			0.429		0.166	
Hungary	0	0	0	0	0			-0.035			
Poland	0	0	4.4	0	0			-0.297			
Romania	0	0	0.3	0	0			0.065			
Slovakia	0	0	0	0	0					0.113	
Slovenia	0	0	0.3	0	0			0.111		0.241	
Croatia	0	0	2.1	0.7	0			0.252	0.289		
Cyprus	0	0.1	7.7	2.2	0.2	0.386	-0.736	0.456	-0.04	0.43	
Greece	0	0	4.3	7.1	0			0.134	-0.11		
Italy	0	0	16.3	0	0			0.121		-1.066	
Portugal	0	0	9.1	0	0.1			0.373		0.492	
Spain	0	0	6.6	0	0.6	-0.592		0.163		0.426	
Malta	0	0	2.4	0	0.1			0.006		0.192	

Source: EUROMOD, own calculations

Note: information on SIC on third tier pensions benefits omitted as the average size is in all countries 0

Table A7: Percentage of workers and old-age individuals within each specific quintile (% of quintile observations), 28 European countries, 2019

Country	Q1 W	Q1 OA	Q1 W	Q1 OA	Q3 W	Q3 OA	Q4 W	Q4 OA	Q5 W	Q5 OA
Austria	10.2	15.5	26.9	18.2	35.7	17.5	48.6	12.7	53.7	10.7
Belgium	5	25.2	17.9	28.9	35.1	16.3	47.4	9.1	57.1	4.6
Bulgaria	5.9	34.5	19.6	28.5	33.3	14.4	44.1	8.2	50.1	3.7
Cyprus	10.2	23.4	24.1	13.2	36.4	6.9	43	6.8	45.2	11.7
Czech Rep.	7.9	41.7	21.2	30.5	38.2	9.6	50.6	4.4	57	2.9
Germany	14.1	26	27.2	30.3	41.5	16.7	52.1	10.5	60	7.3
Denmark	8.9	26.5	23.6	26.5	40	12.1	50.8	9.3	53.9	6.6
Estonia	10.7	42.9	28	23.6	42.7	6.2	51.8	4.4	56.4	2.1
Greece	6	12.6	11.8	21.7	18.4	17.9	27.7	15.3	35.8	11.6
Spain	14.1	8.2	23	15.2	33.6	14.5	42.3	11.7	47.9	10
Finland	2.9	27	14.7	27.2	29.9	17	40.1	11.1	49.8	6.5
France	10.9	21.9	25.9	22.2	37.5	17	44.3	13.3	42.6	14
Croatia	4	20.3	18.6	20.2	30.7	13.2	38.9	10.4	49	8.3
Hungary	12.5	4.3	20.7	5.6	36.6	3.2	50.7	2.2	56.6	1.2
Ireland	5.4	22.1	18.1	25.6	36.8	5.3	44.3	3.3	53.3	2
Italy	7.9	6.2	17.2	17.3	25.5	19.4	35.9	15.4	36.4	16.4
Lithuania	1.9	41.9	13.4	26.6	28.8	9.7	43.2	5.3	49.8	2.9
Luxembourg	23.4	9.5	36.8	9.8	35.9	15.8	40.9	13.9	50.2	12.5
Latvia	5.4	40.3	25.1	25.2	37.6	9.3	48	5.9	55.4	3.6
Malta	9.7	23.1	25.3	19.1	39.7	9.6	50.9	5.6	61.9	3
Netherlands	10.1	22.3	22.7	28.6	35	15	42.8	9.7	45.8	7
Poland	8.2	20.2	18.3	21.7	29.9	16.8	40.4	11.9	50.5	6.2
Portugal	11.6	25.4	28	23.3	41.3	15.4	47.3	12.9	44.6	15.8
Romania	0.6	18.9	13	25.7	31.9	18.9	48.6	10.9	63.8	5
Sweden	8	20.2	23.9	26.3	37.4	14.7	47	7.9	52.3	6.3
Slovenia	7.5	22.7	23.5	18.7	38.9	10.8	47.7	7.4	55.7	3.8
Slovakia	10.8	27.7	25.8	22.4	38.2	10.8	51.5	8.5	61.2	4.6
United Kingdom	12.4	21.3	24.4	24.8	40.7	19.9	54.2	12.8	58.8	9

Source: EUROMOD, own calculations

Figure A2: Scatter plot of measure of vertical inequity (rate of pensioners taxed into poverty) and horizontal inequity, 28 European countries, 2019

Source: EUROMOD, own calculations

Note: The measure of horizontal inequity is the average difference in PIT rates of pensioners and employees across quintiles. Negative values indicate that PIT rates of pensioners are lower than PIT rates of employees.