The Multidimensional Adequacy and Efficiency of European Pension Systems: the Ranking and Relationships

Filip Chybalski
Lodz University of Technology
Department of Management
Piotrkowska 266
Lodz, 90-924
Poland
e-mail: filip.chybalski@p.lodz.pl

Abstract
The paper discusses the issue of the adequacy and efficiency of European pension systems. The author perceives the adequacy and efficiency as multidimensional categories expressing the "goodness" of contemporary pension systems. Adequacy refers to the social aspect of pensions whereas efficiency reflects its economic conditions, however broadly understood, including not only financial sustainability, but also the impact pensions have on the labour market. The main goal of the study is to evaluate the multidimensional adequacy and efficiency of European pension systems and to find possible relationships between these two categories of a pension system. The method employed in the study is mainly based on the multidimensional statistical analysis and correlation analysis. The data used in the analysis comes from Eurostat and covers 30 countries in the years 2007 – 2011. The study allows to identify the change in the relationship between synthetic adequacy and synthetic efficiency in a given period from negative to positive one. The paper supports the view that in the long run efficiency is a necessary condition for income adequacy.

Keywords: pension, adequacy, efficiency, synthetic indicators
JEL codes: J26, J11, J14, J18, J21

1. Introduction

Due to deteriorating demographics, pension systems have been constantly evolving all over the world for few decades. The best model has been sought by many countries, however, the reforms or retreats from reforms, like in CEE countries in 2008-2013, suggest that the optimal solutions in pension security have not been found so far. Comparative analyses across many countries may serve for looking for better pension system models, since they are usually based on empirical solutions in this field instead of theoretical models simulated for a given country. Therefore, the main goal of the study is to evaluate the multidimensional adequacy and efficiency of European pension systems and to find possible relationships between these two categories. The paper includes the comparison of 30 European pension systems and the proposition of a ranking based on two main criteria: income adequacy and efficiency of pensions. However, these two categories are treated as multidimensional ones and their dimensions are defined. The Author also tries to find any relationships between adequacy and efficiency. The study enables two important questions to be answered.

- Question 1: is it possible to identify any models of pension systems which in the period of 2007-2011 seem to work better than others?
- Question 2: are there any relationships between the adequacy and efficiency of pension systems?

To solve the stated problem, first the concept of a pension system as well as pension adequacy and efficiency are defined. Then the dimensions of these two categories and indicators serving for their measurement are proposed. Subsequently, simple adequacy and efficiency indicators are aggregated into synthetic indicators and on this basis the ranking of pension systems is presented. The last stage of the study includes the correlation analysis of the relationships between adequacy and efficiency. The interpretation of the results is presented in the conclusion section.

2. Pension Adequacy and Efficiency: the Concepts and Idea of Measurement

A pension system is defined in literature from two different perspectives: micro- and macroeconomic one. From the microeconomic perspective, a pension system is a tool of consumption smoothing in the life cycle (Barr and Diamond 2006; Blake 2006; Góra, 2008). From the macroeconomic perspective a pension system is a tool for dividing the current GDP between the working generation and the generation of pensioners (Góra, 2008). Therefore, future GDP is crucial in a pension system, since the consumption of future pensioners will be determined by future production, generated mainly by the generation of their children (Barr and Diamond, 2006). These micro- and macroeconomic perspectives of studying a pension system allow perceiving them as an input-output model in which adequacy and efficiency are directly connected. Namely, a pension system is a system in which some inputs (mainly pension expenditure, but also administrative costs) are transferred into outputs (pension adequacy) by exogenous demographic conditions (expressed by e.g. old-dependency ratio), however some important side-effects also occur and they concern a labour market first of all. Adequacy refers to the main output or effect of a pension system, whereas efficiency expresses the r between this effect and inputs; however it also includes the main side effects.

Pension adequacy is usually regarded in the literature as a one-dimensional category of a pension system. In such an approach, the most common measure of this adequacy is the replacement rate, defined however in many different ways. Biggs and Springstead (2008) analyze pension adequacy with the use of four types of replacement rates, each based on a different measure of income in the pre-retirement period. They prove that replacement rates can vary significantly depending on the construction of the indicator. Holzmann and Guven (2009) study the replacement rates understood as "a useful yardstick for measuring the adequacy of pension benefits, because they express benefits relative to pre-retirement earnings, thereby indicating the degree to which income is replaced when workers retire" and suggest two main variants of the replacement rates: gross and net, and include benefit indexation in their analyses. Cole and Liebenberg (2008) associate pensioner income level with the level of pensioner consumption using two indicators: the income replacement rate and the consumption replacement rate. This approach refers directly to the fact that a pension system should allow to smooth consumption in the life cycle, and income only enables this through its appropriate allocation in time (see e.g. Barr and Diamond, 2006). A comparative analysis of pension adequacy based on cross-sectional data for 12 selected countries was conducted by Borella and Fornero (2009). They employ so called comprehensive replacement rates (CORE) constructed as the relation between living standards after retirement and living standards during the working years. However, Borella and Fornero (2009) focus only on one dimension of pension adequacy as comprehensive replacement rates apply solely to the optimal level of consumption smoothing.

On the converse side, the multidimensional approach to the analysis of adequacy may be employed and seems to be more appropriate. This results for instance from the Open Method of Coordination, where indicators refer to two dimensions: poverty alleviation and consumption smoothing. Since a pension system in a microscale, according to the life cycle hypothesis, is perceived as a tool of consumption smoothing in an agent's lifecycle, the level of consumption smoothing should ensure the maximization of agent's utility. However, the consumption during the retirement period should be over the poverty line (Barr and Diamond, 2006; Blake, 2006). Therefore, in this paper pension adequacy is perceived as a category consisting on two main dimensions: poverty alleviation and consumption smoothing, and one dimension which is actually the derivate from the two first: differences in adequacy between the genders (see Chybalski and Marcinkiewicz, 2015).

To assess adequacy thus understood, the following measures referring to the first and second dimension are employed. To evaluate the poverty alleviation, the at-risk-of-poverty rate (ARP) and sever material deprivation ratio (SMD) are applied. ARP is defined as the percentage of pensioners' population with income lower than 60% of the median equivalised income in a given country. The equivalised income is a measure of household income that takes account of the differences in the household size and composition (European Commission, 2012). ARP measures relative poverty and it is based on the threshold measured as a percentage of median income, which means that the greater the incomes of a population are, the higher the threshold is. Since relative poverty is sensitive to income equality, severe material deprivation ratio is used as a supplementary measure. SMD is defined as the share of population living in households unable to afford at least 4 out of the following 9 items: i) to pay

rent or utility bills, ii) heating to keep the home sufficiently warm, iii) face unexpected expenses, iv) eat meat, fish or a protein equivalent every other day, v) a week holiday away from home, or which could not afford (even if they wanted to) vi) a car, vii) a washing machine, viii) a colour TV, or ix) a telephone (Eurostat, 2012; Maitre et al., 2013). The severe material deprivation ratio is resistant to the income equality which is an important advantage of this measure in the comparison to ARP.

The other two variables refer to consumption smoothing. The first one is the aggregated replacement ratio (ARR) and the other one is the relative median income ratio for people aged 65 and over (MRI). The ARR indicator is defined as median individual pension of 65–74-year-olds relative to median individual earnings of 50–59-year-olds. This measure is based on gross incomes and does not include other social benefits. Chybalski and Marcinkiewicz (2015) show the main disadvantages of this measure and undermine its representative character as the measure of pension adequacy indicating the relative median income ratio as a supplementary measure. The MRI indicator is based on net incomes, as opposed to the ARR, since it takes median disposable household income for people aged 65 and over and for people aged under 65 into account. Therefore, this measure seems to be more reliable when evaluating incomes of pensioners in the comparison to the incomes of working population.

To measure the third dimension of pension adequacy referring to the differences in poverty and consumption smoothing between males and females, differences (males-females) for all the indicators mentioned above are calculated.

The other multidimensional category of a pension system is efficiency. Due to deteriorating demographics, this category has gained importance and the evaluation of pension systems disregarding the efficiency and accounting only for adequacy would be faulty. To define and measure pension efficiency, following methodology is employed (Chybalski, 2015). Pension system efficiency is perceived as an overall category and refers to both a pension system as well as the economy (mainly the labour market). In this approach, a pension system is perceived as a tool for transferring inputs into outputs by a given demographic conditions, as it was mentioned before. Therefore, the efficiency of a pension system refers to the relation between its adequacy (the main output of functioning of a pension system, including poverty alleviation and consumption smoothing), and its cost in the sense of inputs (pension expenditure, administrative costs) as well as in the sense of side effects on the economy, perceived mainly as the impact a pension system has on the labour market.

To measure pension system efficiency, thus defined, from the static perspective, four sets of indicators referring to different dimensions of this efficiency are employed. Dimension 1 - GDP-distribution efficiency - includes one indicator (Chybalski 2014; Marcinkiewicz and Chybalski 2014):

$$\text{GDP-D\_e} = \frac{\text{PE/GDP}}{\text{ODR}} \tag{1}$$

where *GDP-D_e* denotes the GDP-distribution efficiency indicator. This indicator refers directly to the macroeconomic definition of a pension system according to which a pension system is perceived as a tool for dividing current GDP between generation of workers and generation of pensioners (see Barr and Diamond, 2006; Góra, 2008). I also discount conditions in which this distribution is realized since the old-age dependency ratio affects the GDP distribution. *GDP-D_e* measures the resistance of this distribution to the demographics since it is the ratio between pension expenditure as the percentage of GDP, and old-age dependency ratio. The lower the value of this indicator is, the greater the resistance of pension system to demographic changes is (i.e. to the aging of population).

Dimension 2 - Adequacy efficiency - measures the efficiency at which the pension adequacy is ensured. Following indicators are employed to measure this dimension:

$$\text{ARP\_e} = \frac{1/\text{ARP}}{\text{PE/GDP}} \tag{2}$$

$$\text{SMD\_e} = \frac{1/\text{SMD}}{\text{PE/GDP}} \tag{3}$$

$$\text{ARP\_e} = \frac{\text{ARR}}{\text{PE/GDP}} \tag{4}$$

$$\text{ARP\_e} = \frac{\text{ARP}}{\text{PE/GDP}} \tag{5}$$

where *ARP_e* and *SMD_e* denote the efficiency of relative and absolute poverty alleviation, MRI65+_e and *ARR_e* denote the efficiency of consumption smoothing measured respectively by the aggregated

replacement ratio and relative median income ratio. The first two indicators destimulate the efficiency of a pension system (the-lower-the-better), and the other two stimulate it (the-greater-the-better).

Dimension 3 - Labour market efficiency - measures the most important side effect of a pension system which is its impact on the labour market. This set includes three indicators:

$$EMP55-64\_e = \frac{EMP55-64}{PE/GDP} \quad (6)$$

$$EMP65-74\_e = \frac{EMP65-74}{PE/GDP} \quad (7)$$

$$ARA\_e = \frac{ARA}{PE/GDP} \quad (8)$$

where *EMP55-64_e* denotes efficiency in terms of labour market I, *EMP65-74_e* denotes efficiency in terms of labour market II and *ARA_e* denotes efficiency in terms of labour market III (due to data structure, *ARA_e* is calculated for males and females separately). All the indicators classified to this set refer to two age-groups: directly before retirement, and directly after retirement. They stimulate the efficiency and measure how the GDP distribution affects the labour market.

Dimension 4 - Cost efficiency, includes one indicator which is *AC_e* – administrative cost of pension systems expressed as a percentage of GDP:

$$AC\_e = \frac{AC}{PB} \quad (9)$$

where *AC_e* denotes the administrative cost of a pension system expressed as a percentage of pension benefits. Obviously, this indicator affects the efficiency of a pension system negatively (the-greater-the worse).

To summarize this section, according to the presented concepts of adequacy and efficiency, and the methods of their measurement, adequacy refers mainly to the microscale and characterizes the capacity of a pension system to ensure the elderly appropriate income and, therefore, living standard over the poverty line (relative or absolute) at least. The efficiency refers to macroscale and is developed on the concept of a pension system perceived as a tool for dividing current GDP between generations. As a result, efficiency takes also into account the relationship between pensions and the labour market, similarly to relations between generation of pensioners and generation of workers.

3. Data and Research Strategy

The data used in the analysis comes from Eurostat database and OECD database (only average age of retirement ARA) and cover the period of 2007-2011. The main limitation of the analyzed period results from the data gap in average rate of retirement for the year 2012. The analysis embraces 30 European countries: Belgium (BE), Bulgaria (BG), Czech Rep. (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (GR), Spain (ES), France (FR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), Great Britain (GB), Island (IS), Norway (NO) and Switzerland (CH).

The research strategy consists of the following stages. First, all the simple indicators are standardized and transferred into stimulant variables (the-greater-the-better) and the group indicators for each dimension of adequacy and efficiency are calculated as a linear combination (simple mean) of all the indicators used to measure a given dimension of adequacy or efficiency. Second, synthetic indicators of adequacy and efficiency are calculated as a linear combination (also simple mean) of group indicators, obviously for adequacy and efficiency separately. For each year, all the simple indicators are used to calculate group indicators, and as a consequence, to calculate synthetic indicators (see Chybalski, 2012). This results from the fact that the only criterion for variables selection in the multidimensional analysis is of substantial nature. Any correlation analysis is not used to eliminate possible similar variables since it could result in different sets of indicators used to calculate group and synthetic indicators for different years. The last stage of the study includes the interdependence analysis of different dimensions of adequacy and efficiency to find possible relationships between them.

4. Ranking and Relationships

Table 1 presents the synthetic indicators of adequacy (SA) and efficiency (SE), and Table 2 the adequacy ranking positions and efficiency ranking positions of the countries studied.

Table 1: Synthetic Adequacy (SA) Indicators and Synthetic Efficiency (SE) Indicators

	2007		2008		2009		2010		2011	
	SA	SE	SA	SE	SA	SE	SA	SE	SA	SE
BE	0.71	0.45	0.72	0.45	0.69	0.45	0.67	0.45	0.60	0.44
BG	0.39	0.56	0.39	0.57	0.21	0.52	0.18	0.50	0.17	0.50
CZ	0.75	0.5	0.74	0.51	0.70	0.51	0.71	0.49	0.65	0.49
DK	0.67	0.26	0.71	0.26	0.65	0.24	0.61	0.27	0.59	0.27
DE	0.77	0.42	0.78	0.43	0.78	0.44	0.74	0.46	0.72	0.48
EE	0.41	0.81	0.45	0.78	0.39	0.74	0.49	0.69	0.50	0.83
IE	0.68	0.57	0.75	0.57	0.71	0.57	0.73	0.50	0.67	0.51
GR	0.55	0.52	0.6	0.49	0.64	0.56	0.53	0.48	0.54	0.39
ES	0.72	0.6	0.74	0.64	0.70	0.65	0.63	0.61	0.68	0.61
FR	0.85	0.24	0.8	0.23	0.89	0.19	0.84	0.20	0.82	0.23
IT	0.66	0.44	0.77	0.44	0.69	0.44	0.66	0.44	0.63	0.42
CY	0.34	0.54	0.47	0.58	0.47	0.59	0.44	0.50	0.44	0.47
LV	0.30	0.68	0.26	0.65	0.23	0.57	0.44	0.52	0.53	0.60
LT	0.37	0.60	0.47	0.58	0.46	0.54	0.69	0.61	0.60	0.66
LU	**0.93**	**0.83**	**0.95**	**0.86**	**0.92**	**0.86**	**0.92**	**0.86**	**0.94**	**0.87**
HU	0.81	0.55	0.87	0.58	0.82	0.62	0.79	0.57	0.74	0.62
MT	0.66	0.53	0.64	0.53	0.68	0.55	0.63	0.53	0.6	0.58
NL	0.77	0.30	0.81	0.33	0.78	0.31	0.76	0.32	0.74	0.32
AT	0.85	0.40	0.82	0.39	0.73	0.40	0.65	0.40	0.64	0.41
PL	0.76	0.47	0.74	0.48	0.67	0.49	0.59	0.47	0.58	0.47
PT	0.69	0.46	0.68	0.46	0.64	0.48	0.63	0.47	0.66	0.46
RO	0.47	0.59	0.59	0.64	0.59	0.61	0.61	0.6	0.62	0.61
SI	0.60	0.62	0.63	0.66	0.59	0.67	0.51	0.62	0.48	0.62
SK	0.69	0.45	0.71	0.52	0.70	0.53	0.74	0.53	0.67	0.56
FI	0.68	0.49	0.65	0.49	0.64	0.46	0.63	0.46	0.56	0.46
SE	0.81	0.53	0.79	0.53	0.71	0.53	0.64	0.54	0.59	0.55
GB	0.69	0.44	0.69	0.43	0.70	0.42	0.66	0.42	0.61	0.42
IS	**0.68**	**0.79**	**0.71**	**0.86**	**0.68**	**0.87**	**0.71**	**0.9**	**0.71**	**0.84**
NO	0.65	0.72	0.72	0.78	0.68	0.77	0.60	0.73	0.63	0.74
CH	0.67	0.29	0.65	0.30	0.59	0.31	0.57	0.30	0.53	0.29

Source: own calculations on the basis of Eurostat and OECD data

We can see that the best pension system in terms of both studied categories in the whole analyzed period is that of Luxembourg. The SA indicator values for this country are not lower than 0.9 which means that this pension system is almost equal to a hypothetical system being the best in terms of all the adequacy dimensions (for such a theoretical pension systems SA would equal 1). In terms of efficiency, this pension system is a bit more distant from a theoretical one being the best in terms of all the efficiency dimensions, however, in each year SE exceeds 0.8. The second best pension system in terms of adequacy is that of France, however, in terms of efficiency it is definitely the worst. The Luxembourgian pension system suggests that adequacy goes hand in hand with efficiency while the example of France indicates

something quite the opposite. The other adequate pension systems are those of the Netherlands, Hungary, Denmark and Austria. The other CEE countries like the Czech Rep. or Slovakia are characterized also by relatively adequate pensions. However, Bulgaria and Lithuania are placed on the opposite end with the lowest pension adequacy. Estonia, Slovenia, Latvia or Romania have also very low pension adequacy.

Table 2: The Ranking of Pension Systems Based on Synthetic Adequacy (SA) and Synthetic Efficiency (SE) Indicators (the Position of a Given Country in a Given Year)

	2007		2008		2009		2010		2011	
	SA	SE	SA	SE	SA	SE	SA	SE	SA	SE
LU	1	1	1	1	1	2	1	2	1	1
FR	2	30	5	30	2	30	2	30	2	30
NL	7	27	4	27	5	28	4	27	3	27
HU	5	12	2	11	3	7	3	9	4	6
DE	6	25	7	24	4	24	6	22	5	17
AT	3	26	3	26	6	26	14	26	12	25
IE	15	10	9	13	7	11	7	14	8	14
CZ	9	17	12	17	11	18	9	17	11	16
IS	16	3	15	2	16	1	8	1	6	2
ES	10	7	10	8	9	6	17	6	7	9
SK	12	22	17	16	10	15	5	12	9	12
SE	4	14	6	15	8	16	15	10	21	13
GB	13	24	18	25	12	25	12	25	16	24
BE	11	21	13	22	13	22	11	23	17	22
IT	21	23	8	23	14	23	13	24	13	23
PT	14	20	19	21	20	20	16	19	10	21
NO	22	4	14	4	17	3	22	3	14	4
PL	8	19	11	20	18	19	23	20	22	19
DK	18	29	16	29	19	29	21	29	20	29
MT	20	15	22	14	15	13	18	11	18	11
FI	17	18	21	18	22	21	19	21	23	20
RO	25	9	25	7	25	8	20	8	15	8
GR	24	16	24	19	21	12	25	18	24	26
CH	19	28	20	28	24	27	24	28	25	28
LT	28	8	27	9	27	14	10	7	19	5
SI	23	6	23	5	23	5	26	5	28	7
EE	26	2	28	3	28	4	27	4	27	3
CY	29	13	26	10	26	9	29	16	29	18
LV	30	5	30	6	29	10	28	13	26	10
BG	27	11	29	12	30	17	30	15	30	15

Source: own calculations on the basis of Eurostat and OECD data

As far as efficiency is concerned, the group of the best pension systems belong (next to Luxembourg) also Iceland, Estonia, Norway or Slovenia. The lowest efficiency, next to France, is exhibited by such countries as Denmark, Switzerland, Netherlands or Austria. Since the goal of the study is to indicate the best and the worst pension systems in terms of adequacy and efficiency and, then to search for possible relationships between these categories, the selected pension systems are not characterized. The answer to the question why given countries have better and others have worse pension

systems is also very important and this is a subject for further possible research based on the results presented here. However, since the Danish pension system is assessed as one of the best when using the Melbourne Mercer Global Pension Index (Australian Centre for Financial Studies, 2012), some explanation is needed. Denmark has a relatively low level of consumption smoothing measured by ARR and MRI indicators. In the studied period ARR for Denmark oscillates between 0.39-0.44 while the mean value for the whole studied group equals 0.47-0.53 it is 0.70-0.76 and 0.79-0.89 respectively. This results in low adequacy efficiency, especially due to relatively high pension expenditure as proportion of GDP. In Denmark it was about 9.2%-11.2% while the mean for all the countries equals 6.5%-8.1%. This expenditure is relatively high when accounting for old-age dependency ratio. Therefore, Denmark has one of the worst proportions between pension expenditure and old-age dependency ratio (I dimension of pension system efficiency – GDP – distribution). Besides, Global Pension Index does not account for the labour market indicators for age groups directly before or after retirement age, as opposed to the approach presented in this paper.

Figure 1 presents the scatter plots for SA and SE indicators for each of analyzed years. This suggests that there is no significant relationship between synthetic adequacy and synthetic efficiency. However, the figure reveals to some extent surprising regularity, namely, that the regression line changes from negative to positive one. This suggests that the relationship between synthetic adequacy and synthetic efficiency has changed over the studied period of time. However, as was mentioned previously, this relationship is very weak, if it exists at all, therefore any conclusions about the changes in this relationship must be very cautious.

Figure 1 also confirms that Luxembourg has the best pension system. Additionally, Iceland, Norway, and Estonia seem to be at a different efficiency level in comparison to the rest of countries. Bulgaria is at the lowest level in the sense of adequacy and the graph shows that this distance to other countries is really significant and seems to grow. The fact that there are not identified strong relationships between synthetic adequacy and synthetic efficiency does not imply that there are no such relationships between given dimensions of these categories.

The correlation analysis for different pairs of group indicators (after their stimulation) suggests that:

- Poverty alleviation SA(I) is positively correlated with consumption smoothing SA(II) - the lower the poverty rates, the higher the consumption level among pensioners (see Figure 2). This results from the fact that three of four adequacy indicators are directly affected by incomes and one indicator (SMD) referring to the absolute poverty is also affected by incomes, however in an indirect manner;
- Labour market efficiency SE(III) is positively correlated with the GDP-distribution efficiency SE(I) (see Figure 3) and adequacy efficiency SE(II) (see Figure 4). Additionally, the relationship between adequacy efficiency SE(II) and labour market efficiency SE(III) has become more and more positive. This all may suggest that contemporary economies need an effective interactions between a pension system and labour market to ensure adequate and relatively cheap benefits (as the adequacy efficiency is the ratio between adequacy and pension expenditure);
- The relationship between poverty alleviation SA(I) and labour market efficiency SE(III), although weak, has evolved from negative to positive in the studied period (see Figure 5). This confirms the conclusion drawn in the point above that an adequate pension system (also in the sense of poverty alleviation) needs an efficiency referring to the labour market since the interactions between a pension system and labour market are perceived as the main side-effect of pensions.

The identified relationships suggest that the impact a pension system has on the labour market, and vice versa, since this relation has obvious feedback resulting in the income from taxes or contributions to a public pension fund, seems to be stronger and transforming into a positive one in the studied period (see Figure 4 and 5). This efficiency is also positively correlated with the efficiency of GDP-distribution (see Figure 3). This all suggests that in the period of deteriorating demographics the impact of a pension system on the labour market has been crucial for financial sustainability and therefore, on pension system adequacy, especially in terms of poverty alleviation. As Figure 5 shows, the negative relation between labour market efficiency and poverty alleviation has transformed from a

negative to positive one, while, which is worth noting, in the case of labour market efficiency and consumption smoothing has remained very weak (lack of correlation). This may suggest that today, the first dimension of adequacy (poverty alleviation) is more sensitive to the efficiency of a pension system in terms of its main side effect which is the impact on labour market, then the second dimension of adequacy (consumption smoothing). Going forward, since the relationship between a pension system and the labour market can be perceived as a function of the retirement age, the increasing of this age seems to be obvious means to keep pension systems financially sustainable, regardless whether any other reforms have been taken and what their direction is (to funded or unfunded model, to defined benefit or defined contribution).

5. Conclusion

The theoretical background for studies on the relationship between pension system adequacy and efficiency is still very weak since these two categories have been relatively recently regarded as multidimensional ones. The study allowed two questions asked in the introduction to be answered. The proposed measurement procedure based on synthetic indicators calculated as linear combinations of given simple indicators of adequacy and efficiency, allows the evaluation of different pension systems on the basis of comparable data. However, this method has some limitations. The first is regarding the equal wages of each simple indicator, and then of each dimension of adequacy or efficiency when calculating synthetic indicators (SA and SE). The other limitation concerns the relativeness of the evaluation. This enables the comparison of different pension systems at a given moment of time, however the comparison based on time series (between different moments of time) could be faulty since the increase in a given synthetic indicator does not necessarily mean that a given pension system has improved, and vice versa. This may result from changes in the values of indicators describing other pension systems to which a given system is compared. However, the proposed approach to the evaluation of adequacy and efficiency seems to be working and enables indicating a better and worse pension system.

One of the most important results of the study is identification of transforming relationship between synthetic adequacy and synthetic efficiency from a negative to positive one. It seems to confirm that in the long prospect a main condition for income adequacy is efficiency. When demographics have been deteriorating, only an efficient pension system can ensure adequate benefits in the long run. The above mentioned change from a negative to a positive relationship between these two multidimensional categories allows to suspect that the time in which many countries benefit from a demographic dividend has gone and governments have to face the problem of optimization the adequacy by a given demographic constraints instead of its maximization. Another interesting and strong relationship exists between the first and the third dimension of efficiency. Pension system with a better GDP-distribution between generations (with lower pension expenditure in relation to old-age dependency ratio) has weaker negative side effects on labour market – the lower the pension expenditure in comparison to the old-dependency ratio is, the higher the employment rate in population aged close to retirement age is. This all allows to draw a cautious conclusion that contemporary pension systems require better stimulation of people to stay longer on labour market and keep them economically active throughout the motivation to increase their pension benefits. Therefore, many countries have decided the change a benefit formula from defined benefit (DB) to defined contribution one (DC). This has impact not only on the microeconomic level (households) but also affects the macroeconomics of a pension system throughout the change in the structure of GDP distribution between generations.

A preliminary study of the relationships between synthetic adequacy and synthetic efficiency as well as between their dimensions described in this paper opens the prospect for further studies in this area. These could concern seeking solutions (model and parameters) in selected pension systems making them better than others, as well as more in depth analyses of the relationships between different dimensions of adequacy and efficiency. However, these analyses could be based not on aggregated but on simple indicators, referring to poverty, consumption smoothing, pension expenditure, old-dependency ratio, administrative cost, and labour market indicators. The coincidence or causal relationships between the labour market and the pension system seems to be the most interesting and important when searching for the best models and parameters (including retirement age) of a pension system.

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References

AUSTRALIAN CENTRE FOR FINANCIAL STUDIES (2012). Melbourne: Mercer Global Pension Index.

BARR, N., DIAMOND, P. (2006). The economics of pensions. *Oxford Review of Economics Policy*, vol. 22, no. 1, pp. 15–39.

BIGGS, A.G., SPRINGSTEAD, G.R. (2008). Alternate measures of replacement rates for social security benefits and retirement income. *Social Security Bulletin*, vol. 68, no. 2, pp. 1–19.

BLAKE, D. (2006). *Pension Economics*. West Sussex: John Wiley and Sons.

BORELLA, M., FORNERO, E. (2009). *Adequacy of pension systems in Europe: An analysis based on comprehensive replacement rates*. ENEPRI Research Report No. 68. Brussels: Centre for European Policy Studies.

CHYBALSKI, F. (2012). *Measuring the multidimensional adequacy of pension systems in European countries*. Pensions Institute Discussion Paper PI-1204. London: Cass Business School.

CHYBALSKI, F. (2014). Financial Stability of Pension Systems: A Cross Country Analysis. In *Proceedings of the 14th International Conference on Finance and Banking*. Karvina: Silesian University, pp. 150–158.

CHYBALSKI, F. (2015). The Multidimensional Efficiency of Pension System: Definition and Measurement in Cross-Country Studies. *Social Indicators Research* (accepted paper, doi: 10.1007/s11205-015-1017-3).

CHYBALSKI, F., MARCINKIEWICZ, E. (2015). The Replacement Rate: An imperfect Indicator of Pension Adequacy in Cross-Country Studies, *Social Indicators Research* (accepted paper, doi: 10.1007/s11205-015-0892-y).

COLE, C.R., LIEBENBERG, A.P. (2008). *An Examination of Retirement Income Adequacy Measures and Factors Affecting Retirement Preparedness*. Working paper. New York: Social Science Research Network.

EUROPEAN COMMISSION (2012). *Pension Adequacy in the European Union* 2010-2050. Brussels: European Commission.

EUROSTAT (2012). *Measuring material deprivation in the EU*. Eurostat Methodologies and Working papers. Luxembourg: Publications Office of the European Union.

GÓRA, M. (2008). *Retirement decisions, benefits and the neutrality of pension systems,* ENEPRI Research Report No. 51. Brussels: Centre for European Policy Studies.

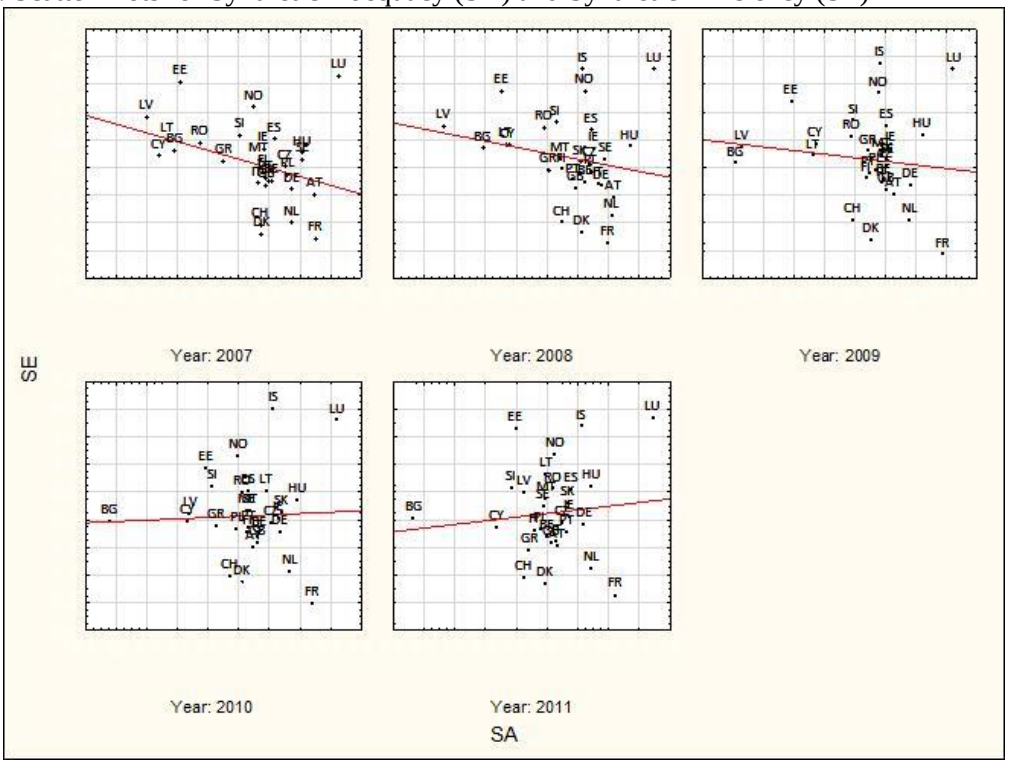
HOLZMANN, R., GUVEN, U. (2009). *Adequacy of retirement income after pension reforms in Central, Eastern, and Sothern Europe: Eight country studies*. Washington, D.C.: The World Bank.

MAITRE, B., NOLAN, B., WHELAN, T. (2013). *Critical Evaluation of the EU 2020 Poverty and Social Exclusion Target: The Analysis of EU-SILC 2009*, Geary WP2013/09. Dublin: UCD Geary Institute for Public Policy.

MARCINKIEWICZ E., CHYBALSKI F. (2014). How to measure and compare pension expenditure in cross-country analyses? *International Journal of Business and Management*, vol. 2, no. 4, pp. 43–59.

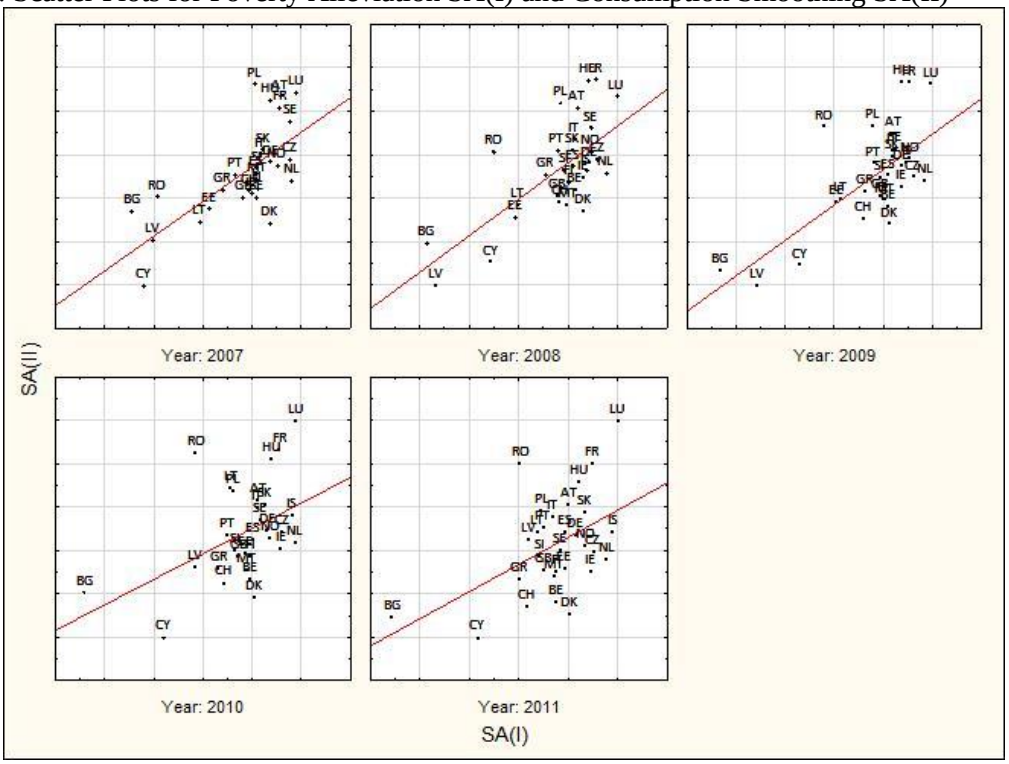
Appendix

Figure 1: Scatter Plots for Synthetic Adequacy (SA) and Synthetic Efficiency (SE)



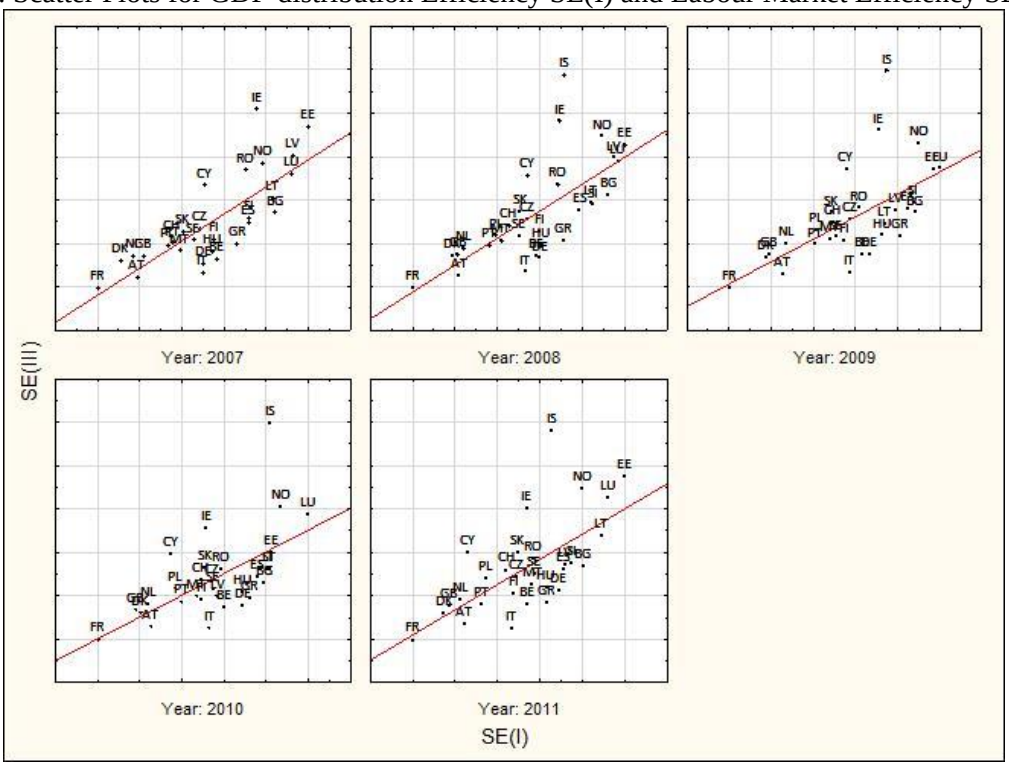
Source: own calculations on the basis of Eurostat and OECD data

Figure 2: Scatter Plots for Poverty Alleviation SA(I) and Consumption Smoothing SA(II)



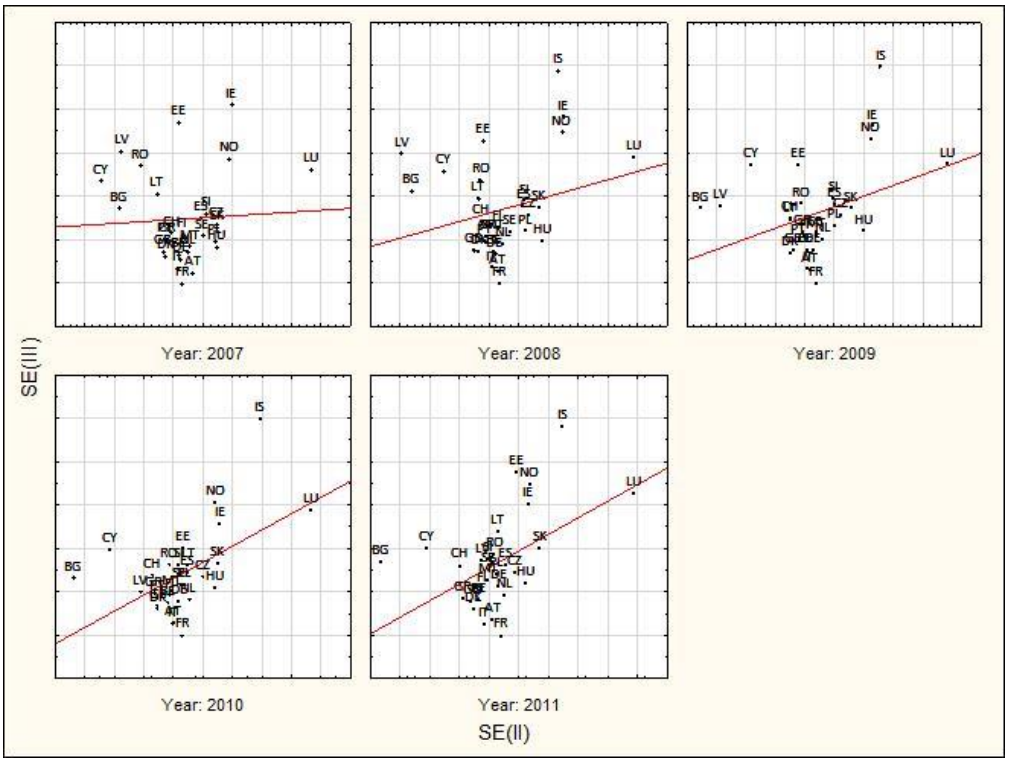
Source: own calculations on the basis of Eurostat and OECD data

Figure 3: Scatter Plots for GDP-distribution Efficiency SE(I) and Labour Market Efficiency SE(III)



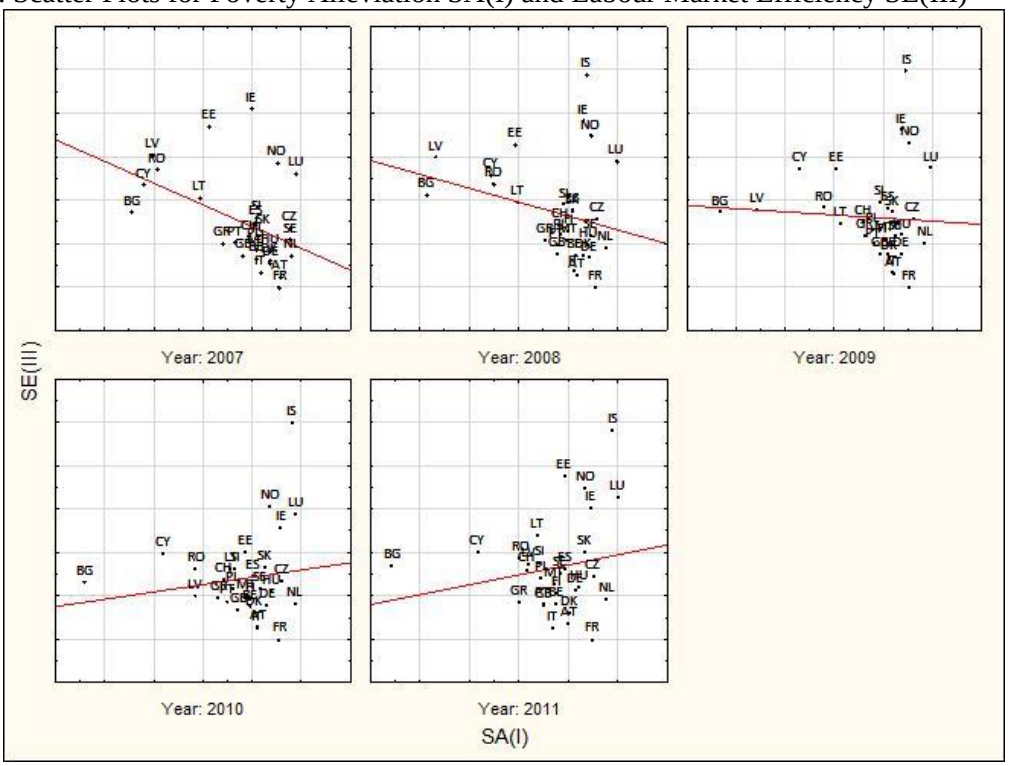
Source: own calculations on the basis of Eurostat and OECD data

Figure 4: Scatter Plots for Adequacy Efficiency SE(II) and Labour Market Efficiency SE(III)



Source: own calculations on the basis of Eurostat and OECD data

Figure 5: Scatter Plots for Poverty Alleviation SA(I) and Labour Market Efficiency SE(III)



Source: own calculations on the basis of Eurostat and OECD data