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New figures on unfunded public pension entitlements across Europe: Concept, results and applications

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DISKUSSIONSBEITRÄGE DISCUSSION PAPERS

New Figures on Unfunded Public
Pension Entitlements across Europe
– Concept, Results and Applications

Klaus Kaier
Christoph Müller

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New Figures on Unfunded Public Pension Entitlements across Europe – Concept, Results and Applications

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April 2013

Abstract

A major aim of the recent updates of National Accounting standards (SNA2008 and ESA2010) is to provide a more complete picture of households' wealth. In this course it will become mandatory for European countries to publish annual estimates of unfunded public pension entitlements (UPPE) from 2017 onwards. This study describes the methodological concepts behind this new figure of national accounts. After a review of past studies on the subject of UPPE we provide a large cross-country comparison for 18 EU countries of this new pension wealth figures and discuss a number of possible applications for policy makers and researchers. This includes the use to estimate the offset between UPPE and savings (Feldstein 1974). Finally, we show the distribution of households' wealth across Europe including financial wealth, dwellings and UPPE. Many prosperity differences between countries with Beveridgean and Bismarkian pension systems as well as between western and central eastern European countries are eliminated when considering these three wealth categories. In addition, a direct comparison of UPPE with replacement rates shows that these two proxies for the generosity of pension systems are completely uncorrelated at the cross-country level.

Key Words: Households' wealth, pension liabilities, pension entitlements, household saving

JEL-Classification: E21, H55, H63

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1 Introduction

Entitlement figures from private pension schemes can be already obtained from national accounts. These figures, however, reflect only a part of households' pension wealth. Especially in Europe the predominant part of pension benefits is derived from public, pay-as-you-go (PAYG) pension schemes. So far this large share of households' pension entitlements can, generally, not be derived from actual accounts. The aim of the recent updates of the of the System of National Accounts (SNA2008) and its European counterpart, the European System of National and Regional Accounts (ESA2010), is to bridge this gap by providing figures on unfunded public pension entitlements.¹ In this course it will become mandatory for European countries to publish annual estimates of unfunded pension rights from 2017 onwards. From the households' viewpoint this new figure can be interpreted as an asset or entitlement, namely an unfunded public pension entitlement (UPPE). From the government perspective this figure represents an obligation or liability, more precisely an accrued-to-date liability (ADL).

The present article provides a detailed analysis of the methodological concepts behind these new figures of national accounts (Chapter 2). Furthermore, it reviews past studies on unfunded public pension entitlements (Chapter 3) and provides the largest cross-country comparison of unfunded public pension wealth for the EU so far (Chapter 4). On this basis the main determining factors for the observed heterogeneity of pension entitlements across Europe are presented and scrutinized in a sensitivity analysis (Chapter 5). Finally, a number of possible applications of these new figures of national accounts are discussed in Chapter 6. This includes the possible use of these figures to estimate the offset between unfunded pension entitlements and savings rates (Feldstein, 1974). In addition, some insights into the distribution of households' wealth across European countries are provided. Contrary to past international wealth estimates by Davies et al. (2011) and the ECB - European Central Bank (2013), we take into account not only financial- and non-financial assets (dwellings) but also unfunded pension wealth. We can show that many prosperity differences between countries with Beveridgean and Bismarkian pension systems as well as between western and central eastern European countries are eliminated when considering all three of these households' assets. In addition, we show that there are substantial differences between the replacement

¹ See Müller (2012).

rates and our ADL variable. Finally, two annexes provide some more technical details on the methodology of determining unfunded public pension liabilities and give a first insight into the new supplementary table on pension schemes to be introduced in European national accounts from 2017 onwards.

2 Concepts of measuring implicit pension liabilities

From the households' perspective unfunded pension entitlements (UPPE) can be regarded as an asset – so far, generally, not included in wealth estimates. From the government perspective these entitlements translate into a liability often referred to as an implicit pension debt (IPD). For further analysis it should be made clear what kind of liability is referred to, and to which degree entitlements from private households are included. In the literature, three main definitions of pension liabilities are well-established:²

Accrued-to-date liabilities (ADL)³: these contain the actual pension payments and the present value of pensions to be paid in the future on the basis of accrued rights; no rights can be accrued after the base year – neither by present nor by future workers.

Current workers and pensioners' liabilities (CWL): in this case allowance is made for the pension scheme to continue its existence until the last contributor of today dies, while no new entrants are allowed. With this concept, not only ADL is covered but also the present value of pension entitlements that will be accrued by current contributors due to their future contributions.

Open-system liabilities (OSL): these also include the present value of pensions of new workers entering the respective pension scheme. In other words, it is assumed that the pension scheme will be continued for a relatively long time horizon; the range of options extends from including only children not yet in the labour force, to an infinite perspective.

² See Franco (1995), Holzmann et al. (2004)

³ The terms UPPE and ADL are used synonymously in this study.

Table 1: Definitions of Pension Liabilities

Liabilities		Definition of Liabilities
1)	Accrued-to-date liabilities (ADL)	Present value of future pensions accrued by current retirees; + Present value of future pensions accrued by current workers due to past contributions
2)	Projected current workers' and retirees' liabilities (CWL)	1) + Present value of future pensions due to future contributions of current workers
3)	Open system liabilities (OSL)	1) + 2) + Present value of pensions due to contributions of future (worker's) generations

Source: own illustration based on Holzmann et al. (2004).

Table 1 demonstrates that the difference between the three main definitions of pension liabilities reflects alternative views on how future pension benefits should be considered. For instance, looking at the concept of open system liabilities, current pensioners and workers as well as future workers (and thus all future retirees) are taken into consideration. In contrast, accrued-to-date liabilities regard only rights accrued by existing and former workers until the base year.

In this study we focus on gross liability concepts. In other words, liabilities are not confronted by any kind of revenues or existing assets.⁴ Additionally, we concentrate on the concept and estimation of ADL. For this liability type two different estimation approaches have been chosen in the past literature: the *projected benefit obligations approach (PBO)* and the *accumulated benefit obligations approach (ABO)*. The crucial difference between these two methods concerns the treatment of future wage increases. Under the PBO treatment, (expected) future pay increases – whether determined by promotions and/or general wage growth – are taken fully into account. Pension rights accrued by current contributors are increased in line with these expected pay increases. The ABO method, on the contrary, considers only the present value of benefits earned up to date, based on the past earnings history.

There are clearly advantages and disadvantages of each approach. Generally, it is outlined that the probability of a termination of the respective pension plan assessed (before the end

⁴ For an extension and estimation of net-liabilities of public pension schemes see e.g. Chand and Jaeger (1996) or Müller et al. (2010).

of the worker's career) should determine which method to apply. If the respective pension scheme will exist until the end of the worker's career, his or her future wage growth should be taken into account applying the PBO method. Therefore, especially in the case of pension plans for government employees this approach is often recommended since the probability that the employer will dismiss the employee in mid-career is quite low.⁵ Given this background, the International Public Sector Accounting Standards (IPSAS25) opted for the PBO approach to measure obligations of DB plans.⁶ Also most business accounting rules, namely the International Accounting Standards (ISA 19), require a PBO procedure. For the case of social security pension schemes the PBO method seems appropriate, too, since an early termination of these schemes is normally not expected.

3 Previous implicit pension liability estimations for European countries

First estimates of ADL of unfunded public pension schemes on an international level have been provided by Van den Noord and Herd (1993), Chand and Jaeger (1996) followed by Kuné (2000). The latest international estimates were presented by Holzmann et al. (2004) who examined public pension systems of 35 low and middle income countries.

Our estimates of unfunded public pension entitlements cover ten old EU member states (such as DE, FR, IT) as well as eight new member states (inter alia PL, HU, CZ). With these 18 EU member states our survey represents the most comprehensive European cross-country survey of ADL estimates so far.⁷

In all past cross country studies the size of ADL is substantial. The implicit pension debt ranged from 55 to 357 percent of GDP in EU and G7 countries (see Table 2). The average of ADL reached a level between 100 and 200 percent of GDP in studies carried out in the 1990s. The most recent survey by Holzmann et al. (2004) recorded higher average ADL of 224 percent of GDP. In our cross-country comparison implicit pension debt amounted to an average of 263 % of GDP. Generally, one may conclude that the value of ADL is significantly higher than the recorded public debt.

⁵ See e.g. Reinsdorf (2010), p. 190 et seq.

⁶ In fact, the IPSAS25 require an entity to use the Projected Unit Credit Method which is equivalent to the PBO approach.

⁷ These estimates are based on a large cross-country benchmark calculation carried out by Müller et al. (2009).

Table 2: ADL results of previous and own estimates

EU and G7 countries assessed	Van den Noord and Herd (1993) - PBO	Chand and Jaeger (1996) - PBO	Kune (2000) - ABO	Holzmann et al. (2004) PBO	Own estimates - PBO	Standard deviation (between)
Austria					360	-
Belgium			75			-
Denmark			87			-
Germany	157 ^a	221	138		330	96
Finland					301	-
Greece			185		231	32
Spain			93		204	79
France	216	265	83		362	116
Ireland			55			-
Italy	242	357	157		323	89
Sweden		131			284	109
Luxembourg			156			-
Netherlands			103		236	94
Portugal			93		299	146
UK	156	117	68			44
USA	113	108				4
Japan	162	166				3
Canada	121	94				19
Slovenia				298		-
Romania				256		-
Poland				261	361	71
Portugal			93	233	298	105
Malta				234		-
Bulgaria					202	-
Czech Republic					201	-
Latvia					125	-
Slovakia				210	211	1
Hungary				203	257	38
Croatia				201		-
Estonia				189		-
Lithuania				155	180	18
Average	167	182	107	224	263	
Standard deviation (within)	47	92	40	41	71	

a These estimates cover only Western Germany.

Source: own illustration.

Which factors explain the difference to previous studies

Remarkable is the high variation within the studies but also between the surveys for a given country (see Table 2). The latter, the standard deviation between the surveys can be mainly explained by three factors: 1) the concept chosen (PBO or ABO), 2) the assumptions and 3) the coverage of pension types considered.

All studies except for Kune (2000) consider a future increase of earnings for the projection of accrued pension rights and apply the PBO approach.⁸ The outcomes of Kune (2000) are therefore lower than the other cross-country comparisons of ADL. The impact of the earnings growth on the pension indexation is, however, not always accounted for in the ADL estimations. Van den Noord and Herd (1993) apply a price indexation for all countries, while Holzmann et al. (2004) adjust benefits with the increase of wages in all surveyed states. The latter approach leads, generally, to higher results. Chand and Jaeger (1996), on the contrary, take into account the actual, different indexation regimes applied in each country. We outline further below in the sensitivity analysis that the choice of the pension indexation has a significant impact on the overall level of ADL. Our estimates are also based on the PBO approach and we follow the country specific indexation rules.

A key assumption for the valuation of future pension rights represents the discount rate. It determines significantly the level of ADL (see sensitivity analysis in section 5). Relatively similar values of the discount rate have been chosen in past cross-country studies. Chand and Jaeger (1996) apply a discount rate of 3.5 % in real terms, Van den Noord and Herd (1993) use a starting value of 4 % which decreases gradually to 3 percent in the period of 2010-2050. Holzmann et al. (2004) and Kuné (2000) use a discount rate of 4 percent. We apply a discount rate of 3 percent in real terms over the entire projection horizon.

Also the choice of the general wage growth rate is relatively akin in previous studies, except for Kuné (2000) who applies a wage growth rate of zero, in line with the ABO approach (see Table 3). Our cross country estimates are based on a homogeneous wage growth rate of 1.5 percent in real terms. Finally, the impact of these economic assumptions is determined by the differential between the applied wage growth rate and discount rate. This value is slightly lower in our cross-country study which may partly explain our relatively higher ADL results (see Table 2).

⁸ In fact, Kuné (2000) shows in addition to the ABO outcomes also a PBO scenario. His definition of PBO, however, corresponds to the Current Workers' Liability Concept and is therefore not comparable to the other studies. See Kuné (2000), p. 43.

Table 3: Applied assumptions and pension coverage

Studies /Assumptions and Coverage	Applied discount rate	Applied wage growth rate	Survivors' pensions covered	Disability pensions covered	Civil servants pensions covered	Means-tested benefits
Van den Noord and Herd (1993)	4% ^a	2% ^b	-	-	-	√
Kuné (2000)	4%	0%	√	-	√	-
Chand and Jaeger (1996)	3.5%	1.5%	√	√	-	-
Holzmann et al. (2004)	4% ^c	2%	√	√	-	-
Own estimates	3%	1.5%	√	√	√	-

^a The discount rate falls to 3% in the period 2010 to 2050. ^b Only for the US real earnings growth adds up to 1 %. ^c Additionally, they provide outcomes for a discount rate of 2 and 5 %.

Source: own illustration.

The scope of pension benefits and schemes covered, leads to differences of ADL estimates, too. While Van den Noord and Herd (1993) take into account means-tested pension benefits, this is not the case for the other cross-country studies. It is indeed questionable whether one should include these benefits in the calculation of pension entitlements as they are paid out irrespective of any contribution having been made. Also survivors' and disability benefits are not always considered in past surveys. Their coverage may, however, determine considerably the level of ADL as they account for a substantial proportion of public pension expenditures (see section 4). The same counts for civil servants pension schemes which represent up to 40 percent of total expenditures in some countries (see section 4). These special employee pension schemes are only considered by Kuné (2000). In terms of the level of ADL, one may therefore conclude that the past cross country studies may have underestimated unfunded public pension liabilities as they neglect a number of sizeable public pension benefits and schemes. Our study covers not only survivors' and disability benefits but also civil servants pension schemes of European countries. In this respect our estimations are unique as no former study – neither the Organisation for Economic Cooperation and Development - OECD (2011) nor the European Commission (2012)– has so far covered these sizeable special employee pension schemes in their long-term projections.

Additionally, the base year choice may determine the level of ADL. It varies in past studies from the year 1990 Van den Noord and Herd (1993) to 2001 Holzmann et al. (2004). This aspect may lead to different results due to two reasons. First, the legal framework between base years may vary. Newly enacted reforms may lead to, generally, lower pension entitlements (see also section 5). Second, the analysed pension schemes may have matured

which usually leads to higher pension entitlements over time. The impact of the base year choice is, however, generally, not as decisive as the three main factors outlined above.

Most studies apply relatively simplified approaches and apply e.g. one homogenous retirement age for all countries,⁹ or estimate survivors' pension entitlements in a rather simplified manner.¹⁰ These methodological specifications are discussed in the annex which outlines in detail our estimation approach of ADL.

In conclusion, past estimates of ADL are substantial and often add up to multiple of the respective GDP. A comparison of estimates between surveys is, however, barely possible as the applied concepts, assumptions and pension schemes considered vary greatly. In order to compare national estimates we therefore follow Holzmann et al. (2004) and underline the importance of harmonized approaches for the estimation of ADL. This aim is followed with the recently published Eurostat guide Eurostat (2012) which provides clear directions for the calculation of ADL in Europe. Our ADL estimates for 18 EU countries presented in greater detail the following section are based largely on these harmonized Eurostat guidelines.

4 Results

Which factors explain the heterogeneity across Europe?

Which factors may determine the variation of ADL estimates within a cross country study? This question shall be addressed in the following paragraphs. We discuss differences of unfunded public pension entitlements for 18 EU member states.

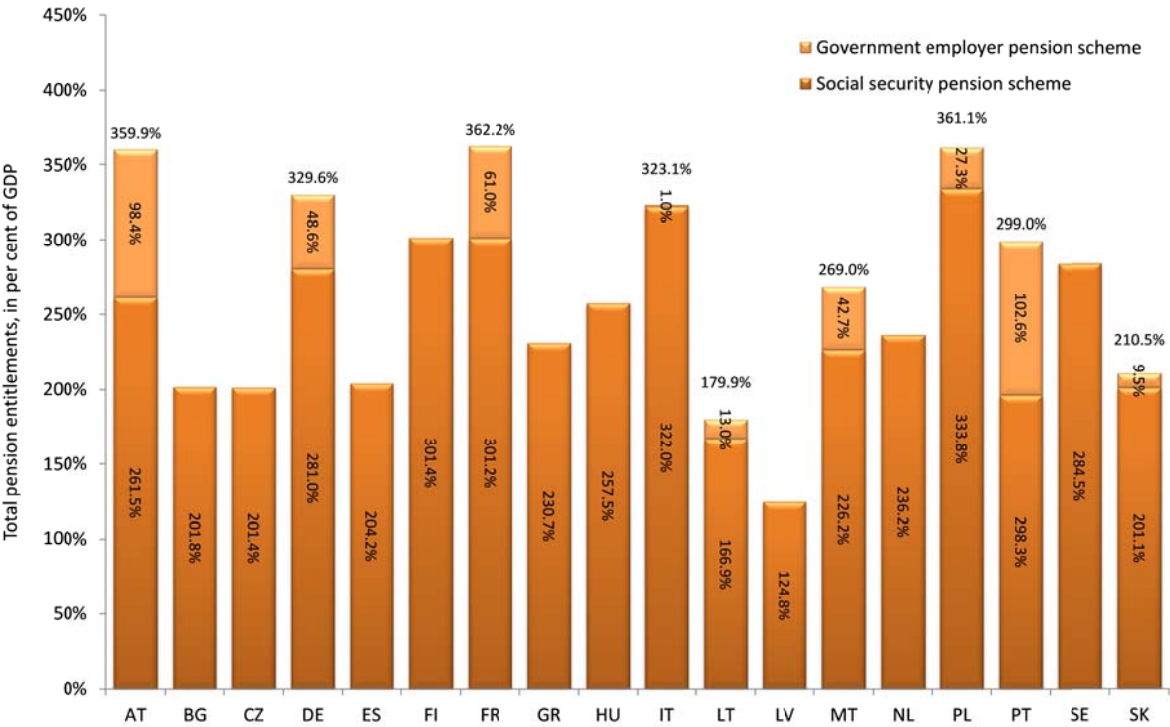
Our estimates of ADL covers ten old member states (such as DE, FR, IT) as well as eight new member states (inter alia PL, HU, CZ). For the estimation of these entitlements all pension reforms adopted until the end of the base year are taken into account. The results are shown in Figure 1 which subdivides the country specific level of ADL into social security and government employee pension schemes, if existent and applicable¹¹.

⁹ See Kuné (2000), Van den Noord and Herd (1993).

¹⁰ See Holzmann et al. (2004).

¹¹ Some countries, namely the Netherlands, Finland, Greece and the Czech Republic, have a separate government employee pension schemes which is not covered in Figure 1. The Dutch government employee pension schemes are funded and therefore not recorded in Figure 1. For Finland and the Czech Republic government employee pension schemes have been recorded as social security expenditures. No separate data was available for Greece.

Figure 1: Cross-country comparison of pension entitlements 2006 (in per cent of GDP)



Source: own calculations.

As shown above, the largest pension entitlements in per cent of GDP can be found in France (362.2), Poland (361.1) and Austria (359.9), followed by Germany (329.6) and Italy (323.1). It might be a coincidence that all these countries possess a special pension scheme for civil servants but even without these schemes they are among the highest figures observed. Most of the other countries show pension liabilities in the range of 200 to about 300 per cent of GDP. The lowest liabilities have been calculated for Lithuania (179.9) and Latvia (124.8). Similar to previous estimates, the magnitude of unfunded public pension entitlements is rather heterogeneous across our EU country sample ranging from 362.2 to 124.8 per cent of GDP.

Determining factors – Initial pension expenditures

We divide the determining factors for the heterogeneity of ADL results into two parts. First we discuss the initial level of pension expenditures (here in the year 2006). These benefits reflect the pension rights which have been accrued by existing pensioners of the base year. They represent the starting point of any entitlement projection. Thereafter we discuss factors which determine the future flow of pension expenditures accrued-to-date. This

includes the demographic development, pension indexation rules and pension reforms. As a Initial pension expenditures represent a main determining factor for the level of ADL for two reasons. First, these pension benefits reflect entitlements after a full contribution history and are therefore substantial compared to benefits accrued-to-date by current contributors. Second, these benefits of already existent retirees are paid out in the closer future and are therefore less discounted in the entitlement calculation than accrued benefits of current contributors.

Austria (12.9), Italy (12.4), France (12.1), Germany (12.0) and Poland (12.0) show the highest expenditures in 2006, amounting to twelve per cent of GDP and above (see Table 4). The majority of countries surveyed feature pension expenditures in the range of about seven to ten per cent of GDP. Rather low expenditures can be observed in the two Baltic countries Lithuania (6.5) and Latvia (5.9) as well as in the Netherlands (6.3). Interesting is that the cross-country ranking of initial pension expenditures follows closely the ranking of pension entitlements in the observed states. The five countries with the highest expenditures also dispose the highest pension entitlements. As initial pension expenditures seem to have a large impact on pension entitlements a closer look shall be taken at the driving factors of these pension expenditures (see Table 4 below).

Table 4: Initial expenditures – determined by generosity and demographic composition

Countries	Total pension expenditures 2006 in per cent of GDP ¹	Old age dependency ratio (60+/20-59) ²	Effective labour exit age ³	Gross replacement rate (statutory old age pensions) ⁴	Expenditures for government employees (+farmers) in per cent of GDP ⁵	Expenditures for disability/survivors' pension schemes in per cent of GDP
AT	12.8	38.9	61.0	68.0	3.5	1.5 / 1.1
BG	7.9	40.4	64.1	41.8	0.0	0.9 / 0.3
CZ	8.5	34.0	60.4	60.7	0.0	1.4 / 0.7
DE	12.0	45.1	61.9	43.0	2 (+0.1)	- / 2.1
ES	7.5	36.9	62.0	90.5	0.0	0.9 / 1.6
FI	8.5	39.4	62.4	63.8	0.0	1.6 / 0.8
FR	12.1	38.5	58.9	66.2	2.1	- / 1.5
GR	8.6	41.4	61.1	105.0	-	-
HU	9.7	37.3	59.8	63.5	0.0	2.6 / 0.6
IT	12.4	44.9	59.9	80.2	0.1	0.2 / 0.4
LT	6.5	36.9	59.9	41.0	0.5	1.4 / 0.3
LV	5.9	39.7	62.7	60.8	0.0	0.6 / 0.2
MT	8.7	34.6	58.5	65.3	1.5	0.8 / 1.7
NL	6.3	34.5	62.1	29.6	0.0	1.6 / 0.3
PL	12.0	29.1	59.5	63.2	0.9 (+1.3)	1.7 / 1.7
PT	10.6	39.8	63.1	74.8	4.4	0.7 / 0.9
SE	9.4	45.0	63.9	50.0	0.0	1.9 / 0.6
SK	7.2	27.0	59.2	49.4	0.3	0.8 / 0.8
Average	9.3	38.0	61.1	62.0	-	-
Standard Deviation	2.3	5.0	1.7	18.5	-	-

¹ Own illustration based on data provided by national central banks and statistical institutes. These expenditures cover all public unfunded pensions except for social assistance benefits - which are paid irrespective of any contribution having been made - are excluded (if possible) as they are not regarded as entitlements.

² Own calculation based on Eurostat data.

³ Eurostat data. For HU, PL, PT and SK level of 2005 have been taken.

⁴ Own illustration based on European Commission (2009).

⁵ In CZ and FI government employee pensions are categorized as social security pensions. Therefore they are not covered here. Government employee pension schemes in the Netherlands are funded. For Greece a further differentiation of pension schemes and benefit types was not possible.

First, the demographic composition, i.e. the number of retirees, affects the countries level of pension expenditures. Here Germany, Italy and Sweden feature the oldest populations with an old age dependency ratio of 45 – defined as the number of elderly people (aged 60 years and older) per hundred people of the working age population (aged 20-59 years). New EU member states, on the contrary, are still relatively young which inter alia explains the relatively low pension expenditures, generally, observed in these countries. Of course, the old age dependency ratio only provides a first hint of the number of pensioners. The definition of “being old” varies – though not extensively – in Europe (see Table 4). While the average age to leave the labour market amounts to 61.1 years in our sample, significantly lower values can be observed in countries such as France (58.9 years) or Slovakia (59.2 years). This gives one explanation why France though showing an average old age dependency ratio still features relatively high pension expenditures.

Additionally, the generosity of a pension scheme plays an important role for the level of pension expenditures and analogously the level of ADL. It may be summarized by the

indicator of the gross replacement rate which reflects the ratio of an average new pension benefit in the base year (here 2006) to average earnings in the previous year (here 2005). For our country sample this ratio amounts on average to 62 per cent (see Table 4). Interesting is the relatively high standard deviation (18.5 per cent) of gross replacement rates across Europe. Rather high values can be observed Greece (100.5 per cent) and Spain (90.5 per cent) while the pension schemes in the Netherlands (29.6 per cent) and Germany (43 per cent) only provide relatively modest replacement rates. However, it should be noted that the replacement rates shown in Table 4 only cover old age pensions of statutory pension schemes.¹² A number of other pension schemes are not covered by this indicator, namely: 1) government employees and farmers pensions schemes – which usually are relatively generous – as well as 2) disability and 3) survivors' pensions.¹³ It may be therefore, not a coincidence that the five countries with the highest pension expenditures all possess a special pension schemes for civil servants since these schemes tend to be more generous than the national pension schemes (Palacios and Whitehouse, 2006).

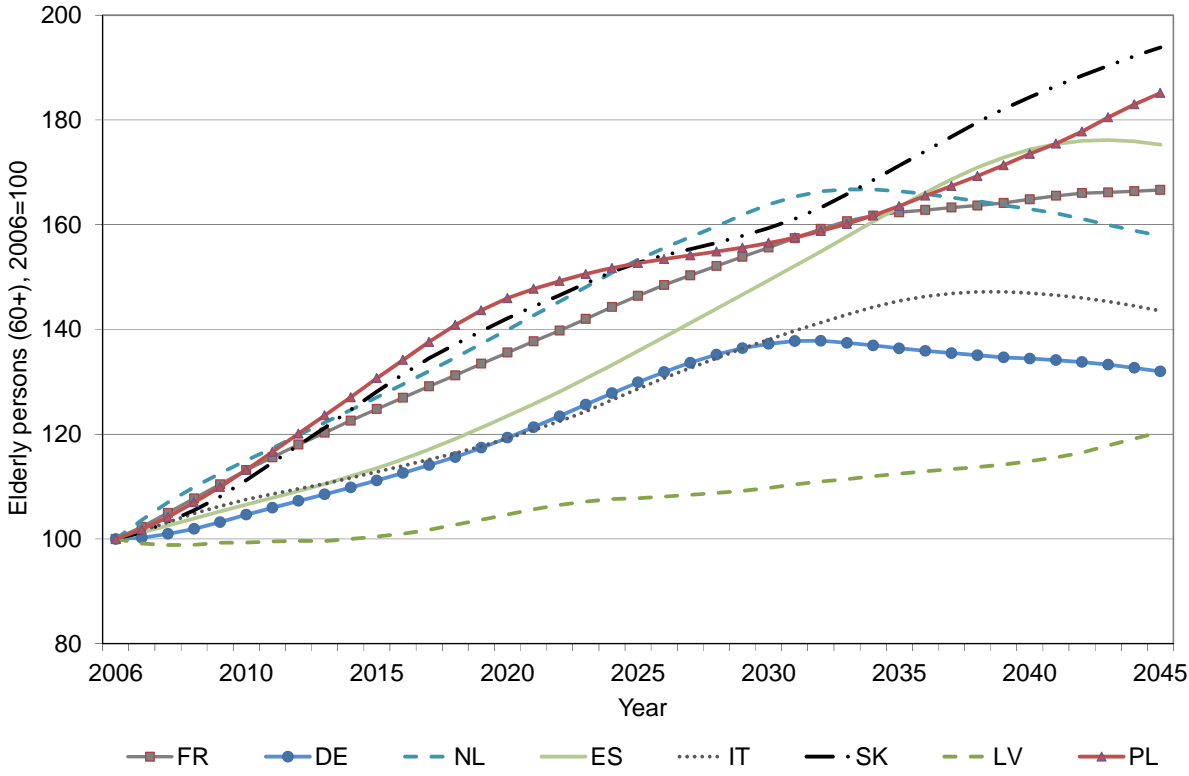
Future number of retirees

However, the level of pension expenditures in the base year represents only a starting point for the estimation of aggregated pension rights. The total of pension entitlements comprises all future pension benefits (paid out after the base year) which have been accrued-to-date. These future benefits are mainly driven by the development of retirees in the coming decades. Figure 2 approximates this trend showing the development of elderly persons (defined as persons aged 60 or older) until 2045. It can be discovered at first sight that in all observed countries the number of elderly persons (60+) is expected to rise considerably until 2045.

¹² Furthermore, the informational value of the replacement rate is limited as it outlines the relative pension level only for the group of new pensioners in the base year. All other retirees are not covered – their replacement rate may vary considerably from new pensioners.

¹³ In some countries such as Austria and Poland these other non-old age pension schemes represent almost half of the overall pension expenditures. Consequently, the indicator of the gross replacement rate provided by the European Commission – covering only old age pensions of the statutory pension scheme – may be less representative for the overall generosity of public pensions in these countries.

Figure 2: Cross-country comparison of the development of elderly persons (60+) 2006 to 2045 (2006 = 100)



Source: own estimation based on Eurostat data and assumptions.

For the estimation of total pension entitlements, the development of the age group 60+ in the first years after 2006 is more significant than in later years. One reason is that new pensioners entering into retirement shortly after 2006, generally, had the chance to earn a larger amount of pension rights until 2006 than younger cohorts retiring later. Furthermore, pensions of retirees in the close future are less discounted – as we apply a present value calculation. The largest increase in the closer future until 2025 is assumed to take place in Poland, Slovakia as well as the Netherlands and France – which can be mainly explained by baby boomer generations entering into retirement. Developments on a rather low level can be observed in Hungary, Bulgaria, Lithuania and especially Latvia. This trend may additionally explain why Poland and France show the highest pension entitlements while Latvia ranks last in our cross-country comparison.

Another determining factor for the amount of pension entitlements represents the future development of benefit levels. Confronted not only by the above outlined increase of future retirees (see Figure 2) but also by a significant decline of future contributors most European countries legislated comprehensive pension reforms in recent years. Though the reform

paths differ across the EU, most countries adopted one or a bundle of the following instruments: 1) increase of retirement age, 2) change of benefit formula, 3) introduction of demographic factors or NDC systems and 4) change of the pension indexation (see Table 5 below). As we estimate pension entitlements for the base year 2006 only reforms legislated until the end of 2006 are taken into account in Table 5.

Table 5: An overview on pension reforms adopted until end of 2006¹ – different recipes in Europe

Countries	Retirement age	Benefit Formula	Demographic Factors/NDC systems	Pension indexation	Reform impact ²
AT	√	√	√	√	Profound
BG	√	√			Moderate
CZ	√				Moderate
DE		√	√		Profound
ES					None
FI		√	√	√	Profound
FR		√		√	Profound
GR					None ³
HU	√	√			Moderate
IT			√		Profound
LT	√	√			Moderate
LV			√		Profound
MT	√	√			Profound
NL					None
PL	√		√		Profound
PT	√	√	√	√	Profound
SE			√		Profound
SK	√	√		√	Moderate

¹ For a further detailed description of the reforms see Müller et al. (2009).

² A numeric calculation of the reform impact on the level of pension entitlements is not feasible for most countries as the reform effects are partially already covered by base year pension data. Furthermore, the timing of reforms and the groups affected by these measures vary greatly between countries.

³ Only minor modifications of the pension system in Greece have been adopted until our base year 2006. They have no impact on our results.

The impact of these reforms on the level of pension entitlements varies from country to country. One reason for this difference represents the timing of future benefit changes. Some countries (e.g. Bulgaria) opted for a rapid increase of the legal retirement age (by 5 years in the period 2000-2009) while others (e.g. Austria) chose a slower pace (5 years in the period 2003-2033). Moreover, the extent of the chosen instruments varies. While some states (e.g. Malta) changed the reference earnings of the benefit formula significantly (from best three to best 40 life time earnings) others countries only adopted smaller modifications (e.g. France from best 10 to best 25 years).

Reasonable seems, that the most profound cuts of future benefit levels can be found in countries with the highest fiscal pressure (AT, DE, FR, IT and PL), i.e. with the highest pension expenditures in the base year. Moreover, in countries which introduced notional defined

contribution (NDC) systems (LV, SE, IT and PL) the future replacement rates will shrink considerably.

Changes of indexation rules affect future benefit levels and analogously accrued current pension rights, too. Most EU countries shifted from a wage to a price or a mix indexation in recent years (FR, AT). As the retirement indexation effect accumulates over the entire retirement span, it is quite decisive for the level of pension entitlements – see sensitivity analysis in chapter 5.

Table 6: Indexation regimes

AT	BG	CZ	DE	ES	FI	FR	GR	HU	IT	LT	LV	MT	NL	PL	PT	SE	SK
Price	Mix	Mix	Wage	Price	Mix	Price	Price	Mix	Price ^c	Mix ^a	Mix	Mix	Wage	Mix	Price ^b	Price ^d	Mix

indexation depending on the GDP growth and pension level. ^cThe indexation generally follows a price indexation depending pension level. ^dThe system follows in principle a price indexation. For more details see Müller et al. (2009), p. 147.

Source: own illustration.

After examining the development of elderly age groups as well as the impact of reforms and the pension indexation, the initial level still seems to be the most important determining factor regarding the level of pension liabilities of a certain country. Table 7 summarizes our findings and gives an overview of the main determining factors detected.

Table 7: Main determining factors of pension liabilities

	Initial level of pension expenditures in % of GDP ¹	Development of elderly persons (60+) ²	Pension Indexation ³	Recent pension reforms: <i>Profound</i> (*), <i>Moderate</i> (**), <i>None</i> (***) ⁴	Ranking of pension liabilities
AT (Austria)	•••	•••	•	•	3
BG (Bulgaria)	••	•	••	••	15
CZ (Czech Republic)	••	••	••	•	16
DE (Germany)	•••	••	•••	••	4
ES (Spain)	••	••	•	•••	14
FI (Finland)	•••	•••	••	••	6
FR (France)	•••	•••	•	••	1
GR (Greece)	••	••	•	••	12
HU (Hungary)	••	•	••	••	10
IT (Italy)	•••	••	•	•	5
LT (Lithuania)	•	•	••	••	17
LV (Latvia)	•	•	••	•	18
MT (Malta)	••	•••	•••	•	9
NL (Netherlands)	•	•••	•••	•••	11
PL (Poland)	•••	•••	••	•	2
PT (Portugal)	•••	••	•	••	7
SE (Sweden)	••	••	•	•	8
SK (Slovakia)	••	•••	••	••	13

¹ Pension expenditures: • = up to 7 percent of GDP, •• = 7-10 percent of GDP, ••• = above 10 percent of GDP

² Increase of elderly persons (60+) from 2006 until 2025: • = less than 20 %, •• = between 20 and 40 %, ••• = more than 40 %

³ Indexation regime: • = price indexation, •• = mixed indexation, ••• = wage indexation

⁴ Own evaluation based on Table 5.

Source: own illustration.

Three points (•••) indicate that the respective factor will considerably increase pension liabilities. One point (•) on the contrary implies the opposite and two points (••) a degree in between. This approach shall be illustrated by an example: Finland shows relatively high (•••) initial pension expenditures as well as a relatively high (•••) increase in the development of elderly people. Furthermore, the Finish mixed indexation of pensions can be regarded as relatively average (••) and it has introduced modest pension reforms (••) in recent years. Overall, Finland features the 6th highest pension liabilities in terms of GDP. Hence, it can be stated that the fewer points a country shows in total, the smaller are its pension liabilities in terms of GDP. However, it should be underlined that the initial level of pensions apparently is the main determining factor for the level of pension liabilities.

5 Sensitivity analysis

To understand the outcomes of the model it is essential to grasp the channels which lead to the respective results. In this context it is of interest how the outcomes change if one varies the assumptions taken. Sensitivity analyses which assess the robustness of a model are useful tools for this purpose. The following section provides a case study of the various factors determining the level of ADL for the example of Portugal. Table 8 illustrates the respective sensitivity analysis of the discount and wage growth rate. Looking at these results it becomes obvious that small alterations of the assumed interest rate (r) change the outcomes considerably. A deviation from the interest rate of the standard scenario from three to two per cent leads e.g. to an increase of entitlements by 19 per cent. Also the level of the growth rate (g) has a sensitive impact on the results – as shown in Table 8. Therefore, the absolute levels of pension entitlements should be taken with cautiousness. Furthermore, this exercise shows that it is essential to apply harmonized assumptions on the wage growth and the discount rate. Only on this basis one may compare estimates of pension entitlements across countries.

Table 8: Sensitivity analysis of the discount and growth rate

Relative deviation of Portuguese ADL to the standard scenario

		discount rate						
		0	1	2	3	4	5	6
w a g e g r o w t h r a t e	0	57%	28%	7%	-8%	-21%	-30%	-38%
	0,5	64%	33%	11%	-6%	-19%	-29%	-37%
	1	71%	38%	15%	-3%	-17%	-27%	-35%
	1,5	79%	44%	19%	0%	-14%	-25%	-34%
	2	102%	60%	31%	9%	-7%	-20%	-30%
	2,5	113%	68%	36%	13%	-5%	-18%	-28%
	3	125%	76%	42%	17%	-1%	-15%	-26%
	3,5	153%	96%	56%	27%	6%	-9%	-22%
	4	172%	109%	65%	34%	11%	-6%	-19%

Source: own calculations.

Assumptions on the future mortality represent a further factor which affects the level of ADL as they determine the future payout phase of pension benefits. In our standard scenario we apply

the Europop presumptions of Eurostat. But how would pension entitlements change if the life expectancy (LE) increases more/less than in the standard scenario? An answer is given in Table 9 which illustrates the change of results if different mortality assumptions are taken. It is interesting that the results do not differ considerably if e.g. the change of the life expectancy is 1.5 times higher. The result would be increased by roughly four per cent – see Table 9. If in contrast the life expectancy of the base year would remain constant in future decades pension entitlements would shrink by roughly 7 per cent.

Table 9: Sensitivity analysis of the life expectancy
 Relative deviation of Portuguese ADL to the standard scenario¹⁴

constant LE	-7%
0.5 times higher LE	-4%
standard scenario	0%
1.5 times higher LE	5%

Source: own calculations.

Additionally, pension reforms may lead to changes of public pension entitlements. Their impact, however, depends on the specific reform measures adopted. Indexation rules show the largest effect on total pension entitlements (see Table 7). A change from a pure price indexation to a mixed indexation – with annual increases of benefits in line with 50 % of wage growth and 50 % of the price development – would lead to an increase of 9.6 %. The impact would be significantly higher with 20.4 % if a shift from a price to a wage indexation is legislated. But of course, this result depends greatly on the assumptions of the wage growth. A higher level of earnings increases would also raise the impact of the wage indexation on ADL estimates – and vice versa. An explanation for the considerable impact of indexation rules provides the compound interest effect. In line with this concept the level of pension indexation accumulates over a long retirement span. Additionally, all scheme members are affected by indexation changes, i.e. current retirees and current contributors. Most other pension reforms only change entitlements of the group of current contributors – see examples below.

¹⁴ The sustainability factor of the Portuguese pension formula which adapts benefit levels in line with changes of the life expectancy is not considered here.

Table 10: Sensitivity analysis of the indexation regime

Relative deviation of Portuguese ADL to the standard scenario

price indexation	mixed indexation	wage indexation
0.0%	9.6%	20.4%

Source: own calculations.

Increases of statutory retirement ages (RA) are a standard measure to cope with rises in life expectancy – observed in several countries (see Table 5). Its effect on the level of pension entitlements depends on the reform design, namely on the absolute rise of RA as well as on the introduction period. A slow increase of RA within a number of decades, as e.g. observed in Germany and Austria, has relatively little impact on pension entitlements. An increase of RA by e.g. 2 years within 20 years reduces pension entitlements by roughly 4 percent – see Table 11. A more rapid rise, on the contrary, combined with a higher increase of RA by 5 years reduces ADL by about 13 percent.

Table 11: Sensitivity analysis of increases of statutory retirement ages

Relative deviation of Portuguese ADL to the standard scenario¹⁵

	Increase within 5 years	Increase within 10 years	Increase within 20 years
Increase of RA by 2 years	-8.5%	-4.9%	-3.7%
Increase of RA by 5 years	-13.3%	-11.3%	-8.1%

Source: own calculations.

A number of countries introduced life expectancy factors in recent years – promoted inter alia by the European Commission.¹⁶ Its effect on the level of ADL is relatively minor as it affects only the group of future new pensioners and as it reduces future pension benefits only very gradually. In the case of Portugal the life expectancy factor reduces initial pension levels by about 10 percent over a period of 20 years. Portuguese ADL increase by “only” 3.6 percent if the life expectancy factor is disregarded in the entitlement estimations.

We may conclude that the level of pension entitlements is most determined by the choices of the discount and wage growth rate. Pension reforms and in particular changes of the pension indexation rules may considerably affect the level of ADL, too. Mortality assumptions are also significant but, generally, less decisive for the overall amount of ADL.

¹⁵ For this estimation we assume no changes of retirement behavior after the reform. This presumption is unproblematic as long as the applied pension decrements and increments can be considered as actuarially neutral.

¹⁶ See European Commission (2010), p. 9.

6 Applications

The new figures of ADL recorded in European national accounts from 2017 onwards may serve both researchers and policy makers for a wide variety of applications. As outlined in the previous section the impact of pension reforms on households' unfunded pension wealth can be measured by the figure of ADL. We showed that an alteration of the pension indexation formula may have a considerable effect on the level of households' pension entitlements. Standard pension policy indicators such as the replacement rate are not able to reflect the impact of indexation changes as they only compare pension payments of the first retirement period with pre-retirement earnings. The figures of ADL may, therefore, serve as one criterion for policy makers in addition to the currently used adequacy and sustainability pension indicators to assess pension reforms. Changes of entitlements due to pension reforms will be illustrated separately in a new supplementary table of national accounts on an annual basis from 2017 onwards (see Table 12 and row 7 in the appendix).

The costs of terminating a pay-as-you-go (PAYG) pension scheme may be measured with the figure of ADL.¹⁷ They may, therefore, be applied to quantify the cost of a (partial) switch from a PAYG to a funded pension system. Moreover, ADL complete the picture of government obligations and therefore should be recorded in addition to the stock of public debt.¹⁸ In Europe it was discussed in past years to add these newly recorded government liabilities to the Maastricht debt. This proposal has, however, been rejected.

As outlined in section 3 the amount of ADL usually ranges from 100 to 350 percent of GDP. This number may be terrifying for policy makers at first glance – especially during the current turmoil of public finances. Therefore, it is crucial to outline also an important limitation of the figure of ADL. It cannot be used to evaluate the fiscal long-term stability of a public finances in general and of the pension scheme in isolation. For such a fiscal sustainability analysis the OSNL concept should be applied (see section 2). In other words, pension entitlements should be confronted with future revenues and the time horizon should be extended to include also entitlements accrued in future years. It is, therefore, important to underline that the extent of ADL of a certain country is not connected to any kind of good or bad state of fiscal affairs.

¹⁷ See Franco (1995).

¹⁸ See Bovenberg and Petersen (1992), Holzmann et al. (2001).

From pension entitlements to households savings

It is often argued that the extent of unfunded pension entitlements may greatly determine the savings' behaviour of household. In the following sections we elaborate this hypothesis and discuss possible applications of ADL to explain cross country differences in saving rates.

One of the first authors to examine the impact of public unfunded pension schemes on savings was Feldstein (1974). He presented time-series evidence for the United States showing that the American public pension system has suppressed households savings. Feldstein (1974) argued that a public pension system has two opposing effects on personal saving behaviour: It lowers personal savings because of reduced needs to accumulate assets for the retirement period ("asset-substitution-effect"). In addition, the existence of a public pension system increases personal savings as the availability of a public pension system induces an earlier retirement. A higher saving rate to realize a given level of old age income during the longer period of retirement is required ("induced retirement effect"). The net effect, the question whether a public pension system increases or decreases personal savings, depends on the relative strength of these ambiguous forces and can, therefore, only be resolved by empirical analysis.¹⁹ Till these years, many studies aimed at determining the effects of a public pension system within a single country. Additionally, several studies estimate the level of social security benefits for a number of different countries in order to examine how the existence of these benefits is able to explain cross-country differences in private savings: Shortly after the first cross-country studies were published Feldstein (1980), Barro and MacDonald (1979), more and more variables had been tested for explaining international differences in saving rates: Koskela and Viren (1983), for instance, added the unemployment rate as a proxy for real income uncertainty which showed to affect aggregate private savings positively. Other studies such as analyses Callen and Thimann (1997), Kessler et al. (1993), Bloom et al. (2007) included variables like direct taxes, per capita public deficit or life expectancy into their.

As pointed out by Feldstein and Liebman (2002), estimation of displacement effects using aggregate time series data – such as ADL figures – is always challenging. One can show the correctness of this claim by means of a simple example. Consider a stationary economy without population growth. Furthermore, let us assume three generations equal in cohort size: 1) very young, none-working generation, 2) middle aged working generation and 3)

¹⁹ See Feldstein (1976), Leimer and Lesnoy (1982).

elderly retired generation. The wage rate is constant over time. According to the life cycle hypothesis (LCH) as expressed by Ando and Modigliani (1963), Modigliani and Brumberg (1954), individual saving or dissaving is motivated by the desire to guarantee a constant level of consumption over one's lifetime. The LCH suggests that individuals save in the middle part of their life, when their earnings are relatively high, and dissave in retirement. Hence, in the absence of a PAYG social security scheme, saving of the individuals in the middle part of their life is completely compensated by the dissaving of individuals that are already retired. Total household saving is equal to zero in such a stationary economy. The existence of a PAYG social security scheme would result in a lower savings rate of individuals in the middle part of their life. Total households savings, however, could remain constant because the already retired also dissave less. In other words, although the lifecycle model predicts substitution effects between social security and saving, on an aggregate level, the observation of substitution effects is always challenging. The application of ADL for the explanation of savings behavior is therefore of limited use.

Beside the above mentioned limitations, private savings regressions using sets of aggregate time-series have been shown to be highly vulnerable to endogeneity problems. The theory of savings is closely related to the theory of consumption as savings are simply the residual between income and current consumption.²⁰ Any shock to aggregate private consumption (savings) affects GDP, given that private consumption is a major component of GDP. The endogeneity of GDP also makes aggregate household disposable income endogenous. This also counts for other potential variables such as the unemployment or the interest rate. Since most of the explanatory variables used in the available literature are expressed in percent of household disposable income,²¹ they are vulnerable to endogeneity. This limitation can be, however, overcome by an identification of instrumental variables that are both relevant and exogenous. Unfortunately, for the studies that analyzed this relationship using aggregate data, this was not the case.²²

Beside these econometric challenges, the selection of an appropriate proxy for unfunded pension wealth is of major interest. Most previous studies which chose a macro data approach applied replacement rates as a proxy for unfunded pension wealth. Our estimates,

²⁰ See Browning and Lusardi (1996).

²¹ See Bloom et al. (2007), Callen and Thimann (1997), Disney (2006), Kessler et al. (1993).

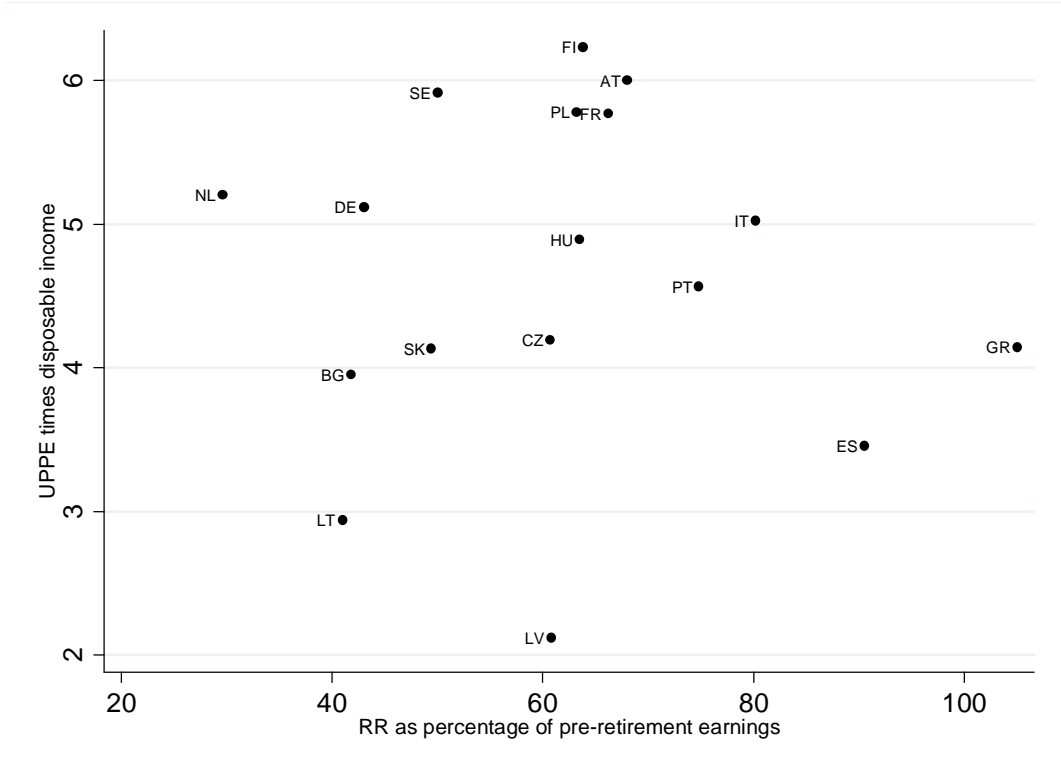
²² See Bloom et al. (2007), Callen and Thimann (1997), Disney (2006), Kessler et al. (1993).

however, show that there are substantial differences between the replacement rates (RR) and the ADL variable. These differences might be explained by the fact that the ADL variable represents the yet accumulated pension wealth of the entire population. The RR, however, represents a crude approximation on the actual pension wealth of the section of the population that currently retires.²³ The age structure of the population as well as the future life expectancy are only reflected in the ADL variable, not in the RR variable. This aspect may explain that the variable of ADL and the RR are completely uncorrelated as shown in Figure 3.

Against this background, The crucial question is: What is the appropriate proxy for the anticipated unfunded pension wealth? And which proxy has to be taken into account when analysing the generosity of pension systems or the impact of reforms? ADLs, RR or some other variable? A number of reasons speak in favor of the former variable. First, the aggregate indicator of ADL reflects the generosity not only of one pension scheme but of a number of pension schemes: such as disability, old age, survivors' of social security and civil servants pension schemes. The standard indicator of RR, generally, mirrors only the relative benefit level of old age social security pensions – which in 2006 amounted to less than 70 % of overall pension expenditures in our country sample. Especially, for countries such as Austria and Germany with large and still generous civil servant schemes one would, therefore, most likely underestimate pension wealth with the indicator of RR. Second, ADL as an aggregate variable can reflect cohort-specific benefit levels. Pension wealth may vary between age groups due to 1) changing pension benefit formulas and 2) different employment histories. Particularly, Central Eastern European countries experienced significant transformations of their pension systems and labour markets in the last 20 years. The benefit level of current retirees reflected in RR may, therefore, be inappropriate to proxy anticipated pension wealth of future new retirees (current contributors). Third, ADLs reflect the coverage rate of public unfunded pension schemes in a respective country (by age and gender groups).

²³ The definitions of the RR may differ. Generally, the RR represents the level of retirement income in the first year after retirement as percentage of earnings in the year prior to retirement. This definition is applied here. We follow the European Commission and apply a gross concept European Commission (2009).

Figure 3: Cross country comparison of pension liabilities and replacement rates (2006)



Source: own estimation (ADL) and European Commission (2009) (RR).

Due to the above discussed limitations of aggregate data, most recent approaches use micro data to identify the offset between unfunded public pension entitlements and savings behavior.²⁴ Despite almost 40 years of research on the topic still no consensus has been reached on the order of magnitude of the asset-substitution-effect.²⁵

Such a micro data approach is, however, also connected with a number of constraints. In detail, those datasets rarely contain information on financial wealth and even less on pension entitlements and typically cover relatively short time periods leading to the fact that, unfunded public pension entitlements does not exhibit much exogenous variation

²⁴ See Diamond and Hausman (1984), Jappelli (1995), Hubbard (1986), Attanasio and Brugiavini (2003), Kapteyn et al. (2005), Kapteyn and Panis (2005), Gale (1998), King (1982), Hurd et al. (2012).

²⁵ In Europe, for instance, a high number of pension reforms took place in recent years, but the extend of the relationship between financial wealth accumulation and pension liabilities is still scanty and incomplete Attanasio and Brugiavini (2003). In his seminal paperFeldstein (1974) used aggregate time-series data from the US and determined displacement effects between -0.30 \$ and -0.50 \$ per additional \$ of pension liabilities. A few years laterFeldstein (1980) used aggregate cross country data to determine a displacement effect of 0.37 \$ per additional \$ of pension liabilities. A recent approach using micro-data sets determined a displacement effect of 0.22 \$ for every additional \$ of pension liabilities Hurd et al. (2012).

Attanasio and Rohwedder (2003). While on a national level micro datasets are available this is so far not the case for large cross-country comparisons.

In conclusion, the new aggregate ADL figures are less applicable for the analysis of savings behavior on a national level. The available micro datasets provide a much better fundament for such an examination. Aggregate pension entitlements may, however, serve as one explanatory variable for large cross-country savings studies. With the new international accounting standards (ESA2010) harmonized figures of ADL will be provided for all European countries from 2017 onwards on an annual basis. This standardized and increasing set of panel data will provide a valuable basis to further explore the consumption and saving decisions of households in Europe.

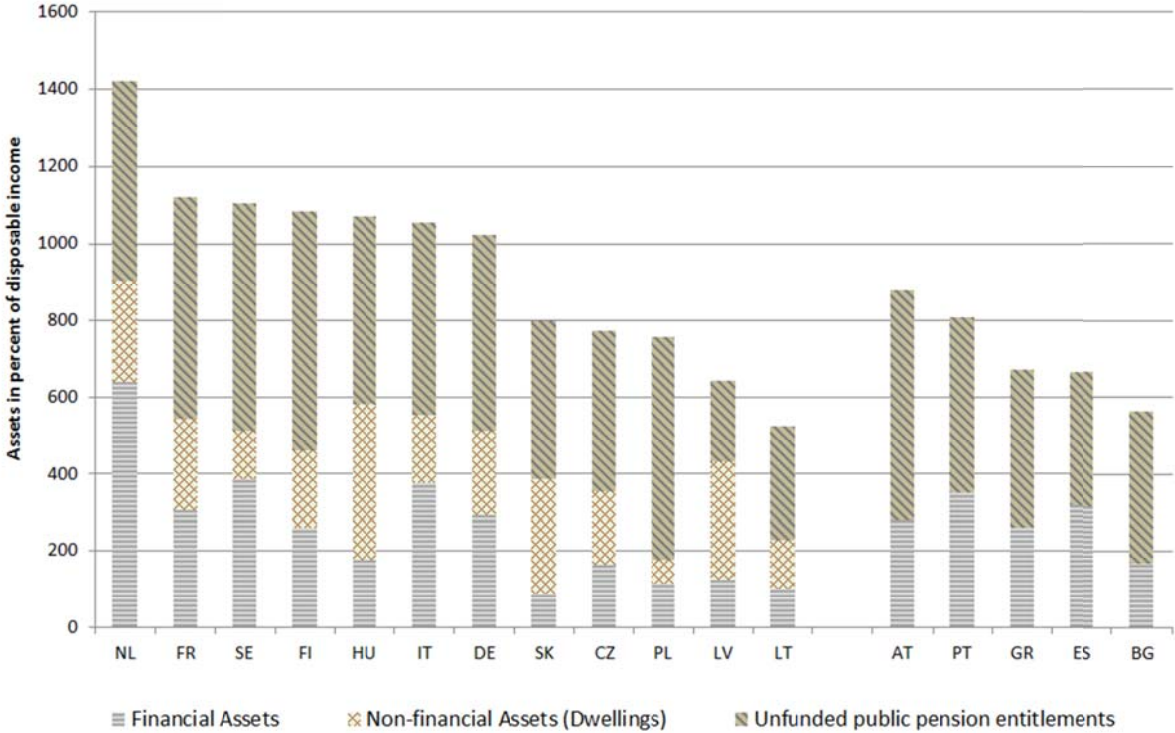
Towards a full picture of households' wealth across Europe

Beside its application in policy and savings analyses, the new ADL figures may also be used to complete the picture of households' wealth on a cross-country level. Past international studies on households' wealth for the Euro-Area,²⁶ and around the globe,²⁷ so far disregarded a substantial part of households' wealth, ADL. Generally, three types of assets may be taken into account for wealth estimates. Besides the above described ADL, these include financial assets (FA) and non-financial assets (NFA). The last piece of the households' wealth puzzle represents the stock of NFA which mainly consists of dwellings. So far comparable cross country data on NFA was rather limited and, therefore, not used for international analyses. With the recent changes of European accounting rules EU member states will record aggregated dwellings figures in future years, too. Figure 3 shows estimates of this new accounting figure for 12 EU states of our 18 country sample. Generally, NFA lead to a convergence of total households' wealth in Europe. Countries with relatively low levels of ADL and FA such as Slovakia (SK) and Latvia (LV) can partly bridge this wealth gap with large NFA. Of course, this figure draws a pre-crisis picture. The composition of households' wealth across Europe may have considerably changed in the last 5 years with the bust of a number of real estate bubbles.

26 See ECB - European Central Bank (2013).

27 See Davies et al. (2011).

Figure 4: Households' wealth in Europe (2006)



Source: Eurostat and Müller et al. (2009).

As shown in Figure 3, the stock of FA held by European households varies widely between different European countries. Generally, in countries with a Beveridgean pension system, such as the Netherlands the stock of FA is significantly higher than in countries with a Bismarkian tradition such as Germany, Austria or France. In addition, it can be stated that in post-communist new member states of the EU such as Poland or Slovakia the stocks of FA are smaller than in other EU-countries due to a lack of saving opportunities under socialist regimes. Taking both FA and ADL into account, one can see that many wealth differences between countries with Beveridgean and Bismarkian pension systems as well as between western and central eastern European countries are eliminated. There are, however, still low levels in some former communist countries such as Latvia and Lithuania.

7 Summary and Conclusion

With the recent updates of national accounting standards unfunded pension rights will be recorded from 2017 onwards. From the households' viewpoint this new figure can be interpreted as an unfunded public pension asset or entitlement (UPPE) so far not recorded in households' wealth estimates. From the government perspective this figure represents an obligation or liability, namely an accrued-to-date liability (ADL). The study at hand outlined the actuarial concept of ADL applied for these new recordings. We showed that the estimation approach of past cross-country ADL studies varied greatly with respect to the economic and demographic assumptions, the scope of pension schemes covered as well as the valuation method of pension rights. These differences explain to a large degree the variance of outcomes between past ADL surveys. On the basis of a sensitivity analysis we showed that the scope of ADL depends significantly on the choice of the discount and wage growth rate. Against this background we highly recommend a harmonized approach to estimate ADL figures in order to ensure comparability of results across countries. The new Compilation Guide provided by Eurostat (2012) offers such a standardized approach for the calculation of ADL across Europe.

We showed own estimates which base on these Eurostat recommendations. With a sample of 18 EU member states this survey represents the largest cross-country comparison for Europe so far. As a first conclusion, unfunded public pension entitlements are substantial in all EU countries assessed. Secondly, we observed a large cross-country variation ranging from 125 to 362 per cent of GDP. The largest ADLs in per cent of GDP can be found in France (362.2), Poland (361.1) and Austria (359.9), followed by Germany (329.6) and Italy (323.1). It might be a coincidence that all these countries possess a special pension scheme for civil servants but even without these schemes they are among the highest figures observed. Most of the other countries show pension liabilities in the range of 200 to about 300 per cent of GDP. The lowest liabilities have been calculated for Lithuania (179.9) and Latvia (124.8). The main determining factor for the heterogeneity of these results represents the initial level of pension expenditures. Furthermore, the development of future retirees as well as the degree of pension reforms plays a role for the level of ADL.

The newly recorded figures of ADL/UPPE may serve both researchers and policy makers for a wide variety of applications. They provide a tool to measure the impact of pension reforms on households' unfunded pension wealth. In comparison to standard pension indicators such as the replacement rate, the figure of ADL is able to reflect the accumulated effects of pension indexation rules over the retirement period. Past applications of replacement rates to proxy the generosity of pension systems and the impact of indexation reforms are therefore limited. In fact, we show that the variable of ADL and the replacement rates of European countries are uncorrelated. Moreover, ADL complete the picture of government obligations and may be used to quantify the cost of a (partial) switch from a PAYG to a funded pension system. In this context it has to be, however, underlined that the figure of ADL cannot be used to evaluate the fiscal long-term stability of pension schemes. For such an analysis the OSNL concept should be applied (see section 2). The ADL figures may also be used for the analysis of savings behavior, serving as a proxy for the level of unfunded pension wealth. Due to a number of constraints they are less applicable for savings studies on a national level. The ADL estimates may, however, serve as one important explanatory variable for large cross-country surveys. With the new international accounting standards (ESA2010) a harmonized and increasing set of panel data will be available for such cross-country studies. It may help to explore further the consumption and saving decisions of households across Europe. Beside the above outlined applications, the new ADL figures may also be used for cross-country comparisons of households' wealth. Current wealth studies so far neglect unfunded pension wealth. We have shown that this leads to a large underestimation of households' wealth as unfunded pension rights represent the largest asset of households' in Europe. Furthermore one can see that many prosperity differences between countries with Beveridgean and Bismarkian pension systems as well as between western and central eastern European countries are eliminated when considering unfunded pension wealth.

In conclusion, our study showed that the new recording of unfunded public pension entitlements opens up a number of new fields for policy makers and researchers, in particular for wealth and savings cross country comparisons. These potential applications are however only feasible if a harmonized approach for ADL calculations across Europe is guaranteed.

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Annex 1 Methodology of estimating ADL

The following section outlines in detail the estimation of unfunded public pension entitlements. The starting point of the model²⁸ applied is the method of generational accounting.²⁹ In general this method can be used for a wide variety of purposes. For this study, the method is applied for public pension schemes in isolation and for the group of existing retirees and current contributors (future retirees) only.³⁰ Additionally, the standard method is modified in order to account for the accrued-to-date amount of benefits instead of considering full future pension benefits (accrued after a complete contribution history). Our calculations include old-age pensions, disability pensions and survivor pensions. Any kind of means-tested social existence is excluded – as far as feasible. We outline below the entire calculation procedure in five steps.

Step 1 – Projecting existing retirees’ pensions: We start with the estimation of the average age-sex-specific existing retirees’ benefits in the base year. The projection of these pension benefits is the centre piece of the calculations since we develop the future new retirees’ accrued pension benefits by a modification of the existing retirees’ benefits. Please note that *future new retirees* involve all individuals which retire after the base year, while *existing retirees* are already in retirement in the base year. Each average representative of an age group is to some extent an existing and a future new retiree in every year of his or her life-cycle.

Generating age-specific pension profiles

First of all, the base year benefits are calculated by distributing the aggregated amount of today’s pension expenditures to the different cohorts in retirement age. By this procedure we create an age-sex-specific benefits’ cross-section profile generated from the budget and micro data of the observed country. It reflects heterogeneous retirement behaviour.³¹

²⁸ The model described has been developed to carry out benchmark calculations of public pension liabilities on behalf of the Eurostat/ECB Contact Group on Pensions for 19 EU countries Müller et al. (2009).

²⁹ This method was developed by Auerbach et al. (1991). See Bonin (2001), Raffelhüschen (1999) for a detailed depiction of theory and application as well as limitations of the method of generational accounting.

³⁰ For a closer look on the application of generational accounting to public pension schemes see Moog and Müller (2011), Müller et al. (2010) who employed the concept of open-system net liabilities to investigate the sustainability of the Germany and other European pension systems.

³¹ For a description of heterogeneous retirement behaviour see Eurostat (2012), p. 80 et seq. Most former surveys Kuné (2000), Van den Noord and Herd (1993) apply one constant average retirement age for their calculations instead of an age-sex-specific pension profile. From our point of view, this approach represents a simplification of retirement behaviour and leads to less accurate results.

Benefits are measured in per capita of the population units. In other words, we quantify pension benefits $p_{b,k}$ (in the base year b of the cohort born in k) of a x ($x=b-k$) year old representative resident of a respective country in a given base year.³² Formally (see equation 1), $p_{b,k}$ is derived by multiplying the average pension benefit of a scheme's retiree $B_{b,k}$ of a certain age x with the number of scheme retirees at this age $M_{b,k}$ and dividing this product by the the cohort size of the overall population.

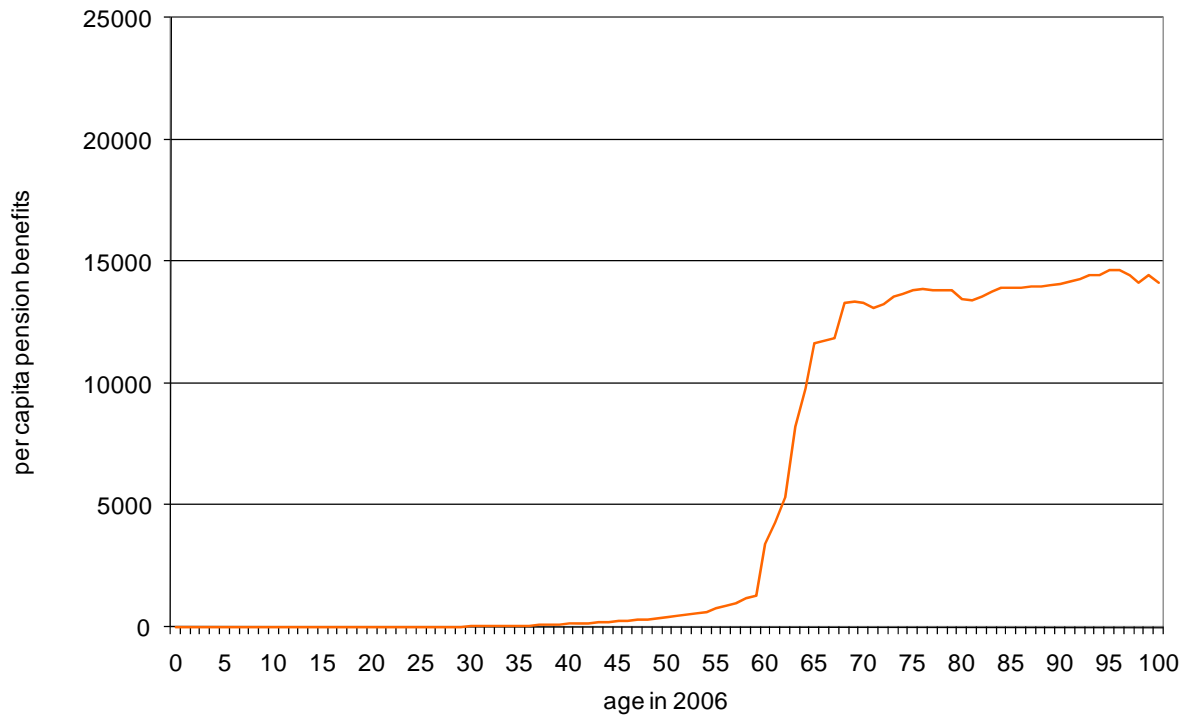
$$(1) \quad p_{b,k} = \frac{B_{b,k} * M_{b,k}}{C_{b,k}}$$

Typical for most European pension schemes is the sharp increase of the pension profile around the age of 60. Such a steep rise can also be observed in the German example (see Figure 5). It mainly reflects an increasing share of pension cases, i.e. the retirement probabilities around the age of 60 are relatively high.³³ It should be noted that the profile also reveals other age-specific characteristics, namely the average participation rate in the respective pension scheme (in per cent of the population) as well as the average pension benefits at a given age ($B_{b,k}$).

³² Since our projection method does not correct aggregates for business cycle effects, base year economic performance is perpetuated indefinitely. This may lead to a bias. Nonetheless this effect seems not as critical in case of considering pension expenditures only since they are for the most part dominated by demography.

³³ At this point it is worth mentioning that we employ age-sex-specific pension data which is broken down into one-year intervals. Most former surveys use five-year interval data which can lead to inaccuracies especially when looking at the cohorts retiring in.

Figure 5: Rescaled profile of average existing retirees' benefits in 2006 (Social security Germany, male, in Euro)



Source: own calculations.³⁴

Rescaling of existing retirees' pension benefits

Formally, the estimation of the existing retirees' benefits is based on the following identity:

$$(2) \quad P_b = \sum_{k=b-D}^b p_{b,k} C_{b,k}$$

This identity states that the sum of age-specific individual pension benefits $p_{b,k}$ (in the base year b of the cohort born in k) weighted with the cohort size $C_{b,k}$ must equal the corresponding overall aggregate pension expenditures, denoted by P_b .³⁵ The problem of equation 2 is that it holds only in theory. While macroeconomic data, typically taken from national accounting statistics, is relatively exact, micro data is in general difficult to gather and tends to be afflicted with inaccuracies. To resolve this problem we estimate re-scaled age-sex-specific benefit profiles. This is done in two steps. First, age-sex-specific information regarding per capita pension benefits has to be collected in order to capture the relative fiscal position of different age groups as accurately as possible. The vector of relative pension benefits by age taken from the statistics, $(\tau_{t,t-D}, \dots, \tau_{t,k}, \dots, \tau_{t,t})$, is then

³⁴ The profiles applied include payments regarding old-age pensions, disability pensions and survivor pensions. In doing so, we are able to take into account survivor pensions in a more accurate way, compared to most other surveys dealing with the measurement of pension liabilities such as Holzmann et al. (2001).

³⁵ Please note that D represents the maximum age of an individual which is 100 years by our assumption.

denoted by $\tau_{t,k}$.³⁶ Note that this vector is supposed to show only the relative pension position in period t of an individual born in the year k and thus imposes less restriction on the accuracy and availability of micro data on the absolute level. Second, the estimated relative age distribution is tallied with the corresponding aggregate pension benefit P_b by application of a proportional, non-age-specific benchmarking factor, denoted by φ . The relative distribution of pension payments is re-evaluated according to

$$(3) \quad p_{b,k}^{rescal} = \varphi \tau_{b,k}$$

for all living generations $b-D \leq k \leq b$, where φ is defined by

$$(4) \quad \varphi = \frac{P_b}{\sum_{k=b-D}^b \tau_{b,k} C_{b,k}}$$

Equation 4 assures that equation 2 is finally satisfied. On the basis of the rescaling factor φ it is assured that the micro pension data matches the given macro data.

Projection of existing retirees' pension benefits

Finally, the resulting rescaled average age-sex-specific existing retirees' benefits are projected according to the indexation rules of the respective country:

$$(5) \quad p_{t,k}^{exis} = p_{b,k}^{rescal} (1+g)^{t-b},$$

for all cohorts $b-D \leq k \leq b$ living in the base year. This equation 5 states that an individual already retired in base year b receives the same pension in a specific year t as in the base year b , only corrected by the indexation g of pension in payment Equation 5, furthermore, implies a "phasing out" of the stock of existing pension benefits since it holds only for all living generations. Thus all existing retirees' pensions of the base year will have disappeared at latest when the youngest existing retiree of the base year is dead. To account for this future cohort-specific development of existing retirees pension benefits, we phase out year-by-year the rescaled age-sex-specific existing retirees' profile and index the pension benefits according to the benefit formula.

Step 2 – Projecting future new retirees' pensions: The age-sex-specific pension profile for future new retirees, which is the basis for the estimation of accrued-to-date entitlements,

³⁶ For ease of notation we drop the sex-specific notation as from now on.

is calculated by manipulating the base year existing retirees' benefits.³⁷ This is done in four stages.

Estimation of pension benefits for new retirees in the base year

First the pension benefits for new retirees in the base year are estimated.³⁸ Formally (see equation 6), the new retirees benefit $p_{b,k}^{new}$ in the base year b for a cohort k is developed by calculating the absolute change in existing retirees benefit $p_{b,k}^{exist}$ of the cohort k to the cohort one year younger in the base year, namely $k+1$.³⁹

$$(6) \quad p_{b,k}^{new} = \underbrace{\left[p_{b,k}^{exist} - p_{b,k+1}^{exist} \right]}_{\text{Stage 1}}$$

Estimation of pension benefits for new retirees in a future year

Up to this point we have estimated age-specific pension benefits of new retirees in the base year. For future years we hold this profile constant, i.e. we, generally, apply the base year retirement behaviour also in the years to come.⁴⁰ As a consequence, pensions of new retirees in future years t are estimated in the same manner as in the base year (see equation 7, stage 2). Only the notation of the respective cohorts is slightly altered and now linked to the future year t and the base year b . Accordingly, a new retiree's benefit $p_{t,k}^{new}$ in a specific year t of a cohort k is developed by calculating the absolute change in existing retirees benefit of the cohort $b-(t-k)$ (the cohort with the same age $(t-k)$ in the base year b) to the cohort one year younger in the base year, namely $b-(t-1-k)$.⁴¹ Equation 7 sums up the calculation of pension benefit for future new retirees in one given future year t :

$$(7) \quad p_{t,k}^{new} = \underbrace{\left[p_{b,b-(t-k)}^{exist} - p_{b,b-(t-1-k)}^{exist} \right]}_{\text{Stage 2}} * \underbrace{(1+v)^{t-b}}_{\text{Stage 3}} * \underbrace{\theta_{t,k}}_{\text{Stage 4}}$$

³⁷ The separation of existing pensions and future new pensions (pensions paid out for the first time after the base year) bears one big advantage: In case of a pension reform which affects only future pensions, only these pensions are changed while existing pensions are held constant.

³⁸ Note that new retirees' benefits represent those benefits that are paid for the first time upon retirement in a specific year $t > b$.

³⁹ Changes after the age of 67 years are generally set to zero since new retirees' old-age benefits after the age of 67 are negligible. The only exception from this rule is widow's pensions.

⁴⁰ Only in some cases where a future increase of the legal retirement age has been legislated, we alter future retirement behavior respectively.

⁴¹ Changes after the age of 67 years are generally set to zero since new retirees' old-age benefits after the age of 67 are negligible. The only exception from this rule is widow's pensions.

for all cohorts $b-D \leq k \leq b$.

Valorization of a future new retirees' pension benefit

As a third stage one has to take into account that past pension rights are annually valorized according to the benefit formula. As a consequence, in most pension schemes pension benefits of new retirees in a year $t+1$ will be higher than in the previous year t . This aspect is reflected with the valorisation rate $(1+\nu)^{t-b}$ (see equation 7, stage 3). The variable ν is the valorisation factor set according to the benefit formula.

Consideration of pension reforms

The majority of European public unfunded pension schemes have made wide-ranging reforms in recent years which will, generally, lower future pension benefits. In a fourth stage future new retirees' benefits are, therefore, diminished accordingly with a deduction factor $\theta_{t,k}$ (see equation 7, stage 4). A further description of the country specific reforms considered is provided in Müller et al. (2009).

Estimation of cumulated future new retirees' benefits

Finally, the accumulated future new retirees' benefits need to be calculated. With this fifth step we cumulate year-by-year all future new pension benefits of a x year old representative (in the base year) over his remaining life-cycle. In other words, we consider that e.g. a 59 year old representative (in the base year) will retire with a certain probability at the age of 60, 61 and so on. Formally, this is done by cumulating year-by-year $p_{t,k}^{new}$ according to equation 8. The accumulated age-sex-specific future retiree pension benefits $p_{t,k}^{fut}$ for a specific year t of the cohort k are defined by:

$$(8) \quad p_{t,k}^{fut} = p_{t-1,k}^{fut} (1 + g) + p_{t,k}^{new}$$

From this equation it follows that the average individual born in the year k receives a future benefit in the year t ($t > b$) which is composed of the accumulated pension payment one period earlier ($t-1$) corrected by the pension indexation g plus the pensions paid to new retirees in this year. In other words, a future new retiree (i.e. an individual which retired after the base year) in year t is to some proportion a new retiree in this year t – receiving $p_{t,k}^{new}$ – and to some extent an “old” retiree who has already received a pension benefit in

the year before $t-1$. Thus, the age-sex-specific benefit profile for future retirees builds up year-by-year to project future accumulated retirees' benefits.

Step 3 – Considering the proportion of full pensions accrued-to-date: Now, in order to meet ADL, only the part of the future pension benefits (of current workers) has to be considered which is earned until the base year. This means in turn that $p_{t,k}^{new}$ must be cut by a factor $\lambda_{t,k}$ representing the cohort-specific amount of entitlements of current contributors in relation to the full entitlements.⁴² Future pension benefits are thus finally defined by

$$(9) \quad p_{t,k}^{fut} = p_{t-1,k}^{fut} (1 + g) + \lambda_{t,k} p_{t,k}^{new},$$

for all cohorts $b-D \leq k \leq b$.

Note that the accrued-to-date concept requires a definition of the valorisation and accruing process for the entitlements. As a matter of principle there are several possibilities to account for, namely ABO and PBO. These two approaches are described further below. For the results presented in this study we apply the PBO approach and we cut the benefits linearly according to the ratio of the contribution years accrued until the base year to the average contribution years accrued until retirement.

Step 4 – Population projection: Following, age-sex-specific projections of base year's population need to be calculated. The demographic model used to generate these projections is based on a discrete and deterministic formulation of the cohort component method.⁴³ The three major determinants of future population changes are in general fertility, mortality and migration. Since ADL regard only rights accrued by existing and former workers until the base year, future migration of the base year population is irrelevant. The development of survival rates is considered by adjusting the initial set of survival rates with an exponential adjustment procedure. The population data used for the calculation is derived from Eurostat. Also the assumptions on the future development of the life expectancy bases on data provided by Eurostat.

⁴² The calculation of the factor $\lambda_{t,k}$ requires the knowledge of the average age-sex-specific wage distribution. Many other surveys work with one single average wage over the whole career which leads to different results, see e.g. Holzmann et al. (2004), Van den Noord and Herd (1993).

⁴³ For a detailed description of the demographic model applied see Bonin (2001), p. 245 et seq.

Step 5 – Aggregating and discounting pension benefits: Finally, the ADL of the pension scheme are calculated by discounting and summing up the projected pension benefits over the cohorts living in the base year. For the real discount rate a value of 3 per cent has been applied. Thus, the ADL_b (accrued-to-date liabilities of the baseyear b) can be expressed like the following:

$$(10) \quad ADL_b = \sum_{t=b}^{b+D} \sum_{k=b-D}^b \frac{(p_{t,k}^{exis} + p_{t,k}^{fut})}{(1+r)^{t-b}} C_{t,k}$$

This means that in every period t the existing retirees pension benefits ($p_{t,k}^{exis}$) and the pension rights accrued until the base year ($p_{t,k}^{fut}$) – which are both discounted by the factor $(1+r)$ for every future year $(t-b)$ – are multiplied with the number of members of this age cohort $C_{t,k}$. This is done for every age-group, beginning with the ones born in $k=b-D$, which goes back 100 years prior to the base year.

Differentiation of the ABO and the PBO approach

In order to receive the ADL of a pension scheme, it is crucial to divide the beneficiaries of future pension payments into two groups: The first group consists of persons who receive pension payments already today. The members of this group dispose of full pension entitlements due to the fact that they have already retired and are not able to increase their pensions by paying contributions.⁴⁴ The second group consists of persons who do not receive pension payments yet. They have earned some kind of pension entitlements in the past – regardless if they just took up employment one year ago or if they are close before retirement – and will probably earn more pension entitlements in the future, up to that point of time when they will retire. It follows that this group does not dispose of full pension entitlements yet. The ADL approach includes entitlements earned up to the base year only, therefore the projected future pension payments of a “future retiree” (or more precisely: a person who will retire after the base year) has to be reduced. Here the question of ABO versus PBO enters the scene:

⁴⁴ This counts only for pension schemes which do not allow their beneficiaries to increase their pension after retirement, i.e. by taking up employment, paying contributions and thus augmenting their pension entitlements.

In a first step, we will distance ourselves from the accrued-to-date idea, just as it is exercised in the model primarily. In every single year after the base year, new pensioners will enter the pension scheme. The question to be answered first is what the amount of the first paid benefit will be in relation to the new pensioners' benefits in the base year. Let the amount of first paid pension – sometimes referred to as the primary insurance amount (PIA) – in the year b be $B(t)$ and the constant per-capita wage growth in real terms be g . When applying the PBO approach, the first paid pension will be defined like the following:

$$(11) \quad B_t = B_b(1 + g)$$

Since g is assumed to be constant over time, the first paid pension can also be expressed subject to the base year b .

$$(12) \quad B_{t+1} = B_b(1 + g)^{t-b}$$

Changing to the ABO approach, one has to bear in mind that no allowance is made for future pay increases. In the current case, only the general wage growth is observed. It follows that the first paid pension of a future year t in the ABO approach changes to:

$$(13) \quad B_t = B_b$$

The difference between equations 12 and 13 can be explained by the different approaches of ABO and PBO. PBO takes into account general future wage growth while ABO does not consider any future changes of earnings; the wage level of the base year is held constant in real terms.⁴⁵

The second difference between ABO and PBO can be observed when reducing the primarily calculated full benefits of “new pensioners” according to the concept of ADL. The full benefits are reduced by a vector – the “accrued-to-date vector” –, which expresses the share of entitlements earned until the base year to the amount of entitlements which qualifies for a full pension. This share is given for every projection year. It is straightforward that the share decreases from a value close to one for primary pensions paid out shortly after the base year up to a value of close to zero for primary pensions paid out in the far future. This vector is multiplied with the respective accounts of full pension entitlements and the outcome is the amount of pension entitlements earned up to the base year for

⁴⁵ It is crucial that this only counts for the calculation of the first paid pension or PIA. When projecting a benefit which has already been paid out before, i.e. the indexation of existing benefits, a constant real wage growth is assumed. In this regard the ABO approach displays a schizophrenic world where in one situation future wage growth is considered and in the other it is not. Please note, that there are other interpretations of the ABO approach which do not consider (post-retirement) pension indexation.

every projection year, the accrued-to-date entitlements. The difference between ABO and PBO in this regard is given by the different consideration of personal earnings increases during working life. Generally, the earnings at the beginning of a career is less than the average earnings and turns out somewhere above average closer to retirement – PBO takes this effect into account, ABO does not.

Regarding the accrued-to-date vector in the PBO approach, only the missing amount of contribution years has to be taken into account, due to the fact that the full pension primarily calculated by the model includes assumptions for personal and general wage growth. In summary, the difference between ABO and PBO consists of two parts. The first part is the general wage growth, in most cases connected to general economic growth. The second part is the development of earnings over the contribution career.

Annex 2 New supplementary table on pension entitlements in national accounts

From 2017 onwards a new supplementary table on pension schemes will be introduced in European national accounts. It covers the stocks of aggregate entitlements of various types of pension schemes, namely those recorded in the non-government sector (columns A-C) as well as those attributed to the government sector (D-H). Unfunded public pension entitlements are shown in column G for government employees and column H for social security pension schemes. The supplementary table also outlines the flows leading to a change of entitlements during a given year. This includes inter alia changes due to pension reforms (see row 7), increases due to actual contributions paid (rows 2.1 and 2.2.) as well as reductions in entitlements due to benefits paid out (row 3).

Table 12: Supplementary table on pension schemes national accounts

Relations	Row No.	Recording		Core national accounts							Not in the core national accounts	Counterparts: Pension entitlements of non-resident households ⁴⁾
		Pension manager		Non-general government			General government				Total pension schemes	
		Defined contribution schemes	Defined benefit schemes and other ¹⁾ non-defined contribution schemes	Total	Defined contribution schemes	Defined benefit schemes for general government employees ²⁾			Social security pension schemes			
						Classified in financial corporations	Classified in general govt 3)	Classified in general government				
Column number	A	B	C	D	E	F	G	H	I	J		
		Opening balance sheet										
	1	Pension entitlements										
		Changes in pension entitlements due to transactions										
	Σ 2.1 to 2.4	Increase in pension entitlements due to social contributions										
	2.1	Employer actual social contributions										
	2.2	Employer imputed social contributions										
	2.3	Household actual social contributions										
	2.4	Household social contribution supplements ⁵⁾										
	3	Other (actuarial) change of pension entitlements in social security pension schemes										
	4	Reduction in pension entitlements due to payment of pension benefits										
	2 + 3 - 4	Changes in pension entitlements due to social contributions and pension benefits										
	6	Transfers of pension entitlements between schemes										
	7	Changes in pension entitlements due to pension scheme reforms										
		Changes in pension entitlements due to other flows										
	8	Changes in entitlements due to revaluations ⁶⁾										
	9	Changes in entitlements due to other changes in volume ⁶⁾										
		Closing balance sheet										
	1 + Σ 5 to 9	Pension entitlements										
		Related indicators										
	11	Output										

Source: Eurostat.

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