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Microsimulation Modelling of the Pension System

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Abstract: One of the most significant social changes in the countries of the European Union is the rapid ageing of their populations and its current and excpectable effects on their balances of economies. Hungarian population, similarly to those of other European countries is also rapidly ageing, making it inevitable to face different challenges in the near future. The most important of these are the reforming of the healthcare system, social insurance, pension system and taxing system. The realization of these reforms require long-term strategies on the part of the state - the strategies should be modelled, tested and controlled. In some countries of the European Union the methodology of microsimulation has been used for a long while in order to check different impacts of different regulations, and it is getting popular in Hungary as well. This study consists of three parts. The first part is presenting the present and excpectable changes of the population of the European Union as a whole. The second part presents the results of pension modelling of the countries of the EU. The third part is describing a possible setting up of a 4 year-long research project examining the economical effects of globally ageing population on pension security.

Keywords: microsimulation, modelling of the pension system, research project

1 Changing of the populations of the European Union and Hungary

At present most countries' social insurance systems are pay-as-you-go (PAYG) systems, i.e. expenses of pesions being payed are covered by the inpayment of jobholders. [2]. The theoretical foundation of this kind of pension system was introduced in a publication of Paul Samuelson in 1958. This theoretical foundation is based on the presumption that the active members of the society support the elderly. This presumption is valid regarding the maintaninability of the system only if the number of babies being born is sufficient to insure enough

active future jobholders to be able to support the preceding generation(s). Another presumption of Samuelson is that by the constant growth of population economic development also takes place [13]. We can examine the distribution of population regarding age by a population pyramid. As the first figure shows- calculations of the website called Population Pyramids- the population of Europe is going to decrease. The figure is representing the pyramid of ageing societies. According to precalculations rapid ageing can be expected- it endangers the long-term sustainability of pension systems of the European countries [4] [16].

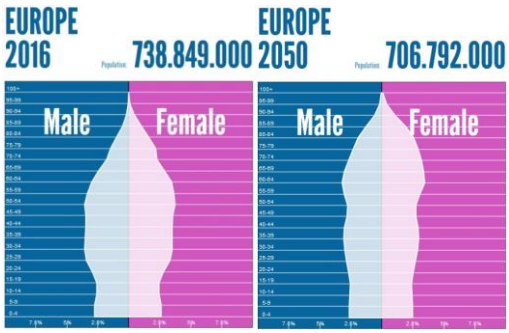

Figure 1.
Population pyramid of Europe in 2016 and 2050 [Population Pyramids]

The population pyramid of Hungary can be found on the website of Population Pyramids or on the website of Hungarian Central Statistical Office (KSH) in a virtual, interactive format. According to the second figure at 2050 Hungary's pyramid – similarly to the of one of the European Union - is going to take the shape of a stagnant population. The proportion of young (children: 20-25%) and middle-aged inhabitants is almost identical to each other, while at elderly generations' (10-15%) lanes the pyramid is getting radically thinner.

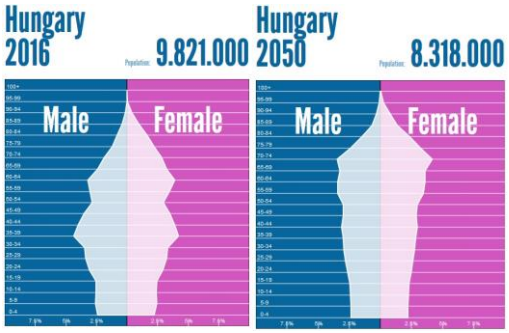

Figure 2.
Population pyramid of Hungary in 2016 and 2050 [Population Pyramids]

The first chart shows the precalculations of a study of Commission of the European Parliament (EPC). According to the study a rapid ageing can be expected of the populations of the European Union as a consequence of the growing lifetime of men and women. [4] Precalculations assume that the number of births are going to change significantly, what more, a stagnant period of time can be expected.

The first chart demonstrates the dramatical changes of the job-holder generations: the active part of the population is going to decrease radically. Expenses of pension payment are likely to grow at the same time. Financing pension payments might become a heavier burden for countries of the European Union including Hungary as well. [4] [16].

	2010	2050
Life expectancy, female	82,1 years	89 years
Life expectancy, male	76 years	84,5 years
Number of births	1,5	1,6
Working age group (15-64)	325 million	283 million
EU pension expenses (GDP %)	10,2 %	12,5 %
Hungary pension expenses (GDP %)	10,4 %	13,8 %

Chart 1.
EPC precalculations for EU [4]

The basis of the maintenance of PAYG pension system would be a significantly bigger number of jobholders than retired citizens in a society- otherwise the system is going to become imbalanced [6]. According to the precalculations of KSH the proportion of younger and older generations are not going to change in a positive direction as the number of elderly population is going to increase, while young (working) population is going to decrease [7].

According to chart 2. the proportion of working and retired inhabitants has hardly changed from the 22,4% values from the 1970's to 2000, but it can rapidly change to 47,7% by 2050 [14]. Practically this change of proportions would mean that while in 1970 one retired person was financed by 5 jobholders, by 2050 one retired citizen can be financed only by 2 active members of the society.

Year	1970	1980	1990	2000	2010	2020	2030	2040		2050
Proportion of retired and jobholder	22,4	26,9	27,2	23,6	24,6	30,2	33,7	38,6		47,7

Chart 2.
Proportion of retired and jobholder (aged 15-64) [14]

2 Possible ways of modelling a state pension system

State pension systems are targeting long-term goals and have long-term impacts. [1]. Hungarian pension system is found on two main pillars: the first pillar is the PAYG principle, the second is the capital provision principle (see Fig. 3.) [12]. In the case of a pension system based on the PAYG principle the incoming contributions are not capitalised nor invested, but yearly pensions are directly payed from them [6]. The PAYG system is comfortable and might seem attractive until population and economy is in the wave of growth [13]. The recent obligatory social insurance system is loaded be the following three problems that endanger the financial balance of the Hungarian pension system : ageing of population, low level of employment, partial payment of contributions. According to demographical data population has stopped growing long time ago, while a the same time pension payments are continuously growing as numbers show [9] [10].

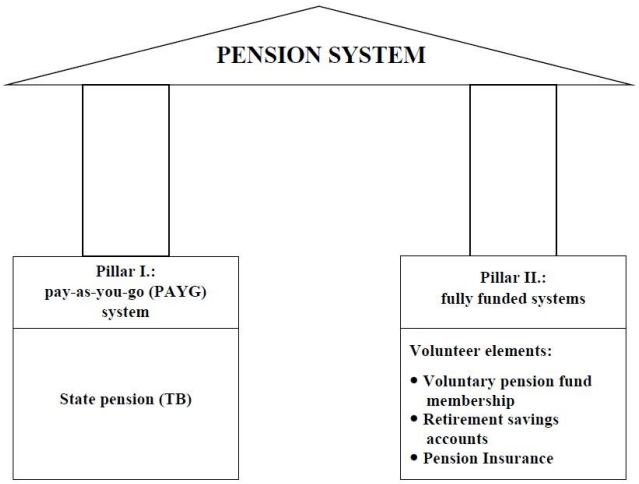

Figure 3.

Pillars of Hungarian pension system now [own figure]

The PAYG systems undergo a serious crisis in the European Union, reforms of pension systems are unescapable. On a macro level of problem-solving an automatism should be designed for contributions and pension payments that would would insure the long-term balance of the system [14]. The above listed problems would require the supervision of the long-term effects of regulations and basic principles of the pension system- the methods of microsimulation are definitely a practicable choice for this [3] [5] [8] [15] [17] [18].

The micro-simulation models applied in the impact analysis of the pension system may be classified according to many aspects, from absolutely static to fully dynamic (see Fig. 4.) [17]. Micro-simulation modelling takes place at the level of individuals and households, i.e. in those locations where the direct impacts of the changes of the pension system are registered. This enables the modelling of the effects in time of the distribution of various characteristics (such as income, amount of the pension).

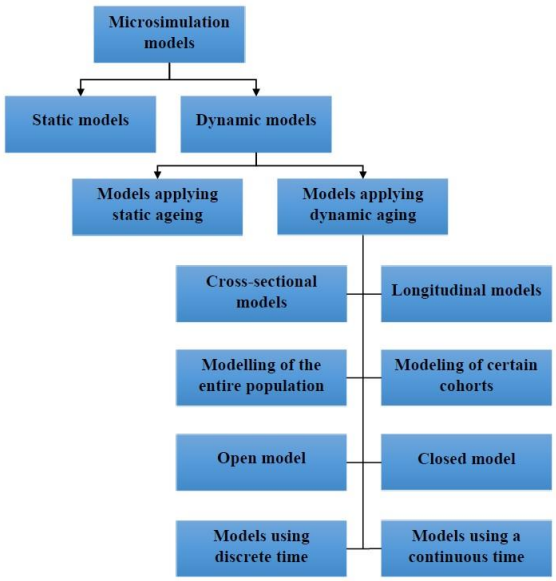

Figure 4.

Microsimulation models [17]

In general, we use the following two micro-simulation models in the impact analysis of pension systems (see Fig. 5) [18]:

- Static models: Pension modelling based on statistical data collection, where we continue writing the data of the known population by aid.

Statistical and probability analysis tools may be used for continuing to project the data of the objects under examination. The impact of the hypotheses assumed in the given model may be assessed by the standard statistical analysis of the results of the simulation, and these results may be considered when strategic decisions are made, e.g. KSH [5] [6] [8] [18].

- Dynamic models: Micro-simulation calculations based on model points, where the focus is on model points: sets assigned to the same category are continued. This means that the volume of required calculations is significantly smaller, however, when the impacts of a pension system are assessed and predictions are made on a time horizon of, say, 50 years, problems may occur with handling the new entrants, e.g. ONYF, NYIKA [3] [5] [17] [18].

In general, dynamic simulation is applied where the demographic module must also be created, concerning which in Hungary the probabilities of birth, death, marriage and divorce may be obtained from the statistical service of the state (KSH). The Hungarian Demographic Research Institute (NKI) provides predictions for the major demographic events, such as birth, death. Being familiar with Hungarian demographic figures, any plans aiming at developing the composition of the population, its impact on the current pension system and its possible evolution in the future, can benefit greatly from the application of microsimulation modelling. It is a widely used method in our days, based on statistical data collection and facilitates making a timeline analysis of the demographic data [3] [5] [6] [8] [9] [17] [18].

Belgium	MALTESE; MEP; MIDAS_BE; MIMOSIS
Bulgaria	ILO PENS (BG)
Czech Republic	Czech Pension Model
Denmark	Danish Pension Model; LAW
Germany	AVID; German Pension Model
Estonia	Estonian Long Term Pension Budget Model
Ireland	Irish Pension Model
Greece	Greek Pension Model
Spain	Spanish Pension Model
France	DESTINIE; PRISME
Italy	CAPP_DYN; CeRP models; RGS
Cyprus	ILO PENS (CY)
Latvia	Latvian Pension Model
Lithuania	PRISM
Luxemburg	LuxMod; REDIS; SOBOLUX
Hungary	Hungarian Pension Models; NYIKA
Malta	PROST (MT)
Netherlands	GAMMA; MICROS; SADNAP
Austria	Austrian Applied Projection Models; Austrian Microsimulation Model
Poland	FUS07
Portugal	ModPensPor
Romania	na
Slovenia	SIOLG 1.0
Slovakia	PROST (SK), MAJA
Finland	Finnish Centre for Pensions models
Sweden	MiMESIS, SESIM
United Kingdom	PENSIM2

Figure 5.
Tools of modelling pension systems in EU [18]

According to Figure 5., countries of the EU use different tools for modelling their pension systems. The task of pension calculation requires the long-term forecast of data, modelling should be well-prepared regarding the issue of data (for example, in the U.S. calculations are performed for 75 years [14], in the EU and in Hungary for 50 to 60 years [3] [4] [17] [18]) .

3 A possible setting up of a 4 year-long research project

The research takes place in the Doctoral School of Safety and Security Sciences, University of Óbuda from 2016 to 2020. The main focus of the research is the ageing of the populations of the countries of EU, its short- and long-term impacts on economical life, with particular regard to pension security in Hungary [6]. The research analyses the recent and future dispersion of populations in the countries of EU, with special focus on Hungary [3] [4] [10] [17] [18]. Detailed examination is going to be carried out regarding social expenses' debits on economic systems. According to forecasts tight frames are not going to assure sufficient safety and that way they mean serious burden for economical systems. In the following 50 years pension expenses of EU countries are going to increase radically in proportion to their GDPs [3] [4] [9] [10] [16] [17] [18].

Aims and directions of research: Examine and measure demographical data, examine self-care plans and possibilities, individual demands in connection with the pension system and designing a microsimulation model [6]. Research is also focusing on the individuals' decision-making processes: motivations, habits effecting the decision of choosing a certain pension paying model [12].

Methods: Adaptation and processing of Hungarian, international experience and results. Based on quantitative research, using microsimulation modelling, changes in the composition of populations and their effect on the present pension system and its future perspectives is going to be presented [3] [5] [8] [15]. Based on qualitative research (using questionnaires, in-depth interviews) individuals are going to be examined on their possible decision alternatives in the future in self-care, i.e. the second pillar of the pension system.

The structure of the dissertation is planned to examine global ageing, aspects in Hungary and EU [4] [16] in its first part. The second part is comparing the PAYG pension systems in EU countries [18]. The third part is modelling the PAYG pension system and its possibilities through microsimulation [3] [4] [5] [8] [15] [17] [18]. The fourth part is analysing the present and future pension system of Hungary [17]. The fifth part is examining the individuals' self-care behaviour patterns in economical aspect [1] [2] [6] [10] [12] [14].

Summary

According to forecasts, current pension sytems are likely to cause severe social and economic problems globally because of the rapid ageing of our societies in Europe. The rich toolbar of microsimulation enables us to model the plans in connection with pension systems. As a matter of course a study or research can not solve all the problems of pension payment itself, but we can clearly define and examine possibilities and effective methods for prediction and problem-solving.

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