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ARTICLE

What do we learn about redistribution effects of pension systems from internationally comparable measures of Social Security wealth?

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Abstract

We present novel estimates of Social Security Wealth (SSW) at the individual level based on the SHARE survey. Our estimates are based on a rigorous methodology taking into account country-specific legislations, the earning history and the longevity prospects of individuals. The key advantage over existing estimates is that our measures of SSW are fully comparable across countries. This allows us to construct indexes of the redistribution enacted by the pension systems in Europe. Finally, we provide descriptive evidence of the relationship between SSW and private wealth.

Key words: Redistribution; SHARE; Social Security Wealth

JEL Codes: D14; D31; H55

In most European countries social security is the prevailing form of insurance and assistance to protect the well-being of individuals at older ages.[1] However, the increasing pressure to meet financial sustainability goals has hampered the action of many governments in reaching the desired level of coverage for retirees. The degree of old-age protection guaranteed by a social security system depends on a number of determinants: the institutional set-up and the rules in place, mortality prospects, labor force participation and indexation rules. The interaction of these forces may lead to different patterns of old-age protection outcomes, which make it imperative to have access to a rich dataset where all these features can be measured and compared across countries in order to carry out meaningful comparisons. Old-age pension rules are often quite complex and could vary considerably over time and across countries, for instance in terms of eligibility rules or benefit computation rules. Hence, it is important to rely on a synthetic and flexible measure of the pension provisions that is able to capture all these different characteristics in a parsimonious way.

Redistribution aspects of pension systems are particularly relevant as the well-being of a large number of individuals may largely depend on public provisions during the retirement years. Yet, while there exists a vast literature on redistribution policies implemented through general taxation, much less has been performed on the role of social security as a means of transferring resources, either intentionally or unintentionally. In recent years financial instability of 'pay-as-you-go' first pillar funds

[1]In this paper we use the terms 'social security' and 'public pensions' as synonymous. The difference between social security and pensions is relevant in those countries where private occupational pensions play a role, such as the Netherlands. However, since we focus our attention on the first pillar only, we can adopt this simplification. For those cases where we want to mark the distinction we speak of 'private pensions' or 'occupational pensions'.

led to significant reductions in the generosity of pension systems in Europe, furthermore many countries replaced Defined Benefit schemes with Defined Contribution schemes (also within the first pillar). These changes may have enhanced differences due to the former occupational status and job-seniority of retirees, potentially boosting inequalities.

In this paper we document the redistributive features of the public (first pillar) pension systems in several European countries by making use of a summary measure of Social Security Wealth (SSW) computed at the individual level. Our measure, is based on the definition used in Feldstein (1974), Stock and Wise (1990), and more recently in the volumes edited by Gruber and Wise (1998, 2004, 2007).

We make use of the SHARE data (Survey of Health, Ageing and Retirement in Europe), a longitudinal dataset based on a representative sample of individuals aged 50 or over living in Europe. The SHARE questionnaire collects extensive information on a variety of aspects relevant to describe individual well-being, ranging from health conditions to economic resources. The estimate of SSW is obtained by combining individual-level information included in the third and the fourth waves of the survey. The third wave (SHARELIFE) collects retrospective information on the main events occurring during the lives of the respondents, including their work histories, while the fourth wave collects information related to the time of the interview.

While several studies have looked at the importance of social security for various dimensions of well-being at the country level (see e.g., the different country-chapters of Gruber and Wise, 2004), very few authors have looked at a comprehensive study of the redistributive features of public pensions across Europe based on micro-data. Indeed, the possibility to carry out a pan-European study of individual-level SSW and the redistribution effects of pension policies has been limited by the lack of appropriate and fully comparable data.[2] One exception in this vast literature is represented by the periodical report by the OECD 'Pensions at a Glance' (OECD, 2009, 2011 and 2013) as it provides an international comparative analysis of the features of pension systems, including benefit calculation rules and distributional effects, based on a synthetic steady-state population and steady-state pension rules. In particular, the OECD Report also presents a 'progressivity index', developed by Biggs *et al.* (2009) and based on inequality measures of SSW and earnings in order to assess the redistribution properties of social security systems.

In this paper we calculate a progressivity index, along the lines of what is proposed by the OECD Report, however our measure is based on the micro-level data available in SHARE, which provides important advantages with respect to a synthetic population. First, the heterogeneity of actual earning histories (e.g., earnings volatility, unemployment spells and time out of the workforce) can interact with public pension benefit criteria and affect SSW. Second, we evaluate the redistributive features of pension systems on a lifetime (and not in a single time period) perspective and also we can assess the generosity of the different pension systems in relation to different sections of the earning distribution. By constructing the ratio between SSW and lifetime income (LTI), we investigate whether and how the different pension systems protect the welfare of low *lifetime* earners. Finally, we look – in a descriptive way – at the possible displacement effects of social security on private wealth by plotting, for different countries, the share of SSW over a comprehensive measure of wealth that aggregates total private wealth and SSW.

The paper is organized as follows. In Section 2 we provide the definition of our relevant measure of SSW and present the SHARE data, explaining how the information available at the individual level in SHARE can be used to generate SSW. Section 3 discusses the properties of the SSW estimates by making use of simple descriptive statistics while Section 4 analyzes the redistribution properties of the different pension systems. Section 5 exploits the SHARE micro-data to study the degree of generosity of SSW along the lifetime labor income distribution of individuals. Section 6 investigates how SSW correlates with private household wealth and hints to a possible 'substitutability' mechanism between these two forms of wealth. Section 7 provides some concluding remarks.

[2]Important examples in close domains are Blau *et al.* (2006), Brandolini and Smeeding (2011) and Nolan *et al.* (2011).

1. Estimating social security wealth in the SHARE sample

This paper is based on a summary measure of the generosity of the social security system known as social security wealth (SSW) that has been widely used to deal with several research questions in pension economics, such as retirement behavior (see, e.g., Stock and Wise 1990), the crowding out of private savings (Gale, 1998; Attanasio and Brugiavini, 2003; Kapteyn *et al.*, 2005, Alessie *et al.*, 2013), and as a general measure of the implicit liabilities of a government vis-à-vis its current and future retirees (Holzmann *et al.*, 2004).

Although the original concept of SSW dates back to the seminal paper of Feldstein (1974) and is quite general, more recent contributions offer operational definitions that may vary substantially, especially if applied at the individual or household level. In this paper we develop an internationally comparable measure of individual SSW based on the SHARE. The SSW measure includes first pillar pension benefits plus minimum pension benefits (guaranteed flat benefits) when relevant, it does not include survivor benefits, it is based on pension benefits net of income and payroll taxes and it is measured in 2010 euros.[3]

Two specifications of SSW are typically adopted in the literature, depending on the individual's labor market status at the time of the interview. We stick to this literature and define the SSW of retired respondents (retired from the labor market) as follows:

$$SSW_i = \sum_{j=R}^{\Omega} P_{i,j}\,\pi(j|a)(1+r)^{a-j} \tag{1}$$

where i is the individual, R is her/his age at the time of retirement, Ω is the maximum attainable age, a is her/his age at the time of the interview ($a > R$), $\pi(.)$ are conditional survival probabilities according to current life tables[4] and r is a financial discount rate. P is the *self-reported* public old age/early retirement pension benefit annualized and net of pension income taxation. The retirement age R is also self-reported (in case of missing values, for panel individuals it is recovered from previous waves). Conditional survival probabilities π are taken from the Human Mortality Database (HMD, 2013) and are country and gender-specific, the maximum attainable age is set to 109. The discount rate r is set to 2% as in OECD (2013).

The SSW of individuals who are still working at the time of the interview is defined as follows:

$$SSW_i = \sum_{j=R}^{\Omega} \hat{P}_{i,j}(R)\,\pi(j|a)(1+r)^{a-j} \tag{2}$$

where $\hat{P}(R)$ is the *computed* public pension benefit from work, which can be either an early or an old age retirement benefit, according to whichever comes first in terms of eligibility. We assume that individuals work until they meet the eligibility requirements (age, insurance and contribution years) and they retire from work through one of these routes as soon as they qualify. The computed public pension benefit is defined according to the early retirement rules if the respondent's current age is lower than or equal to the early retirement age R^e in place in her country of residence. Otherwise, the pension benefit is computed according the rules of old age pensions. More formally, we can write

$$\hat{P}_i(R) = \begin{cases} \hat{P}_i^e(R^e) & \text{if } a \le R^e \\ \hat{P}_i^o(R^o) & \text{if } a > R^e \end{cases}$$

[3]All monetary values in this paper have been adjusted to take into account differences in the cost of living across countries by using purchasing power parity 2010 indexes. As a result, monetary values are expressed in 2010 'German' euros, i.e. the unit of measure is the quantity of goods that it was possible to buy in Germany with 1€ in 2010.

[4]Since we know that the individual survived until the interview year, we set $\pi(j|a)$ equal to 1 for j=R,…,a.

where *e* stands for early retirement and *o* stands for old age. The pension benefit is measured in yearly amounts net of pension income taxation. Old age/early retirement age, *R*, is an institutional 'contextual' variable that depends on country-specific pension legislation, while maximum attainable age, survival probabilities and the discount rate are defined as in the case of the retirees presented above. We use country specific pension regulations on the relevant variables in order to construct an eligibility index.[5]

Data are taken from the SHARE survey, a multidisciplinary, cross-national longitudinal database of micro-data on health, socio-economic status and social and family networks. The SHARE sample is representative of the populations of individuals aged 50 or over living in 20 European countries (plus Israel)[6] and their spouses. Six waves of SHARE are currently available. The first two and the last three waves focus on the status of respondents at the time of the interview. The third wave (SHARELIFE) is a retrospective survey that uses life-history interviews to gather information about the main events occurred throughout respondents' lives with respect to family relationships, employment, health status, health care and housing.[7] Our sample consists of individuals who are interviewed in both Wave 4 of SHARE, which has been mainly collected in 2011, and in SHARELIFE, which has been collected between 2008 and 2009.

The distinction between workers and retirees is based on a question present in the fourth wave of SHARE, asking about the current status in terms of activities. Information on pension benefit, necessary to compute SSW as in equations (1) and (2), is obtained in different ways for retirees and for workers, respectively. In the former case the pension benefit (as well as the retirement age) is observed in the data and can be readily incorporated into the definition of SSW. In particular, the relevant question asks about a typical – after taxes – payment of public old age/early retirement pension in the previous year. The benefit amount is a typical regular payment, excluding any extra payments and bonuses. For workers, the future pension amount they will receive at retirement needs to be computed. This is a complex task since pension benefit computation rules are country specific. We rely on *Mutual Information System on Social Protection* tables (MISSOC, version July 2010) to define the appropriate pension rules for each country, plus information obtained directly from country specific publications. This calculation often requires the reconstruction of the individual working life as well as of the contribution rates and pension rules. Retrospective individual data such as wage history, insurance and contribution years and/or residential information needed to compute the pension benefit have been mainly obtained from the Job Episodes Panel (JEP). The JEP is a dataset based on SHARELIFE and it runs until 2008. It is a retrospective panel dataset in which respondents contribute as many observations as their years of age at the moment of the SHARELIFE interview. This panel stores information about the lifetime evolution of respondents' working conditions, ranging from labor market status to wages and job specific characteristics.[8] Specifically, the JEP reports the following types of wages: first wage for each working spell, the last wage of the main job for retirees and the current wage for individuals still at work in 2010. In order to construct a complete age-earnings profile we need to do some form of back-casting and fill in within spell missing wages in the past, at the same time we have to forecast and project future wages after 2010. As for the former we apply a simple piece-wise linear interpolation which generates a spline with different rates of growth in the different spells, while for future wages in order to generate a prediction after the last observation in 2010, we project constant wages in real terms. This is a standard assumption in the literature (see, e.g., Gruber and Wise 2004) as at older ages observed wages may fall for a number of reasons which generate a spurious decline of the age-earnings profile. In our sample the only case where this might turn out to be an extreme assumption is for workers who are relatively young (say age 50) in the year 2010,

[5]See Belloni *et al.* (2016) for an alternative measure of Social Security Wealth based on the same data.

[6]See Börsch-Supan *et al.* (2013*a* and 2013*b*) and Malter and Börsch-Supan (2013) for more information on the SHARE data.

[7]See Börsch-Supan *et al.* (2011) and Schröder (2011) for more information on the contents and the methodology of the life-history interviews conducted in the SHARELIFE surveys.

[8]See Brugiavini *et al.* (2013) for more details.

but there are very few respondents falling in this category. The pension rules considered to compute the public old age/early retirement pension benefits are those in place in 2010 and are drawn from the MISSOC tables and country-specific publications to fully account for the heterogeneity in pension legislation across cohorts, gender and current employment status.

In estimating SSW we neglect some dimensions of the pension systems: we do not account for survivors' benefits and we do not model the second or third pillar. Although in some cases the role of occupational pensions may be relevant (especially in Sweden, the Netherlands, Denmark and Switzerland, among the countries considered in our analysis, see Table A1 in the Appendix), in this paper we want to describe the provisions that individuals are entitled to in terms of first-pillar social security as this is normally under the direct control of the State and therefore is the natural policy instrument to redistribute resources.[9]

Our analysis is based on individuals living in the following 12 European countries: Sweden, Denmark, the Netherlands, Belgium, France, Germany, Switzerland, Austria, Spain, Italy, Poland and Czech Republic. Estonia, Hungary, Portugal and Slovenia also participated in the fourth wave of SHARE, but did not take part in the third wave of SHARE (SHARELIFE) and we had to exclude them from the investigation. We also excluded SHARE respondents residing in any of the 12 countries who did not participate in the retrospective wave SHARELIFE or respondents displaying missing values in any of the relevant variables.[10] Furthermore, we excluded individuals aged 80 and above in 2010, this is because older pensioners in our sample may have retired at very different ages and may have experienced several pension regimes, hence the comparison based on SSW may be largely affected by sample composition as well as differences in mortality for these cohorts.

Finally, we select the sample of retirees who enjoyed lifetime earnings and SSW above the first decile of their respective distributions. This is because we are not interested in describing redistributive policies which are not strictly related to the work experience. In several countries a retiree who has never worked might qualify for pension benefits, hence giving rise to a very high degree of redistribution of the pension system, which is in fact due to a general poverty relief program, often financed through taxation rather than contributions. We rather focus on workers and retirees who did in fact contribute to the social security system, as to highlight the redistribution properties within the program.

The analysis is carried out separately by gender and working status (distinguishing between workers and retirees). Indeed, historical differences in labor market participation and in earnings-profiles between males and females as well as gender differences in pension rules, provide a strong argument in favor of splitting the sample by gender. Furthermore, as discussed earlier, in estimating SSW for retirees we rely on self-reported pension benefits which were collected in the fourth wave of SHARE, while for workers we compute pensions on the basis of individuals' working career information collected in SHARELIFE and apply country-specific pension rules prevailing in 2010. The final sample contains 2,683 workers and 5,978 retirees.[11]

2. Social Security Wealth in Europe: descriptive statistics

SHARE is the ideal dataset to study the redistributive features of social security systems across Europe since it is based on exactly the same set of questions and the same wording in all countries. Table 1 reports the number of individuals by country, gender and labor market status at the time of the

[9]The arrangements concerning survivor benefits are often complex and subject to earning-tests: to properly compute these benefits a set of additional institutional-level information would be required. Even more complex is the structure of second pillar pensions (occupational pensions), as there might be many types of occupational pensions within the same country.

[10]To limit the presence of outliers in the monetary variables used throughout the paper we drop the observations reporting amounts lower than the first percentile and higher than the 99th percentile.

[11]As stated, we rely on self-reported benefits for retired individuals: this is the most reliable information for this group of individuals in SHARE, as we do not have access to administrative data and we avoid making use of estimates of pension benefits based on past pension rules.

Table 1. Number of observations by country, gender and labor market status at the time of the interview (SHARE selected sample)

	Retirees			Workers		
Country	Total	Males	Females	Total	Males	Females
SE	518	246	272	261	104	157
DK	524	237	287	458	194	264
DE	540	323	217	225	79	146
NL	444	258	186	307	137	170
BE	686	442	244	267	113	154
FR	602	336	266	305	114	191
CH	339	168	171	238	102	136
AT	265	130	135	44	22	22
ES	286	238	48	130	77	53
IT	693	449	244	161	67	94
CZ	539	195	344	152	71	81
PL	542	256	286	135	65	70
Total	5,978	3,278	2,700	2,683	1,145	1,538

interview (workers vs. retirees) included in our final sample.[12] The number of retirees is much higher than the number of workers due to the reference population of the SHARE sample, consisting of individuals aged 50 or over and their spouses.

Table 2 reports the sample size by cohort, gender and labor market status at the time of the interview. As pointed out earlier, we selected individuals born between 1930 and 1960 (i.e., respondents aged 50–80 in 2010).

Figure 1 shows the distribution of our SSW measure by gender and working status. As expected, the SSW distribution has a long right tail, but a clear difference emerges between the distribution for workers and the distribution for retirees (both males and females). The distribution for retirees is more densely populated and smoother than in the case of workers, the right tail reaches very high values of SSW. The distribution for workers is sparse and displays a number of spikes in focal points. This is because we observe fewer workers than retired individuals: the values of SSW which stick out correspond to the legislated minimum pension benefits or to uniform pension benefits of one specific country, as it is the case for Denmark or the Netherlands. Figures 1 and 2 do not immediately reveal the determinants of the observed dispersion in SSW, three factors surely play a role: pension rules, heterogeneity in earnings and the length of the working careers.

Figure 2 shows the box plots of SSW in the four samples of interest by country, working status and gender, while Table 3 reports the corresponding medians. As reported above, all monetary amounts considered in the paper have been adjusted by using purchasing power parity (PPP) indexes so that they are fully comparable across countries. Stark differences in the level of median SSW emerge across countries: Poland has the lowest median SSW for male workers, around €63,000, which is due to both low annual pension benefits and low life expectancy (male life expectancy at the age of old-age eligibility 65 is 14.69 years). Austria is the only country where the median SSW is above €300,000. All the other countries lie in-between and show median SSW values around €200,000. A similar ranking is observed for female workers, except for Germany and Belgium, which score (much) worse than in the case of male workers.

In terms of variability, figures for male and female workers highlight a clear dichotomy. A first group includes Denmark, the Netherlands and Switzerland showing a very small interquartile range: for the first two countries the bulk of individuals reaches full residential requirements for the (flat) pension at the retirement age, for Switzerland most workers' accrued pensions at retirement are limited to the maximum pension which was set rather low for the first pillar in 2010. Also Poland

[12]In all tables and figures, we list countries based on their geographical latitude, basically from the North to the South of Europe, in order to provide an immediate visualization of possible geographical gradients.

Table 2. Number of observations by cohort, gender and labor market status at the time of the interview (SHARE workers and retirees)

	Retirees			Workers	
Cohort	Males	Females	Cohort	Males	Females
1930–1934	570	377	–	–	–
1935–1939	864	586	1935–1947	82	74
1940–1944	984	822	1948–1950	245	223
1945–1949	687	666	1951–1953	402	446
1950–1956	173	248	1954–1956	372	541
–	–	–	1957–1960	28	147

and the Czech Republic display a limited range of SSW while the remaining countries are characterized by a marked variation in SSW.

It is harder to identify a pattern across countries according to the median level of SSW in the case of retirees. This result is likely due to the reforms of the pension systems that the cohorts included in the sample of retirees were exposed to: this heterogeneity mechanically generates a wide variability for unconditional summary measures. Hence, caution should be taken in the interpretation of results based on median values, however some meaningful comparisons can be proposed. Table 3 shows that median SSW for workers is noticeably lower than for retirees in various countries, including Poland (−55% for males, −43% for females), Germany (around −30%), Belgium (−43% for females), Denmark (−45%), Czech Republic (about −30%) and Switzerland (−60% for males and −55% for females). This evidence suggests that these countries recently enacted significant pension reforms aimed at curtailing public spending.[13] It should be recalled that our measure of SSW is based on old-age and early retirement public (first pillar) pension only.

3. Inequality and progressivity of social security

One objective of our study is to highlight how differences in SSW across countries may reflect differences in the generosity of the social security systems (including minimum pensions), as well as differences in lifetime earning profiles. The interplay between these features is embedded in the pension formula: for instance, in the Netherlands, the first pillar benefit (*Algemene Ouderdomswet*, AOW) depends mostly on residential life histories and does not depend on earning life histories (Kapteyn and de Vos, 1999). At the other extreme, the German social security provisions ('earnings points system', Börsch-Supan and Wilke, 2006) are fully based on lifetime relative earnings. In this section we will use SHARE data to assess to what extent the cross-country differences in SSW dispersion previously documented are a result of cross-country differences in the volatility of lifetime earnings or they reflect different architectures of the pension system in each country. Disentangling these two sources of heterogeneity is essential to understand the contribution of the pension systems in shaping within-country SSW inequality.

Besides presenting descriptive evidence on SSW, which is interesting *per se*, we want to measure in a simple way the degree of redistribution present in Europe which can be explained by the social security system carrying out comparisons across countries and within each country. In order to provide this type of evidence for pension provisions we make use of well-known measures such as the Gini coefficient (*G*-index), computed at the country–gender–working status level and based on individual estimates of SSW. However, the observed inequality in SSW among countries and groups as measured by the *G*-index can be due both to heterogeneity in the institutional characteristics of social security systems and to differences in the lifetime earning distribution. Hence, we also consider

[13]When comparing SSW of workers and retirees, it should be kept in mind that heterogeneity in pension legislation may also exist within these two groups (e.g. younger cohorts of retirees may have been affected by changes in pension rules differently than older cohorts).

Figure 1. Distributions of SSW by employment status and gender.
Note: The continuous line represents the Kernel density. SSW distributions are trimmed as indicated in the text.

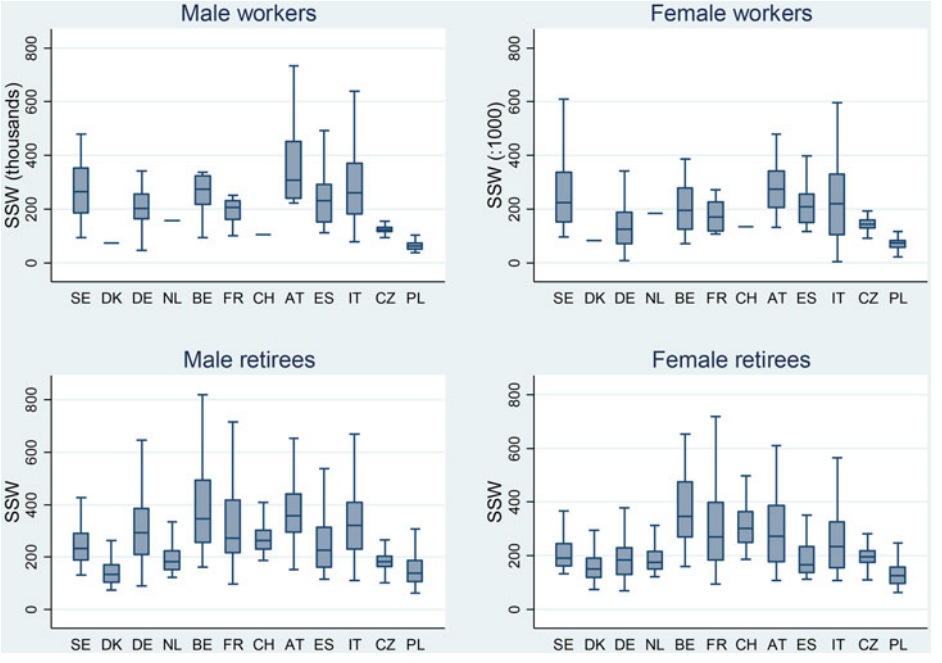

Figure 2. Box plot of SSW.

Table 3. SSW by country, working conditions and gender: median values

	Retirees		Workers	
Country	Male	Female	Male	Female
SE	232,702	191,187	264,607	224,064
DK	133,739	150,221	73,090	82,959
DE	293,348	183,547	202,986	125,189
NL	182,660	175,320	157,131	183,281
BE	345,857	347,238	274,723	196,242
FR	273,510	269,698	206,838	170,896
CH	263,905	302,608	106,619	135,122
AT	358,710	271,720	309,098	274,544
ES	226,819	166,949	230,804	210,123
IT	319,760	234,593	261,969	219,339
CZ	181,865	196,708	123,052	143,422
PL	137,881	127,143	62,681	72,935

a measure of lifetime resources such as LTI. This measure should provide a full life-course perspective of inequality and control for individual resources by distinguishing the lifetime-rich from the lifetime-poor individuals. Following Biggs *et al.* (2009) and the OECD (2009, 2011, 2013), we also consider a *progressivity index*, which is designed to capture the redistribution within the system from high-earners to low-earners.

3.1 Country-level measures of inequality

In order to provide cross-country evidence on inequalities in pension provisions we make use of the *G*-index based on our estimates of SSW at the individual level, computed separately by country, gender and working status. Although our approach is similar to the exercise carried out by the OECD (2009, 2011, 2013), there are relevant differences. We focus our analysis on an estimate of SSW computed at the individual level for a sample of real individuals obtained from micro-data: the selected individuals are SHARE-respondents at a given point in time, hence encompassing a large set of cohorts – part of which are still at work and part are already retired at the time of the interview. As a result, our individuals are subject to different pension rules, both between cohorts and within the same cohort. Plus, we make use of country-specific and gender-specific life expectancy rather than a population-wide life expectancy. Another important difference is that while we consider separately workers and retirees and measure actual SSW (as detailed below), the OECD computes total SSW for a continuous career in the workplace (baseline scenario) referring to a 'representative' individual of the population in one specific country for a steady-state 'virtual' population. Finally, it should be stressed that our estimate of SSW for workers is a lower bound because we project the age-earnings profile making simplifying and conservative assumptions on these profiles and because we do not take account of other provisions on top of old age or early retirement benefits, while the OECD takes into account compulsory pensions also from the second pillar.

We exploit information from the third wave of SHARE (SHARELIFE), which reports retrospective wages along the working history to compute individual LTI. This is defined as the total capitalized sum of annualized earnings received over the whole working history, expressed in 2010 euros.[14] We argue that LTI is a meaningful indicator to summarize individual's position in the lifetime earning distribution as it standardizes earnings with respect to the entire working history. It is however a first-moment summary measure capturing both the length of the career of individuals and the level of earnings in each year. Therefore, an individual could have a high LTI either because he has high earnings over a short career or because he has somewhat lower earnings over a long career.

[14]For capitalization and discounting labor income, we use the same value of the interest rate adopted for SSW.

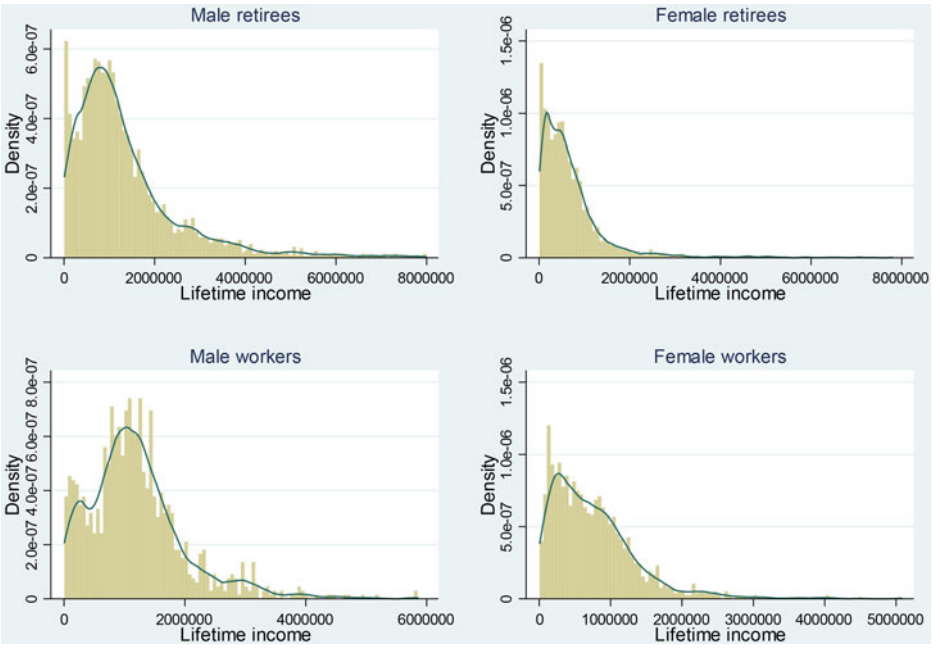

Figure 3. Distributions of LTI by employment status and gender.
Note: The continuous line represents the Kernel density. LTI distributions are trimmed as indicated in the text. For improving figures readability, we additionally exclude values above the 95th percentile to each LTI distribution.

Figure 3 reports the distribution of LTI by gender and employment status. As in the case of SSW, the distribution is skewed with a rather long right tail, especially for retirees.

Results on the measures of inequality are reported in Table 4, where we present the *G*-coefficient for SSW, for LTI, and the progressivity index. The latter is designed to summarize in a single value the extent of the redistribution properties embedded in the social security system rules. It provides a natural ranking of pension systems in terms of redistributive properties: when social security redistributes resources from higher- to lower-earning groups it is regarded as progressive. The progressivity index is defined as follows:

$$\text{Progressivity index} = 1 - \frac{G_{SSW}}{G_{LTI}}$$

where G_{SSW} and G_{LTI} stand for the *G*-index of the SSW and LTI distribution respectively.

The lower the inequality in SSW compared with the inequality in LTI, the higher is the progressivity of the pension system and the higher the progressivity index. It varies from 1 in pure flat schemes (maximum redistribution) to less than zero for highly regressive pension systems. In order to correctly interpret the progressivity index, one has to take into account that the same pension system can be found to be more progressive/regressive in our data depending on the underlying income distribution to which pension rules are applied. Therefore, a meaningful comparison of the index across countries can be performed for countries with similar values of the *G*-index for LTI, which is why we report the *G*-index performed on LTI as well.

Table 4 shows the *G*-index of SSW for retirees and for workers (first four columns). It is characterized by a marked cross-country variability: a striking difference emerges for Austrian male workers vis-à-vis Danish, Dutch or Swiss workers. Cross-country heterogeneity in LTI inequality is also substantial, see columns 5–8 of Table 4. These simple cross-country comparisons can provide some insight about the role played by the pension system architecture in shaping LTI inequality.

Table 4. Gini coefficient of SSW, Gini coefficient of LTI and progressivity index by country, working status and gender

	Gini_SSW				Gini_LTI				Progressivity index			
	Workers		Retirees		Workers		Retirees		Workers		Retirees	
Country	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
SE	0.28	0.29	0.25	0.20	0.36	0.39	0.44	0.47	0.22	0.26	0.43	0.57
DK	0.01	0.01	0.18	0.18	0.32	0.39	0.41	0.52	0.97	0.97	0.56	0.65
DE	0.20	0.32	0.25	0.26	0.24	0.33	0.29	0.33	0.17	0.03	0.14	0.21
NL	0.02	0.02	0.22	0.15	0.23	0.41	0.35	0.63	0.91	0.95	0.37	0.76
BE	0.13	0.25	0.59	0.54	0.58	0.70	0.63	0.69	0.78	0.64	0.06	0.22
FR	0.11	0.17	0.27	0.29	0.33	0.41	0.75	0.81	0.67	0.59	0.64	0.64
CH	0.01	0.01	0.28	0.24	0.23	0.40	0.25	0.42	0.96	0.97	−0.12	0.43
AT	0.48	0.18	0.30	0.33	0.55	0.35	0.48	0.52	0.13	0.49	0.37	0.37
ES	0.24	0.23	0.24	0.24	0.78	0.46	0.80	0.77	0.69	0.50	0.70	0.69
IT	0.27	0.31	0.23	0.25	0.30	0.36	0.77	0.93	0.10	0.14	0.70	0.73
CZ	0.07	0.09	0.11	0.10	0.32	0.30	0.28	0.24	0.78	0.70	0.61	0.58
PL	0.16	0.23	0.28	0.21	0.86	0.89	0.95	0.94	0.81	0.74	0.71	0.78

Compare the case of male workers in Germany and in the Netherlands: The *G*-index for LTI is basically the same (0.24 and 0.23 respectively) but the *G*-index (and thus inequality) in SSW is significantly higher in Germany (0.2) than in the Netherlands (0.02). As a result, the progressivity index for male workers is much higher in the Netherlands (=1 − (0.02)/(0.23) = 0.91) than in Germany (=1 − (0.2)/(0.24) = 0.17). Conditioning on the same level of inequality in LTI, the Dutch pension system appears to be much more redistributive than the German one[15]: result which is in line with the characteristics of the first pillar in the two pension systems.

Figure 4 provides an attempt to compare at the country level the progressivity index we computed with the one published by the OECD (OECD, 2013). We already pointed out that several methodological differences exist between the two approaches and some differences in the results are likely to emerge. In order to minimize these differences we only focus on the progressivity indexes for workers and average over genders. We then exclude three countries from the comparison: Denmark, the Netherlands and Switzerland, as these are the countries where the second pension pillar plays a major role and may drastically change the redistributive features of the social security system. The resulting correlation between the two series of progressivity index is equal to 0.64. If we further exclude Poland,[16] the correlation increases to 0.88 and the R^2 of a regression predicting OECD progressivity index based on the progressivity index computed on our data reaches a value of 0.77.

3.2 Within-country measures of inequality

The analysis based on the progressivity index provides an overall country-level measure of redistribution (separately by gender and employment status) determined by the pension system. However, it is limited in scope as it does not provide information on which part of the earning distribution is more affected by the public pension redistributive rules and it cannot be used to assess the extent to which

[15]We computed the relevant indexes also making use of ALTI (average lifetime income), i.e. the capitalized sum of earnings divided by the number of years in work. The LTI may generate a similar number for a low-wage worker who worked many years and a high-earner who worked a few years. The distribution of ALTI is less dispersed than the distribution of LTI due to the fact that it averages variability in earnings and length of working career. As for the inequality measures the country ranking is preserved and our results are confirmed. We also checked if the results were robust to the sample selection, and removed any trimming in the relevant measures: although differences are more dramatic, due to the massive redistribution taking place in favor of low-LTI individuals, the differences across countries and between groups of the population are preserved.

[16]In our sample most Polish workers are still under the old DB rules, whereas the OECD assumes that Polish workers are covered by the steady state Notionally Define Contribution system, which entails no redistribution.

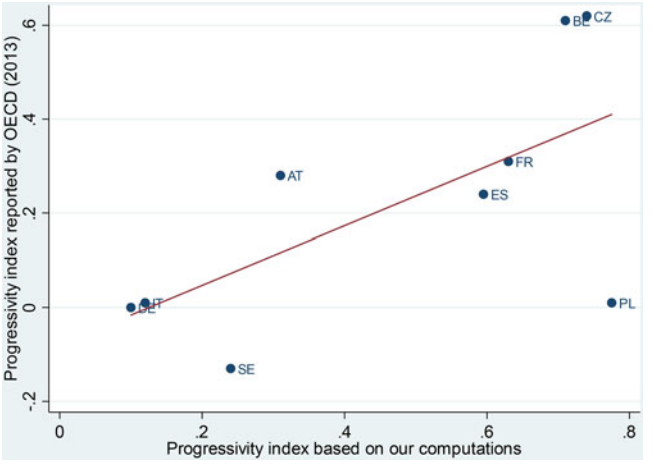

Figure 4. Country-level comparison between the progressivity index based on our computations and the progressivity index reported by OECD (2013).

the pension system of a given country protects individuals who are 'lifetime poor' vis-à-vis those who are 'lifetime rich'.

In order to provide a more accurate representation of inequality and to disentangle the 'pension rules' effect from the 'lifetime-earning distribution' effect at the individual level, we propose a new simple index of Relative SSW (RSSW) given by the ratio between SSW and LTI:

$$\text{RSSW} = \text{SSW}/\text{LTI}$$

Although the motivation is the same as for the progressivity index, we stress that in our analysis both measures are computed at the individual level, so that we obtain a measure of RSSW for everyone in the sample.

We argue that RSSW can be informative of the redistributive features of the pension systems since it shows to what extent the SSW of an individual compares with the cumulative labor income she earned during her whole working career, which is positively related to the amount of contributions paid to the social security administration. The higher is the SSW of a worker relatively to her LTI, the higher is the generosity of the pension system for this worker. The standardization of SSW with respect to LTI, both taken at the individual level, allows for a meaningful comparison of the 'pension generosity' between groups and across countries. However, one has to be cautious on the interpretation of the results as birth-cohorts and age affect SSW and LTI, i.e., both the numerator and denominator of RSSW. Our sample involves individuals from different birth-cohorts who might have been exposed to different pension regimes, which were often phased in according to age or year-of-birth of workers either by explicit design or simply because of the timing of maturity or vesting of benefits. Furthermore, individuals from different birth-cohorts might have faced different phases of the business cycle in different stages of their working careers producing cohort-differentials in their earnings age profiles. Since we are dealing with cross-sectional data we are limited in the ways we can disentangle birth-cohort from age effects, but we are aware of the fact that any in depth analysis of the determinants of RSSW should take them into account. Hence we carry out a regression analysis, which allows us to control for cohort dummies in order to filter out cohort/age effects.

More specifically, we want to assess the redistributive properties of pension systems along the lifetime-income distribution of individuals. Our exercise is designed to document how the generosity of the pension rules varies with individual lifetime earnings and whether these rules are successful in granting higher level of protection to workers who are 'lifetime poor', i.e., workers whose LTI appears in the left tail of the distribution. To do this, we predict the median RSSW at each LTI quintile by performing a set of median regressions separately by country, gender and employment status

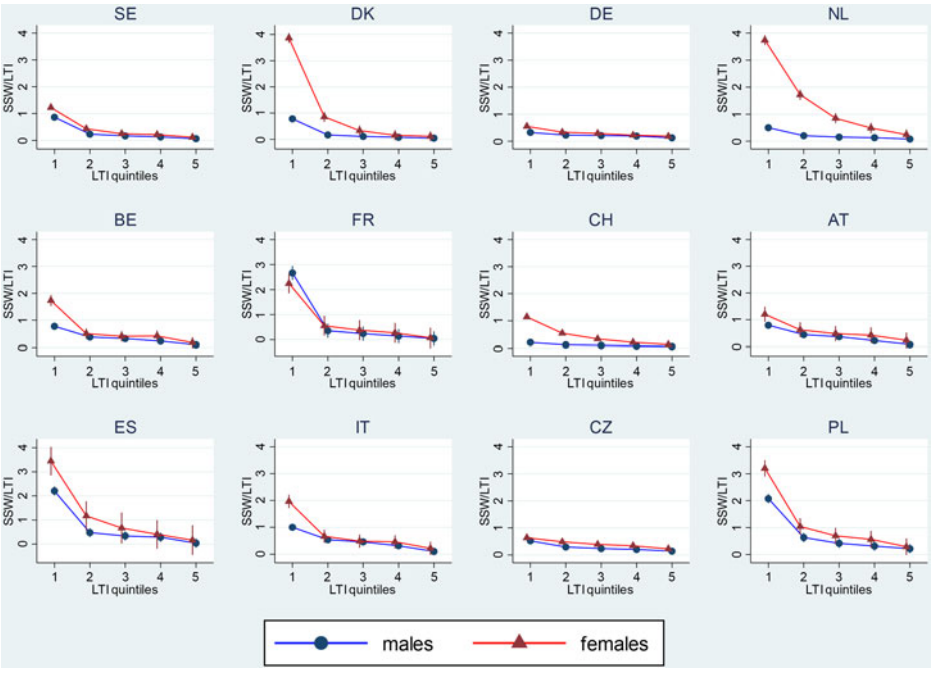

Figure 5. Fitted median and 95% confidence interval of the RSSW index by quintile of LTI, country and gender (retirees).
Note: Fitted medians and confidence intervals are based on median regressions estimated by country and gender and controlling for cohort dummies. LTI quintiles are country and gender-specific.

(retirees/workers). The set of right-hand-side variables crucially includes a full set of LTI quintile dummies (quintiles are country- and group-specific) and a full set of cohort dummies, as defined in Table 2, to control for cohort/age effects.

Figure 5 focuses on retirees and plots the fitted median and 95% confidence interval of RSSW (vertical axis) against quintiles of LTI by country and gender. The inspection of the graphs suggests the presence of three clusters of countries: a first set of countries includes Germany and Czech Republic, for which the fitted RSSW remains constant throughout the whole LTI range. A second cluster includes Denmark, the Netherlands, Switzerland, Spain and Poland exhibiting a declining trend along the whole LTI distribution. This suggests that the redistribution induced by their pension system is not entirely focused on the 'lifetime poor' individuals but it also affects individuals with medium (lifetime) income levels. The third cluster includes the remaining countries, such as Sweden, in which we observe a sizeable drop in RSSW between the first and the second LTI quintile, while for the rest RSSW remains overall stable.

Figure 6 replicates the analysis for workers. We were forced to exclude Austria due to the low number of observations (see Table 1). Looking at the same grouping as above: the first cluster includes only Germany, for which fitted RSSW again remains constant over the whole LTI distribution. This finding suggests that for the birth-cohorts included in this study, the expected SSW of German workers varies proportionally with their LTI so that the same inequality observed in lifetime earnings is to a large extent reflected in pensions. The second cluster of countries includes Denmark, the Netherlands, Switzerland and Poland. In these countries, we observe a marked decline in RSSW between the first and the second quintile of LTI, but we also notice that RSSW decreases steadily for the following quintiles. For example, for female Danish workers, there is a drop in the fitted RSSW from the fourth to the fifth quintile by 43% (i.e., the fitted RSSW drops from 0.07 to 0.04). The intent seems to provide uniform pensions across the population (Figure 2 reports a small interquartile range for Poland). The

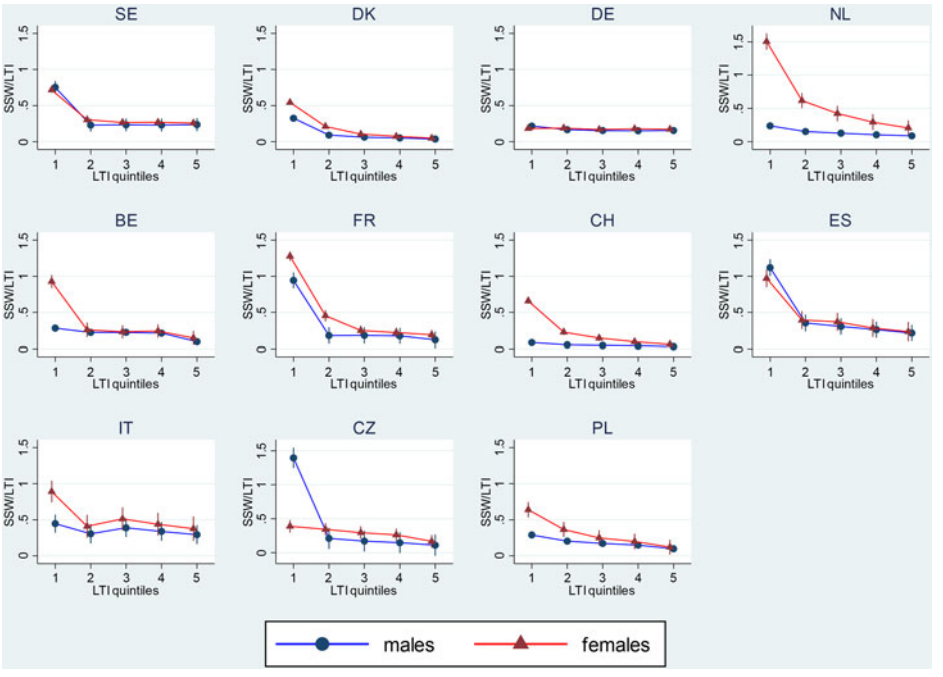

Figure 6. Fitted median and 95% confidence interval of the RSSW index by quintile of LTI, country and gender (workers).
Note: Fitted medians and confidence intervals are based on median regressions estimated by country and gender and controlling for cohort dummies. LTI quintiles are country and gender-specific.

third cluster includes the remaining countries where redistribution in SSW is concentrated in the left-tail of the LTI distribution, with some special cases. For example, the RSSW of Spanish workers exhibits a huge drop between the first and the second quintile (−68% for males) followed by a modest reduction at the higher quintiles (about −15% for each quintile 3 to 5). In the case of Sweden, redistribution only occurs in favor of very poor individuals of both genders in the first quintile, while the same holds in France only for females. Most of the redistribution in this cluster derives from the existence of generous minimum pensions coupled by a pension formula implying a low or very low degree of redistribution.

4. Social security wealth, financial wealth and real wealth

In the previous sections we focused our attention on inequalities in a SSW measure based on first-pillar pensions. However, this is a partial view of the resources available to individuals and households, as it neglects private wealth holdings. In this section, we attempt an estimate of the correlation between SSW and private household wealth. Forward-looking agents who expect lower levels of SSW might have stronger incentives to save and cumulate private wealth in order to guarantee adequate standards of living during their retirement years (see, e.g., Alessie *et al.*, 2013; Attanasio and Brugiavini, 2003). This is a relevant point for policy makers since the design of social security systems may result in a variety of household economic choices related to financial and real wealth investments, including participation in financial markets and home-ownership. Households endowed with higher levels of SSW might be less prone to participate in financial markets or to save in order to buy a house because they know that the wealth accrued in the social security system will be an effective safety net protecting their standard of living at older ages. In some countries, such as the UK, reductions in social security benefits are criticized on the grounds that such reductions will have a roughly one-for-one reduction in

Table 5. Quintiles of the household distributions of SSW, real assets and financial assets

	Household SSW					Household real assets					Household financial assets				
Country	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
SE	156.2	214.4	306.5	418.4	585.2	0.0	55.1	114.6	202.7	484.8	1.7	19.0	40.0	88.1	188.0
DK	82.9	156.0	161.7	197.7	308.4	0.0	52.7	105.5	175.9	351.9	0.2	10.0	31.0	70.3	177.0
DE	119.8	223.4	319.6	429.1	616.3	0.0	32.8	107.9	199.1	369.8	0.0	5.4	18.1	42.5	140.7
NL	157.1	183.2	232.1	331.8	402.2	0.0	59.8	137.0	221.8	392.0	0.5	6.8	21.9	46.1	130.4
BE	208.4	308.9	404.9	560.8	2,447.1	0.0	151.4	216.3	262.3	454.3	1.3	16.8	44.0	105.4	285.5
FR	156.2	239.3	324.9	442.2	753.4	0.0	144.0	219.3	306.0	515.7	0.0	6.7	23.3	62.2	180.9
CH	135.1	241.7	279.0	397.2	548.4	0.0	43.7	131.1	267.6	626.7	0.5	20.4	58.3	145.7	365.1
AT	201.2	294.5	404.5	537.4	712.8	0.0	27.9	72.7	158.3	315.4	0.0	2.2	7.4	20.3	55.3
ES	133.9	179.2	249.8	330.5	468.5	40.5	113.5	162.2	253.4	461.9	0.0	0.5	5.0	10.1	53.7
IT	152.4	255.8	347.2	454.0	688.0	6.0	110.0	177.0	309.7	531.0	0.0	2.6	8.8	22.1	58.6
CZ	141.7	195.6	258.9	347.4	414.5	0.0	50.6	101.3	155.3	270.2	0.0	2.0	6.4	14.4	36.4
PL	76.7	129.0	180.4	240.7	343.9	0.0	18.4	40.5	72.6	141.2	3.6	3.6	3.8	5.4	10.9

Note: Amounts are PPP-adjusted and expressed in thousands of 2010 euros.

retirement incomes. Understanding how SSW associates with private wealth accumulation can be of help to understand how individuals prepare to finance their consumption during retirement years. Some authors have discussed of an actual 'displacement effect' of SSW on private wealth holdings or on the saving rate (Feldstein, 1974; Dicks-Mireaux and King, 1984; Attanasio and Brugiavini, 2003; Blau *et al.*, 2006).

Whether SSW actually produces a displacement effect on financial and real wealth is an empirical issue that requires a comprehensive theoretical framework explicitly designed to model lifetime accumulation of private wealth, insurance contracts and old-age protection instruments. Such a complex model is beyond the scope of this paper, but even in this simplified framework we can exploit the detailed information provided by Wave 4 of SHARE about household financial and real wealth to provide descriptive evidence about the relationship between SSW and private wealth of older European individuals.

SHARE data contain household measures of net financial and real wealth. Net financial wealth is defined as the sum of money held by households in bank accounts, stocks, bonds, mutual funds and savings for long-term investments, net of financial liabilities. Net real wealth is the value of the main residence, of other real estates and of businesses, net of mortgages. Since financial and real wealth in SHARE are measured at the household level, their comparison with the SSW requires the latter to be defined at the household level as well. We construct a household level measure of SSW that is defined as the sum over household members of individual SSW. We denote this measure of Household SSW by HSSW. Note that in doing so we avoid double counting as our definition of SSW does not include survivors' benefits and spousal benefits. We can think of our estimate of HSSW as a lower bound for the effective SSW available to the households.

Table 5 reports the quintiles of the sample distribution of the household level measures of SSW, real assets and financial assets. Amounts are expressed in thousands of 2010 euros for all countries and PPP-adjusted to account for country level differences in the cost of living.[17] In order to assess the association between HSSW and the level of financial and real wealth, we introduce a measure of total 'augmented' household wealth as the sum of HSSW, financial wealth and real wealth measures. This definition allows us to compute the shares of private wealth and SSW in terms of the 'augmented' total wealth.

In Figure 7 we plot the country-level averages of the share of total household wealth held in financial wealth against the corresponding share of SSW. To the extent that the share of real wealth is not totally fixed, the association between these two components of wealth provides a *prima facie* suggestion of the likely underlying relationship. Although we cannot draw firm conclusions on the

[17]The sample selection operated in this part of the paper is the same as before: in particular we dropped singles older than 80 and couples where both couple members are older than 80.

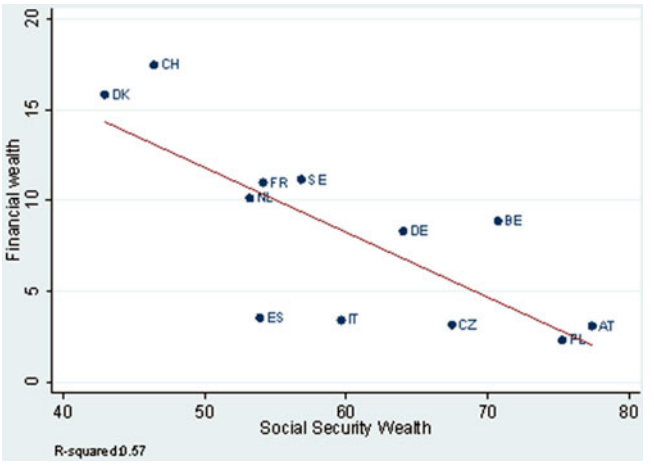

Figure 7. Country-level averages of the shares of total household wealth held in SSW and financial wealth.

'substitutability' between the two forms of wealth, a negative cross-country gradient emerges. The portfolio of Danish and Swiss households is characterized by low shares of HSSW and high shares of private financial wealth, at the other extreme, Austrian and Polish households seem to rely mostly on HSSW. The simple evidence presented in Figure 7 prompts for a deeper and more elaborate model of household's portfolio decision in terms of old-age insurance: the SHARE dataset lends itself to this type of further investigation because the researcher can control for many confounding factors which affect household level data also retrospectively and exploit the variability in different welfare systems in Europe.

5. Conclusions

In this paper we investigate the distribution of old-age resources for a large number of European countries by making use of the SHARE data. We present a novel estimate of SSW, which is computed at the individual level based on the third and the fourth waves of SHARE data. Our SSW measure focuses on the first pillar of pension systems and provides a discounted sum of the pension benefits received from the retirement age to the end of the life-cycle, weighted by country- and gender-specific survival probabilities, based on alternative specifications for retirees and workers. While SSW for retirees is the stock-equivalent measure of observed benefits, we calculated the pension benefits of current workers by combining the individual-level retrospective data provided by SHARE about their age-earnings profiles and contribution histories with information about the institutional details of the pension systems currently in place in their countries. Our SSW measure is an effective summary indicator of the resources that individuals could have access to in their old age through public pensions.

Building upon this new measure, we are able to look at traditional inequality indexes: some countries show low median values of SSW but also very little variability over the possible range of values taken by the SSW, in particular Denmark and the Netherlands. At the other extreme we observe countries, such as Italy and Austria, where the dispersion of SSW is much higher. Cross-country and within-country differences in SSW inequality might depend on different architectures of the pension systems as well as on heterogeneity in individual characteristics, in particular the amount of earnings collected during the working career. In order to control for individual heterogeneity due to differences in lifetime earnings, we exploit the information from SHARE to compute individuals' LTI (earnings). We then compute a *progressivity index* along the lines of the OECD Reports (2009, 2011 and 2013) that compares inequality levels in SSW and LTI in order to measure the degree of redistribution in SSW generated by the pension systems. Our exercise complements the traditional approach followed by OECD. While OECD computations are based on a 'steady-state' population and steady-state

pension rules, our SSW and LTI measures stem from real individual data, which present heterogeneity with respect to many dimensions relevant to the SSW computation, such as earning history, working career length and pension system rules. This heterogeneity provides us with valuable information to understand the actual levels of redistribution produced by pension systems.

A refinement of this is to 'anchor' our measure of SSW to the distribution of LTI. More precisely, we introduce an RSSW measure, defined as the ratio of SSW over LTI, in the attempt to shed light on the redistributive features of pension systems controlling for the labor income over whole working career. In fact, LTI is positively related to the average amount of yearly contributions paid to the social security administration and could enter directly and indirectly into the pension formula. The higher is the SSW of a worker relatively to her average LTI earned (and the contributions paid), the higher is the generosity of the pension system for this worker.

We present how the median RSSW ratio varies over the quintiles of average LTI. In Germany the RSSW ratio remains overall constant across LTI quintiles suggesting that the inequality found in lifetime earnings is maintained in SSW. In other countries, such as the Netherlands, Denmark, Switzerland and Poland we observe that the redistribution is in favor of the 'lifetime poorest' individuals, i.e., those in the first quintile of LTI distribution, is sizeable but it is still present at higher levels of LTI, while in Sweden the redistribution is strongly in favor of the lifetime poorest.

Finally, we provide descriptive evidence of a household-level analysis of the association between social security and private wealth. We show that in those countries where the first pension pillar is relevant, the share of financial wealth is lower. Although we cannot draw firm causality conclusions on the displacement effect of SSW on private wealth, the negative correlation suggests that households who feel more protected by the welfare state are expected to cumulate lower levels of private financial assets.

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Appendix

Table A1. Percentage of individuals receiving an old age first pillar pension who also receive an occupational pension benefit

	Male		Females	
Country	Retirees (%)	Workers (%)	Retirees (%)	Workers (%)
SE	73.42	3.23	74.33	2.92
DK	41.52	3.85	33.86	1.40
DE	33.51	1.23	16.93	0.00
NL	84.84	7.52	38.69	5.96
BE	4.57	2.00	3.27	1.59
FR	3.31	0.00	1.05	2.00
CH	69.83	5.77	32.50	3.13
AT	15.79	0.00	6.40	5.56
ES	3.44	0.00	2.30	0.00
IT	3.23	0.00	1.05	0.00
CZ	0.65	0.00	0.44	0.00
PL	0.00	0.00	0.00	0.00

Source: our computations on SHARE data; note: category 6 'Occupational survivor pension from your spouse or partner's job' has been excluded.

This table reports the proportion of individuals receiving an old age first pillar pension who also receive an occupational-pension benefit. Second-pillar provisions are prevalent in Sweden, the Netherlands, Denmark and Switzerland; results from SHARE on these percentages are in line with what reported by other sources, such as OECD (2016).

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