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Abstract
In our paper, we discuss pension expenditure as one of the main indicators of pension system sustainability. However, given the large demographic diversity between the European countries, public spending on pensions is hard to compare. We proposed two alternative indicators visualising the level of pension expenditure. The first is the quotient of pension expenditure and GDP and old-age dependency ratio. The second replaces the old-age dependency ratio with the proportion of population aged 65 and over. Such standardisation of the commonly used pension expenditure to GDP indicator makes it possible to provide for the demographic effect and this way it facilitates a comparison of pension expenditures between countries with very different population structures.

KEYWORDS: pension expenditure, pension system, sustainability, cross-country analysis
JEL Classifications: H55, J26

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1 Introduction

Confronted by the ageing of societies, the European Union Member States are forced to reform their pension systems. Because of dynamic demographic changes, the existing well-functioning pension systems are now threatened on the one hand by lack of financial stability and on the other hand by reduced pension adequacy. Considering the gravity of the problem, the streamlined process of the Open Method of Coordination (OMC) on Social Protection and Social Inclusion, which first started in 2006, postulates in one if its specific objectives ensuring adequate and sustainable pensions. The problem is very common and public spending on pensions, growing at a high rate, is one of the main challenges facing the governments. The current demographic situation makes it evident that it will continue growing, as demography is one of the main factors, if not the most important, that determine pension spending.

The European pension systems of the 20th century performed their functions when the working population was much more numerous than the pensioner population. However, the age structure of European societies is changing inevitably and at an increasing pace. Life expectancy is growing, while fertility rates are dropping. In the early 1990s, in EU-27 the average old-age dependency ratio (ODR), defined as the ratio of people aged 65+ to people aged 15-64, was 20%. In just two decades, it went up by 8.5 percentage point on average (see Figure 1). According to Eurostat projections, in 2030 the rate will be 38.3%, and in 2050 - it will reach 50.2%. It is a huge change that PAYG pension systems will not be able to cope with. At the same time, European societies do not have a homogeneous demographic structure and there exist major differences in the old-age dependency ratio between the respective countries. The countries with the highest old-age dependency ratio are Greece (30.9% in 2013), Germany (31.3%) and Italy (32.7%), while the demographic burden is relatively low in Slovakia (18.4%), Ireland (18.6%) and Cyprus (18.8%).

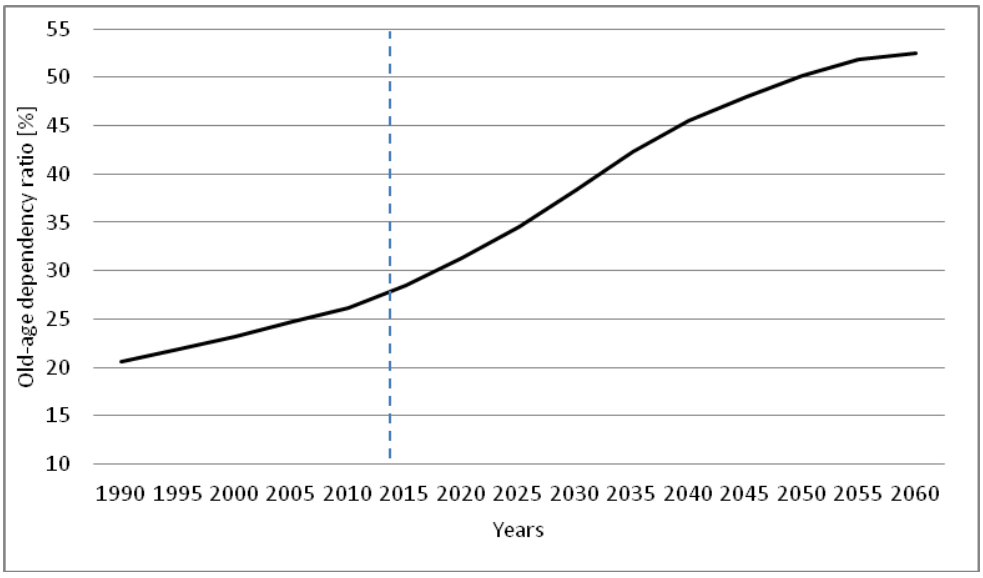

Figure 1. Old-age dependency ratio in 27 EU countries in 1990-2010 and projections for 2015-2060

Source: Eurostat

Given the large demographic diversity between the European countries, public spending on pensions is hard to compare. However, considering the ongoing pension system reforms in Europe, the effects of pension policies require monitoring. Thus, an indicator is needed to enable a cross-country analysis of pension systems taking into account demographic differences. In our paper, we discuss pension expenditure as one of the main indicators of pension system sustainability. The purpose of the paper is to evaluate the ratio of pension expenditure to GDP, which is a commonly used indicator in pension system sustainability analyses. Assuming that it is not an adequate measure for the purpose of cross-country analyses, we propose our own indicator to evaluate the level of pension expenditure that will enable such comparisons.

2 Literature review

The literature concerning pension expenditure focuses mainly on analysing the determinants of age-related public spending. The factors that affect the level of expenditure may be diversified. Cristian (2012) developed a model in which the dependent variable was pension expenditure as % of GDP, while the independent variables were: fertility rate, life expectancy, effective retirement and gross saving. Based on a sample of 15 European Union Member States covering variables analysed for the period between 1995 and 2009, it was proven that all these variables significantly affect public pension expenditures within EU-15 Member States. Pampel & Williamson (1985) analysed the determinants of public expenditure from a somewhat different perspective. Using both time-series and cross-national data, they analysed variables based on the industrialism theory and variables based on the class theory, and they discovered that pension expenditures were mainly affected by age-structure variables and social insurance program experience, with little or no impact of class variables. Sapiri et al. (2010), using a simulation analysis, studied the impact of demography and changes in salary levels on pension expenditure. Using the System Dynamics Model, they analysed the impact of various political scenarios on old-age related public spending. De la Fuente & Domenech (2013), too, developed a model for making projections of expenditures. Conditional on a series of assumptions about the evolution of employment, productivity and demographics, they evaluated the impact of the Spanish pension system reform of 2011 on pension expenditure as a share of GDP.

The other direction in the field of analysing pension expenditure concerns comparative cross-country analyses of age-related spending. As was postulated by the European Commission (2009), pension spending as a share of the gross domestic product (PE/GDP) is a national indicator and it should not be directly compared between different objects (countries). However, there are some studies that compare the PE/GDP level. Loredana (2008), for example, used this indicator to make a comparative analysis of pension spending in 26 European countries. Also, Schneider (2009) and Croitoru (2012) analysed current and projected pension spending in selected EU Member States. However, pension expenditures are not always directly compared. Grech (2010) compared pension expenditures in 25 European countries at the same time confronting them with pensioner poverty in those countries. This way, he identified four groups of countries, where pension reforms took different directions.

3 Pension expenditure as an indicator of pension sustainability

As pointed out by Pallares-Miralles, Romero & Whitehouse (2012), the ultimate measure against which any pension system should be evaluated is the ability to effectively deliver the promised benefits in an efficient and secure manner over multiple generations. The World Bank (2010) developed six criteria that determine the generally understood performance of pension system. Each system may be evaluated in terms of:

- coverage of the pension system by both mandatory and voluntary schemes,
- adequacy of retirement benefits,
- financial sustainability of pensions to the society (taxpayers and contributors),
- economic efficiency, taking into account the impact on economic behaviour of individuals,
- administrative efficiency reflected in low administrative costs of a system,
- security of retirement benefits.

Our analysis focuses on the indicators of financial sustainability. According to Holzmann & Hinz (2005), sustainable refers to the financial soundness of the scheme, now and in the future. This means that all measures aimed at maintaining financial sustainability of a pension system (such as the amount of contributions and benefits or pension age) should be planned in advance and included in the structure of the system. Sustainability relates to the level of the output, which determines the possibilities of ensuring the promised benefits. In the simplest terms, financial sustainability of a pension system is the result of pension expenditures and pension contributions, and expenditures may be divided into expenditures financed from employee and employer contributions and expenditures financed from taxes (European Parliament, 2011). However, such definitions of pension sustainability could suggest that the best system is that with the lowest expenditures, which is an oversimplification that may lead to wrong conclusions. As Grech (2010, p.10) stated "spending on pensions is but a means to an end – the alleviation of poverty and the provision of income replacement during retirement. While spending is an important constraint, having low spending should not be elevated to the status of an objective. A pension system is not successful just because it involves little spending – a successful system is that which achieves its goals with the least pressure on constraints". Thus, a reaction to the ageing of the population may not just be to cut pension expenditure. Asher &d Bali (2013) distinguished between financial and economic sustainability of a pension system. The first focuses on the matching of assets and liabilities, while the other is defined as the capacity of the economy to finance projected liabilities without sacrificing economic growth or other priorities.

As mentioned above, pension sustainability is a category that can be evaluated both as it is now and as it will be in the future. The latter approach seems to be even more important, as it could serve as a warning forecast and mobilise the governments to modify their pension policies. Each pension system is founded on a long-term obligation towards the working population, counted in decades. The ability to fulfil that obligation may be defined as the sustainability of a pension system. As was observed by Pallares-Miralles, Romero & Whitehouse (2012, p.83) "a pension system is sustainable only when it has the capacity to pay current – and future – benefits over a long horizon under reasonable assumptions without shifting substantial burdens to future generations and without having to cut benefits, increase contributions, or change qualifying conditions".

Because of the complexity and ambiguity of the concept of pension sustainability, many papers suggest a broad range of measures to monitor and evaluate sustainability. According to a publication of the World Bank (2010), financial stability of pension systems may be measured with the following indicators: Projected pension spending (% of GDP), Projected contribution revenues (% of GDP), Implicit pension debt (% of GDP) and Present value of contribution revenues (% of GDP). Pallares-Miralles, Romero & Whitehouse (2012) proposed a somewhat different set of pension sustainability indicators: Pension spending to GDP ratio, most recent year, Pension spending to general tax revenue ratio, Unfunded pension liability (accrued to date minus reserves) as share of GDP and tax revenues and Net pension liability (net of assets and projected revenues) as share of GDP and tax revenues. Moscarola (2009), on the other hand, divided sustainability indicators into macroeconomic and microeconomic. The first group, based on aggregated values, includes, for example, the ratio of pension expenditure to GDP, the equilibrium tax rate, the coverage index and the ratio of deficit to GDP. The other group includes indicators determined on the individual level and fully accounting for the individual's heterogeneity in lifetime contribution and benefits profiles.

A broader approach is presented in a publication of the European Commission (2009), which presents sets of indicators to monitor the overarching objectives, as well as specific objectives of the three strands: social inclusion, pensions and health care, provided for in the OMC strategy. Each objective is associates with a separate portfolio of indicators. They are divided into three categories: EU indicators, national indicators and context information. The first group concerns commonly agreed measures, which are relevant to a comparative analysis. The other category of indicators helps evaluate the nature and scale of political measures, however, it should be interpreted jointly with essential background information. These indicators do not enable direct comparisons between countries or they do not have a clear normative interpretation, even though they are computed on the basis of common definitions and methodology. The third group of indicators, relating to context information, enables better understanding of the national context. Additionally, the indicators in the respective portfolios were divided into primary EU and national indicators, which are supposed to cover all the essential dimensions of the defined objective, and secondary EU and national indicators, which, although not essential, provide a better insight into the nature of the analysed problem. For the purpose of monitoring the objective of sustainable pensions, the following four primary indicators were proposed: Total Current Pension expenditure (% of GDP), Employment rate, Effective labour market exit age, Projections of pension expenditure, public and total, 2004-2050 (% of GDP). Both indicators concerning pension expenditure (the first and the fourth) were defined as national, and as such, they are not entirely useful for cross-country comparisons. The secondary indicators for this objective are: Total social protection expenditures (% of GDP), Decomposition of the projected increase in public pension expenditure, both national. The latter indicator includes decomposition with the old-age dependency ratio, the employment effect, the take-up ratio and the benefit ratio. Context information includes: Old-age dependency ratio, Evolution of life expectancy at birth and at ages 60 and 65, by gender, Pension system dependency ratio and Contribution to public and private pension schemes. The first two are EU indicators, and the other two - national indicators.

An interesting modification of the pension expenditure indicator was proposed by Schneider (2009), who studied the pension reform index (PRI). The indicator was defined as the difference between

projected pension expenditure in a single moment in time determined in two different periods, for example: projected expenditure on public pension schemes in 2050 as expected in 1995 and the expenditure in 2050 as expected in 1999. This way, it was possible to determine the impact of pension system reforms in the surveyed European countries on pension sustainability. A positive value of PRI means a lower future fiscal burden associated with age-related expenditures and negative - a higher burden. Zaidi (2012) analysed pension sustainability gap, the indicator of a financial gap (as % of GDP) that has to be covered in order for the government to finance future obligations.

The nature of pension sustainability is very complicated. Although a very desirable property of a pension system, it is hard to define, characterise and quantify in a precise manner. It seems that sustainability as a concept is not gradable. However, if we look at the respective indicators of pension sustainability, we can think about its desired level and compare various objects (countries) by admitting the gradability of sustainability. Various approaches to financial sustainability, focusing on the present and on the future and covering an actuarial approach and an approach based on current national calculations, prove that its nature is hard to identify and that it is a multi-dimensional phenomenon.

Nonetheless, in all the above mentioned lists of indicators for analysing pension sustainability, pension expenditure (as % of GDP) is the most important. It is defined as a part of the national product allocated to pay pension expenditures. This applies both to the current and the projected future level of pension spending. However, the PE/GDP is limited in such a way that makes it not adequate for cross-country comparisons. First of all, it does not take into account demographic differences between countries. It seems that the border between an acceptable level of pension expenditure and a too high level that needs to be reduced is determined by demographic structure and by the level of another dimension of pension performance, namely pension adequacy. The resultant of the two objectives: financial stability of a pension system and adequacy, determines the optimum level of the indicator. The level may differ between countries, depending on the structure of the population. Thus, even though from the point of view of the financial stability of a pension system expenditure should be as low as possible, it is hard to say whether a given pension system is better or worse than another only on the basis of public pension spending.

Sapiri et al. (2008) as well as de la Fuente & Domenech (2013), decomposed the pension expenditure indicator into 4 factors:

$$\frac{pension\quad exp.}{GDP} = \left(dependency\quad ratio\right)\times\left(\frac{1}{employment\quad rate}\right)\times\left(\frac{pensioners}{population\quad 65+}\right)\times\left(\frac{average\quad pension\quad benefit}{average\quad productivi\ ty}\right) \qquad (1)$$

These factors may be characterised as follows:

- a population-ageing effect, represented by the old-age dependency ratio,
- an employment effect, associated with the inverse of the employment rate of the working-age population,
- an eligibility effect, associated with the rate of pension coverage (the share of those receiving benefits in the 65+ age group),
- a benefit effect, reflecting the generosity of a pension system, expressed as the ratio between average pension and average labour productivity (average output per employed worker).

Using simple simulations, Kąsek, Laursen & Skrok (2008) proved that old-age dependency ratio will have the biggest impact of all the above factors on the level of future pension expenditure. Based on a sample of 11 countries (the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovakia, Slovenia, Bulgaria, Romania and Croatia), they found out that, given that the other factors remain unchanged, as a result of the expected demographic changes responsible for the population-ageing effect, in different countries pension spending would rise by 4.1 to 14 points of GDP between 2004 and 2050. Demographic susceptibility of pension expenditure as a share of GDP may be illustrated by correlation charts between this indicator and such variables as old-age dependency ratio or proportion of population aged 65 and over (PP_{65+}). Figures 2 and 3 present regression estimates for pairs of the analysed variables based on a sample of 31 European countries in 2011 (the most up-to-date data in Eurostat's database). In both cases, the determination coefficient was above 0.30, whereas the Pearson correlation coefficient between PE/GDP and ODR was 0.8, and between PE/GDP and PP_{65+} it was 0.55, which proves a significant positive correlation between the respective variables. The higher the demographic burden of a society as a whole or of the working population only, the higher the pension spending level.

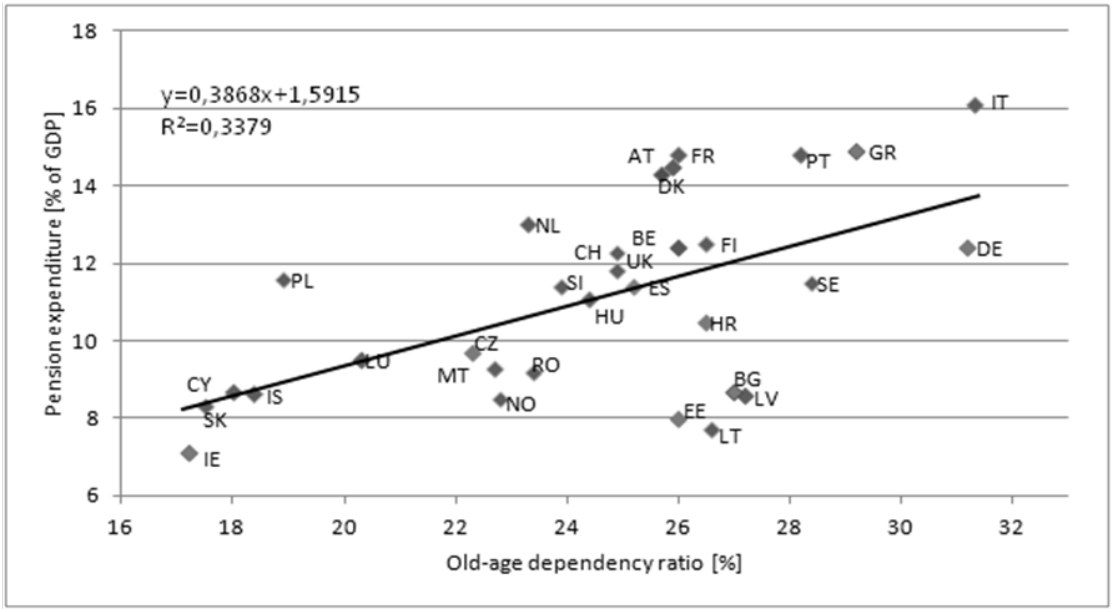

Figure 2. Pension expenditure as % of GDP versus the old-age dependency ratio (31 European countries)

Source: Eurostat

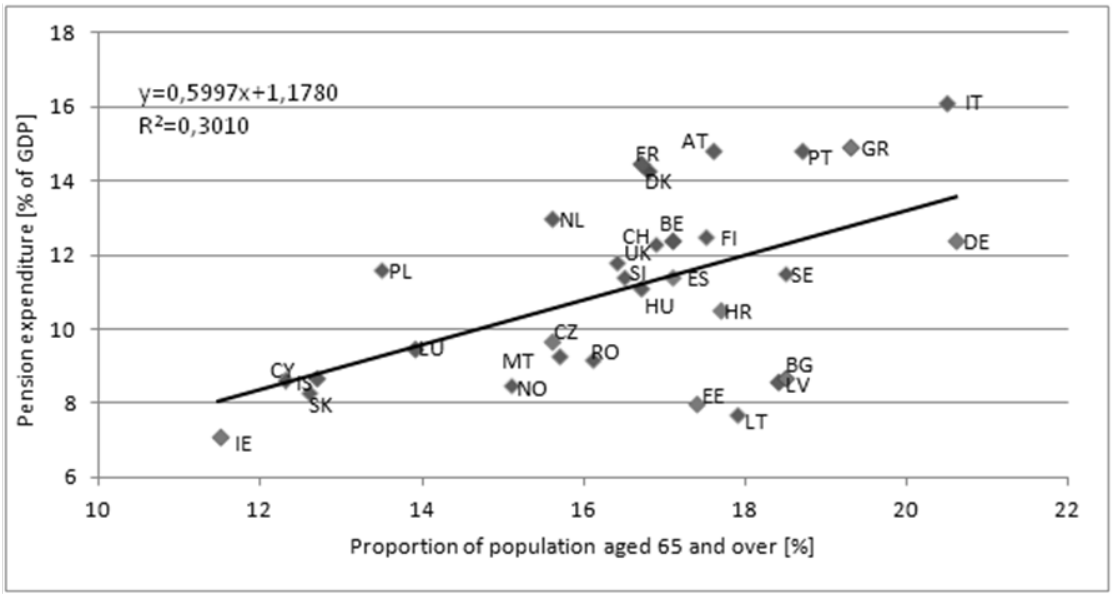

Figure 3. Pension expenditure as % of GDP versus the percentage of the population over age 65 (31 European countries)

Source: Eurostat

A scheme similar to that shown in Figure 3 was presented by Pallares-Miralles, Romero & Whitehouse (2012). Using a much bigger sample of countries from all over the world, they estimated the regression parameters of public pension spending depending on the proportion of population aged 65 and over. In this case, the determination coefficient was 0.75, which is much above the adjustment of our model developed for a sample of 31 European countries. This is an evident proof of the serious impact of demographic conditions on the volume of age-related expenditures. However, the same as in our study, the authors observed a significant variation around the fitted line. This variability is affected by other, non-demographic factors. As was mentioned in the literature review section, pension expenditure determinants may be of different nature, but it seems that the demographic ones are among the most important for and the most influential on the sustainability of pension systems. The other factors are based on macroeconomic variables and variables relating to the structure of a pension system. According to the decomposition presented in formula (1), having eliminated the demographic effect, pension expenditure depends on employment rate, pension system coverage and the level of pension benefit in relation to labour productivity. Obviously, there are a number of other factors that affect pension spending by having an indirect impact on the above effects. It seems, however, that the demographic effect, of all the factors listed in formula (1), is the least susceptible to measures undertaken within the framework of the government policy and that its reaction to changes is slow. Of course, it may be assumed that demographic factors are also to some extent susceptible to policies. The old-age dependency ratio may change, for example, as a result of pro-family policies aimed at increasing the fertility rate. However, the expected effect of such measures, namely reduced ODR, occurs only in a long time perspective. A measure that yields quicker results is, for example, opening borders to immigrants, but such policy is also associated with high social costs. Based on the above deliberations, it may be claimed that the other factors concern determinants that are more flexible and

more dependent on policy-makers. Thus, the relationship between pension expenditure and demographic conditions also determines the border between the attainable and unattainable levels of pension sustainability.

4 Alternative indicators of pension sustainability

Our deliberations concerning pension expenditure indicators and their actual relevance are based on pension system definitions presenting the system from various perspectives. Following Góra (2008), in the macroeconomic scale, we will perceive the pension system as a tool for sharing the current GDP between the working population and the pensioner population. It is a universal definition not dependent on the type of a system (funded or unfunded). This definition is supplemented by a micro-scale definition, where the pension system is identified as a tool for income allocation or consumption smoothing in an individual's life cycle (Barr, 1993; Barr & Diamond, 2006; Blake, 2006; Góra, 2008). The amount of pension spending in a given state is associated with the macro definition, as it shows how the current GDP is shared between generations. Whether we measure pension expenditures as absolute values or as a GDP ratio, we are not able to estimate the amount of pension expenditures in terms of a fair division without taking into account the number of the working population and the population in post-productive age. The proportions between the two populations seem to be the key factor for assessing whether and to what extent GDP is shared in a way that is beneficial for pensioners. Also, by taking these proportions into account in pension expenditure, we are able to evaluate the generosity of a pension system.

The first indicator concerns the ratio of pension expenditure to GDP standardised by the demographic burden indicator measured by the old-age dependency ratio (Chybalski, 2013). This indicator may be associated directly with the definition of a pension system as a tool for sharing GDP between the working population and the pensioner population, as it determines the ratio of gross domestic product, in the form of pension expenditures, that goes to an individual from the pensioner population to the gross domestic product generated by an individual from the working population, which may be expressed and decomposed in the following way:

$$\frac{\frac{PE}{GDP}}{ODR} = \frac{PE}{GDP} \times \frac{popul_{15-64}}{popul_{65+}} = \frac{\frac{PE}{popul_{65+}}}{\frac{GDP}{popul_{15-64}}} = \frac{PE \quad per \quad pensioner}{GDP \quad per \quad wor\,ker} \times \frac{COV}{EMP_{15-64}} \tag{2}$$

where *PE* denotes pension expenditure, $popul._{15\text{-}64}$ is the size of the population aged 15-64, $popul._{65+}$ is the size of the population aged 65 and over, *COV* denotes the pension coverage rate expressed as the share of the pensioners in the 65+ age group, $EMP_{15\text{-}64}$ is the rate of employment in the 15-64 age group.

The pension expenditure indicator decomposed in formula (2) corresponds to the decomposition presented in formula (1). *PE per pensioner* corresponds to average pension benefits, while *GDP per worker* is an indicator of labour productivity. The *COV* factor is related to the share of the elderly in a pension system, while $EMP_{15\text{-}64}$ means the ratio of the working population that actively contributes to generating the output.

It may be expected that the PE/GDP/ODR indicator will be explained differently for long and short time horizons. Any major changes in the old-age dependency ratio level are unlikely in short periods of time, for example from year to year. A significant increase in PE/GDP/ODR over a period of few years would rather mean that pensioners' share in GDP went up. However, in long periods of time, covering decades, when ODR can change significantly, this indicator has a higher information load than the commonly used measure of pension expenditure as % GDP. In the case of cross-country comparisons for the same time spans, this indicator may be interpreted as the share of pensioners in the part of GDP allocated to them, if we divide GDP according to the age structure, which is visible after converting the indicator's formula to PE/(GDP·ODR). The higher the PE/GDP/ODR, the higher the share of pension expenditure in the part of GDP that is proportional to the ratio of pensioners to the total population.

The ratio of pension expenditure to GDP may be modified in another way, too:

$$\frac{\frac{PE}{GDP}}{PP_{65+}} = \frac{PE}{GDP} \times \frac{popul}{popul_{65+}} = \frac{\frac{PE}{popul_{65+}}}{GDP\ \ per\ \ capita} = \frac{PE\ \ per\ \ pensioner}{GDP\ \ per\ \ capita} \times COV \tag{3}$$

where *popul* denotes the size of the whole population.

The same as was the case with PE/GDP/ODR, because of its complexity, interpreting PE/GDP/PP_{65+} may be somewhat difficult and it may require additional background knowledge. In the case of cross-year comparisons for an individual country, an increase in PE/GDP/PP_{65+} means that the share of the pensioner population in GDP increased more or decreased less than did the ratio of pensioner population to the total number of people in the country concerned, or that the pensioners' share in GDP went up, while their ratio to the total population went down. Likewise, a lower value of the indicator means that the share of the pensioner population in GDP increased less or decreased more than did the ratio of pensioner population to the total number of people in the country concerned, or that the pensioners' share in GDP went down, while their ratio to the total population went up.

An indicator similar to PE/GDP/PP_{65+} was used by Pampel & Williamson (1985), who, studying the determinants of pension expenditure, applied two measures of the explanatory variable: the first is pension expenditure to gross national product and the other covers pension expenditure standardised with respect to the size of population entitled to receive pension benefits. It was calculated as pension expenditure per person aged 65 and over divided by the gross national product per capita. According to Pampel & Williamson (1985), such indicator may be interpreted as average pension benefit related to the standard of living.

It should be noted that the above measures are not free of defects. The relationship between pensioners' share in GDP and their ratio to the total population is in a way only an approximation. This is due to the fact that both ODR and PP_{65+} relate to the ratio of the population aged 65+ to the working population or the total population, respectively. Meanwhile, in most countries, the retirement age is different for men and women and a large percentage of the population still retires at an age below the statutory retirement age. Thus, it is just an approximation, but if we want to analyse how the indicator develops in time, rather than its specific values, the results of such analysis will not be significantly distorted.

However, an analysis of the proposed indicators does not tell us whether the division is fair and what level is sufficient, too low or too high. This is due to a close correlation between pension system sustainability and adequacy. The postulate to ensure stability of a pension system is inseparably associated with the postulate to ensure pension adequacy. These objectives, however, may be perceived at the same time as contradictory and as complementary. On the one hand, low pension expenditures, as a part of GDP allocated to pensioners, mean a lower load on the working population and help increase sustainability, but on the other hand, they also result in a lower pension system adequacy. On the other hand, financial sustainability of a pension system is a necessary condition to ensure adequacy in a long time horizon. Measures aimed at increasing adequacy without securing sustainability may yield opposite economic results and potential side effects. As stated by Grech (2010, p.10) "Fiscal sustainability and pension system adequacy are not conflicting aims, but rather two sides of the same coin. Real fiscal sustainability cannot be achieved without ensuring pension system adequacy. If pension systems fall short, there could be strong political pressure for higher government spending on other support". The correlation between the proposed indicators and pension adequacy is shown by their structure. If we decompose PE/GDP/ODR and PE/GDP/PP_{65+} using formulas (2) and (3), we can see that the first contains the component *PE per pensioner/GDP per worker*, and the other - *PE per pensioner/GDP per capita.* In other words, it is the ratio of pensioner consumption to, in the first case, the output generated by the working generation and in the other case - the output per capita. These factors may be, by simplification, called the "macro-scale adequacy". Proper adequacy is measured mainly by the level of an individual pensioner's earnings, and as such it relates to the microeconomic scale.

5 Comparing PE/GDP, PE/GDP/ODR and PE/GDP/PP_{65+} values between selected European countries.

Our empirical study compares the values of the commonly used indicator of pension expenditure as a share of gross domestic product (PE/GDP) to the relevant indicator standardised with respect to demographic inequalities, i.e. PE/GDP/ODR and PE/GDP/PP_{65+}. All the data used in the research come from the Eurostat database. They concern 31 European countries (EU-28, Iceland, Norway and Switzerland) in a 10-year period between 2002 and 2011. According to the ESSPROS methodology, pension expenditures in the respective countries cover the sum of the following social benefits: disability pension, early-retirement due to reduced capacity to work, old-age pension, anticipated old-age pension, partial pension, survivors' pension, early-retirement benefit for labour market reasons.

Table 1. PE/GDP, PE/GDP/ODR and PE/GDP/PP_{65+} in 31 European countries

	PE/GDP			*PE/GDP/ODR*			*PE/GDP/PP*		
Country	2002	2011	change	2002	2011	change	2002	2011	change
Belgium	11,20	12,40	1,20	0,43	0,48	0,04	0,66	0,73	0,06
Bulgaria	-	8,70	-	-	0,32	-	-	0,47	-
Czech Republic	8,40	9,70	1,30	0,43	0,43	0,01	0,60	0,62	0,02
Denmark	10,70	14,30	3,60	0,48	0,56	0,08	0,72	0,85	0,13
Germany	13,40	12,40	-1,00	0,53	0,40	-0,13	0,78	0,60	-0,18
Estonia	5,90	8,00	2,10	0,26	0,31	0,05	0,38	0,46	0,08
Ireland	4,60	7,10	2,50	0,28	0,41	0,13	0,41	0,62	0,20
Greece	11,80	14,90	3,10	0,46	0,51	0,05	0,68	0,77	0,09
Spain	9,30	11,40	2,10	0,38	0,45	0,08	0,55	0,67	0,12
France	13,00	14,50	1,50	0,53	0,56	0,03	0,81	0,87	0,06
Croatia	-	10,50	-	-	0,40	-	-	0,59	-
Italy	14,50	16,10	1,60	0,52	0,51	-0,01	0,78	0,79	0,01
Cyprus	6,40	8,70	2,30	0,37	0,48	0,12	0,55	0,69	0,14
Latvia	8,30	8,60	0,30	0,37	0,32	-0,05	0,54	0,47	-0,07
Lithuania	6,90	7,70	0,80	0,32	0,29	-0,03	0,48	0,43	-0,05
Luxembourg	10,00	9,50	-0,50	0,48	0,47	-0,01	0,72	0,68	-0,04
Hungary	8,90	11,10	2,20	0,40	0,45	0,06	0,58	0,66	0,08
Malta	8,30	9,30	1,00	0,45	0,41	-0,04	0,66	0,59	-0,07
Netherlands	12,70	13,00	0,30	0,63	0,56	-0,07	0,93	0,83	-0,09
Austria	14,50	14,80	0,30	0,64	0,57	-0,07	0,94	0,84	-0,09
Poland	13,70	11,60	-2,10	0,75	0,61	-0,14	1,09	0,86	-0,23
Portugal	10,90	14,80	3,90	0,44	0,52	0,08	0,66	0,79	0,13
Romania	6,70	9,20	2,50	0,33	0,39	0,06	0,48	0,57	0,09
Slovenia	11,30	11,40	0,10	0,55	0,48	-0,07	0,78	0,69	-0,09
Slovakia	7,40	8,30	0,90	0,45	0,47	0,02	0,65	0,66	0,01
Finland	10,90	12,50	1,60	0,48	0,47	-0,01	0,72	0,71	0,00
Sweden	11,50	11,50	0,00	0,43	0,40	-0,03	0,67	0,62	-0,05
United Kingdom	10,70	11,80	1,10	0,44	0,47	0,03	0,67	0,72	0,05
Iceland	6,60	8,60	2,00	0,37	0,47	0,10	0,57	0,70	0,13
Norway	8,30	8,50	0,20	0,36	0,37	0,01	0,56	0,56	0,01
Switzerland	12,40	12,30	-0,10	0,54	0,49	-0,04	0,79	0,73	-0,07

Source: Eurostat data and own calculation

The first stage of our research focused on analyzing the level of all the three indicators between 2002 and 2011 and their change dynamics (see Table 1). While in most countries pension expenditure ratio to GDP increased and only in 4 countries the ratio dropped, in the case of PE/GDP/ODR, pension expenditures went down in 13 countries, and expenditures measured by PE/GDP/PP_{65+} dropped in 11 countries. In other words, pensioners' share in the part of GDP allocated to them drops if we divide GDP according to the age structure. An explanation of the mechanisms of these changes requires, however, a more in-depth study covering an analysis of changes both in gross domestic product per capita and in pension adequacy indicators, such as, for example, replacement rates. Another interesting observation concerns very high values of the PE/GDP/PP_{65+} indicator reported in 2002 in the following three countries: the Netherlands, Austria and Poland. In the latter country, the value of the indicator was 1.09, meaning that Polish pensioners consumed a higher share of GDP than they should judging by the ratio of the pensioner population to total population.

Table 2 presents the correlation between variables PE/GDP and PE/GDP/ODR, and between PE/GDP and PE/GDP/PP_{65+} in the time span between 2002 and 2011 for time series relevant to the respective surveyed countries. In most cases, there exists a correlation between PE/GDP ratio and PE/GDP/ODR ratio (and PE/GDP/PP_{65+} ratio), as the values of Pearson correlation coefficients are close to one. However, in some cases these coefficients are surprisingly low. This is the case, for example, with Malta, where Pearson coefficient is negative both in correlation with PE/GDP/ODR and with PE/GDP/PP_{65+}. This means that a growth in pension expenditure as a ratio to GDP was accompanied in the analysed period by a drop in indicators corrected by the demographic effect. In the analysed period, both pension expenditure and ODR and PP_{65+} in Malta increased, but demographic indicators were growing at a faster rate, thus the negative correlation. The countries where the correlation between the three analysed variables was small but positive included Italy, the Netherlands and Austria. The low correlation coefficient in the case of these countries means that conclusions concerning pension expenditure trends in these countries were different for PE/GDP analysis than for analyses of any of the PE/GDP/ODR and PE/GDP/PP_{65+} indicators. For example, in Austria the PE/GDP indicator slightly fluctuated between 2002 and 2011, rising and falling in turns. Over the span of 9 years, its value increased in total by 0.3 percentage points, which is very little compared to the other European countries (see Table 1). Meanwhile, PE/GDP/ODR gradually decreased, falling by 0.07 in total. This was a major change resulting from a relatively large increase in the old-age dependency ratio (from 22.8% in 2002 to 26.0% in 2011). Thus, an analysis of pension expenditure in Austria only on the basis of PE/GDP leads to the conclusion that it remained on a constant level in the analysed period, while an analysis of PE/GDP/ODR suggests that pension expenditure was limited and the system became less generous.

Table 2. Correlation coefficients between the ratio PE/GDP and the ratios PE/GDP/ODR and PE/GDP/PP (2002-2011 time series)

Country	*PE/GDP & PE/GDP/ODR Pearson coeff.*	*PE/GDP & PE/GDP/PP Pearson coeff.*
Belgium	0,99	0,99
Bulgaria	0,98	0,98
Czech Republic	0,85	0,86
Denmark	0,97	0,98
Germany	0,87	0,88
Estonia	0,98	0,98
Ireland	0,99	0,99
Greece	0,96	0,97
Spain	0,98	0,99
France	0,98	0,98
Croatia	1,00	1,00
Italy	0,48	0,71
Cyprus	1,00	0,98
Latvia	0,94	0,94
Lithuania	0,90	0,88
Luxembourg	0,99	1,00
Hungary	0,98	0,98
Malta	-0,09	-0,27
Netherlands	0,35	0,39
Austria	0,26	0,26
Poland	1,00	1,00
Portugal	0,99	0,99
Romania	0,99	0,98
Slovenia	0,72	0,78
Slovakia	0,95	0,88
Finland	0,65	0,71
Sweden	0,84	0,83
United Kingdom	0,99	0,99
Iceland	0,96	0,98
Norway	0,97	0,98
Switzerland	0,87	0,86

Source: Eurostat data and own calculation

Table 3 shows that the correlation between the values of PE/GDP and PE/GDP/ODR as well as $PE/GDP/PP_{65+}$ decreased in the analysed time span between 2002 and 2011. In both cases, the indicators were the most correlated in 2002 and the least correlated in 2010, which may mean a growing difference between countries in terms of pensioners' share in the part of GDP allocated to them. Let us analyse, for example, Germany and the Netherlands. Both countries had very similar pension expenditures in 2011: 12.4% of GDP in Germany and 13.0% of GDP in the Netherlands, and both countries were among the first ten countries with the highest PE/GDP indicator - the Netherlands on the 7th place and Germany on the 9th place (see Table 1). However, an analysis of PE/GDP/ODR suggests that the situation of both countries was completely different. Considering its demographic structure, Germany spent a smaller part of its GDP on pension benefits, while the Netherlands spent a bigger part. In this respect, the Netherlands was the 4th of all the surveyed countries, while Germany was far behind it on the 24th place.

Table 3. Correlation coefficients between the ratio PE/GDP and the ratios PE/GDP/ODR and PE/GDP/PP (cross sectional series)

Variables	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
PE/GDP & PE/GDP/ODR Pearson coeff.	0,85	0,85	0,85	0,84	0,84	0,83	0,78	0,67	0,66	0,71
PE/GDP & PE/GDP/PP Pearson coeff.	0,88	0,88	0,88	0,88	0,87	0,86	0,83	0,75	0,74	0,78

Source: Eurostat data and own calculation

6 Conclusions

Our paper analyses pension expenditure from different perspectives. The most popular indicator of age-related expenditures is pension spending as a share of gross domestic product. It can be calculated both with respect to current expenditures and as long-time projections. At the same time, it is one of the main measures of pension sustainability. However, this indicator has some limitations that make it difficult to compare in cross-country analyses. The reason why pension expenditures are hard to compare between countries is diversified demographic situation reflected as different pensioner population to total population ratios. As was shown in our paper, demographic conditions have a major impact on pension expenditure, being one of the dominant, if not the most important, determinants of those expenditures.

Because of these reasons, we proposed two alternative indicators visualising the level of pension expenditure. The first is the quotient of pension expenditure and GDP and old-age dependency ratio. The second replaces the old-age dependency ratio with the proportion of population aged 65 and over. Such standardisation of the commonly used PE/GDP indicator makes it possible to provide for the demographic effect and this way it facilitates a comparison of pension expenditures between countries with very different population structures. For example, the old-age dependency ratio in Italy is nearly 33%, while in Ireland it is only 19%, meaning that the load on the working population is much lower in the latter country. Thus, pension expenditure as a share of GDP is not a sufficient indicator if we want to verify which of these two countries better supports its pensioners. The indicators proposed by us are

not free of defects and their full interpretation requires an analysis of the macroeconomic context, but, because they eliminate the effect of demographic differences, they are more appropriate for comparative analyses, especially if we analyse trends over a span of many years.

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