PENSIONERS IN SMART CITY – THE MODELS OF THE SMART PENSION SYSTEM

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ABSTRACT

The reform of the pension system is a cardinal and noteworthy subject in all countries of the European Union (EU), particularly the Visegrád Four. Visegrád Four are the four central European post-communist countries, the Czech Republic, the Republic of Hungary, the Republic of Poland and the Slovak Republic – the issue of ageing society and the problems of its pension systems' is often discussed in myriad scientific meetings. These economic and social challenges necessitate long-term government strategies, which need to be modelled, simulated (tested and verified). The study shows the numbers and the problems of the state pension system of Visegrád Four, particularly with regard to the main problems of Hungarian social security system is based on the expected population and demographic statistics. The study is based on statistical projections, it includes an attachment of the results of a questionnaire-based behavioural economics research, a presentation of a vision of pension expenses and pension standards in EU and Hungary.

KEYWORDS

CLASSIFICATION

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INTRODUCTION: CHANGING OF THE POPULATIONS OF THE EUROPEAN UNION AND V4

At present most countries' social insurance systems are pay-as-you-go (PAYG) systems, i.e. expenses of pensions being payed are covered by the inpayment of jobholders [1]. The theoretical foundation of this kind of pension system was introduced in a publication of Paul Samuelson in 1958 [2]. This theoretical foundation is based on the presumption that the active members of a society support the elderly. This presumption is valid only if the number of babies being born is sufficient to insure enough active future jobholders to support the preceding generation(s). Another presumption of Samuelson is that as the population increases, the economy also grows [3].

We can examine the distribution of the population by age with a population pyramid. As the first figure shows, the calculations of the website https://populationpyramid.net show that the population of Europe is going to decrease. The figure represents the pyramid of ageing societies. According to precalculations, rapid ageing can be expected, which endangers the long-term sustainability of the pension systems of the European countries [4-7].

The population pyramid of Visegrád Four (V4), see Figs. 1-5, can be found on the website mentioned. According to the second figure, Hungary's population, similarly to the population of the European Union, is going to be stagnant in 2050.
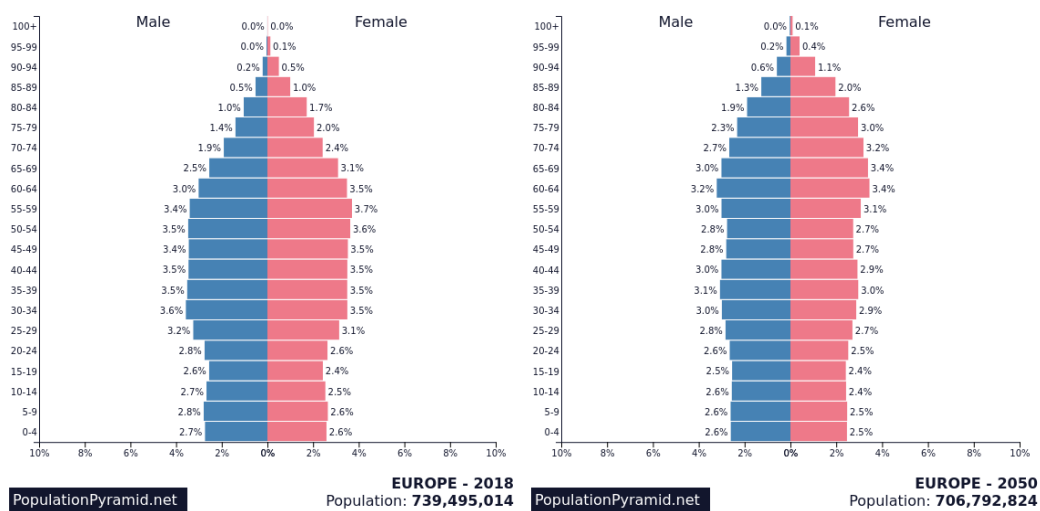

Figure 1. Population pyramid of Europe in 2018 and 2050.
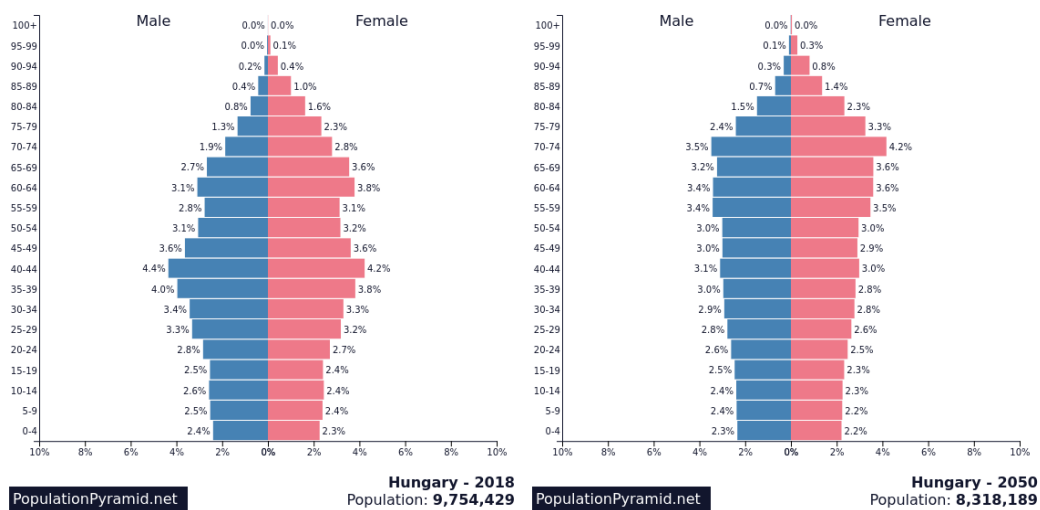

Figure 2. Population pyramid of Hungary in 2018 and 2050.

Fig 2 shows that in Hungary in 2050 the proportion of young and very old people is almost the same as in 2018, but between these two age ranges the pyramid is radically different, which will be the subject of further research.
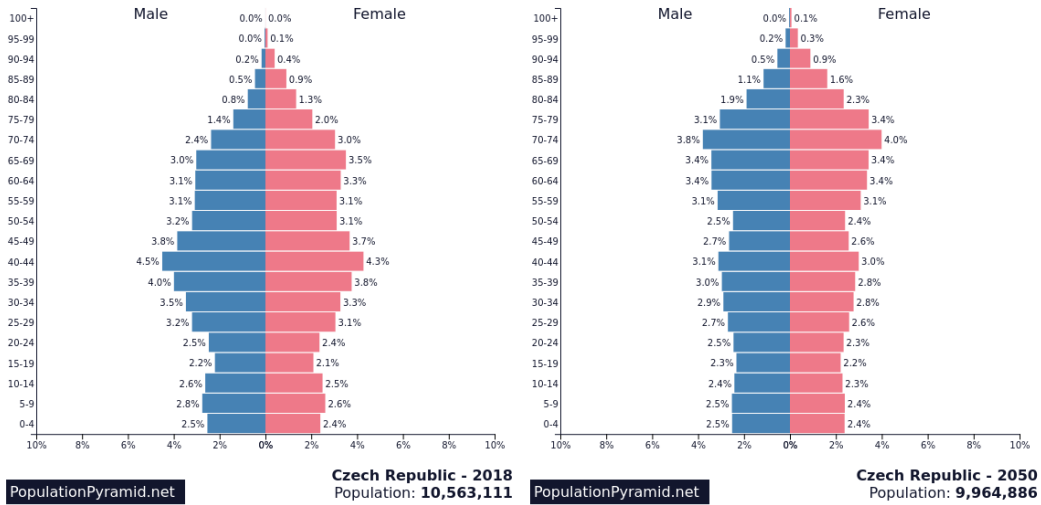

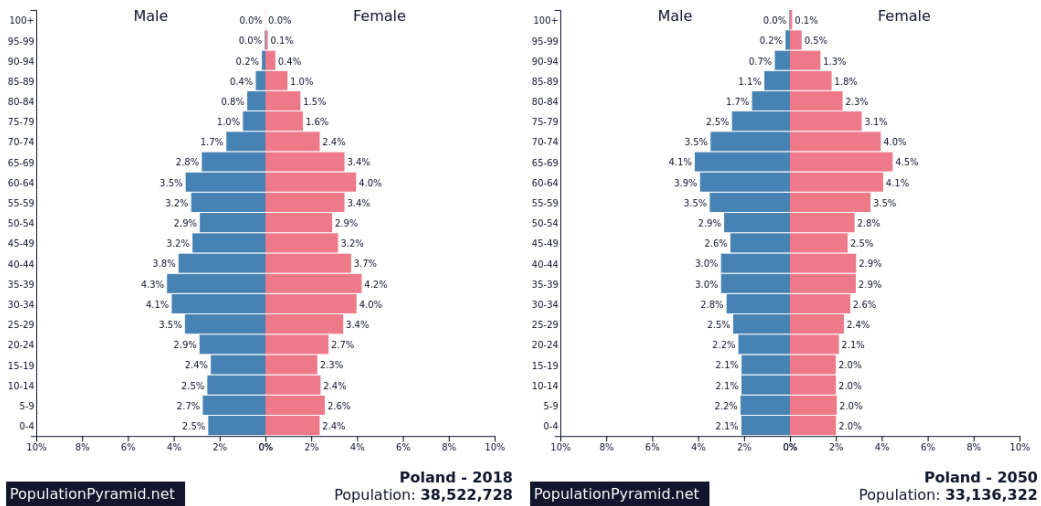**Figure 3.** The population pyramid of the Czech Republic in 2018 and 2050.

Figure 4. Population pyramid of Republic of Poland in 2018 and 2050.
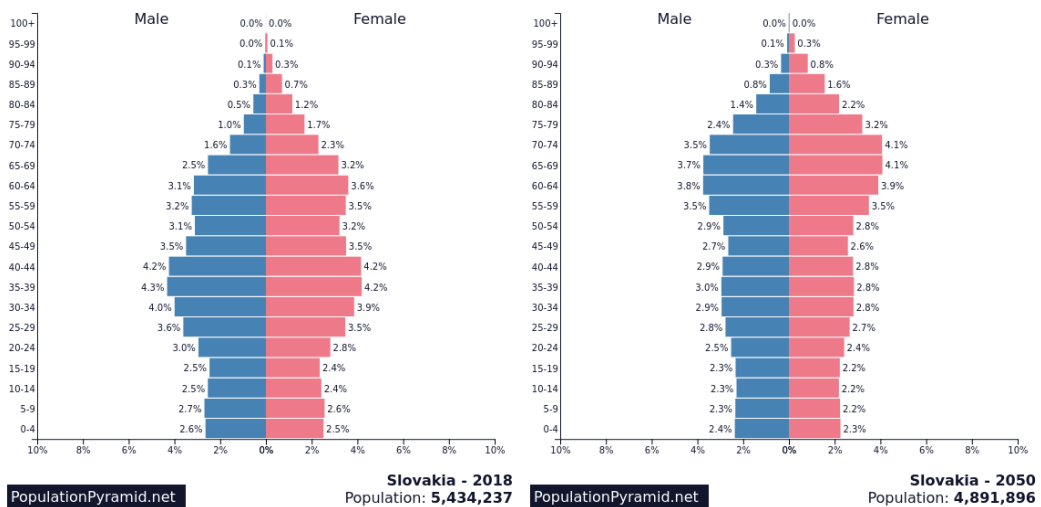

Figure 5. Population pyramid of Slovak Republic in 2018 and 2050.

Based on these reports, in Eastern Europe in the next few decades it is dramatically decreasing. Among the fastest shrinking ethnic groups in Eastern Europe (some in Central and Northern Europe) according to the UN 2017 forecasts [4]. According to Table 1, EU and V4, their population shrinks by 5 % or more. Hungary, Poland, their population shrinks by 15 %.

The tables show the precalculations of a study of the Commission of the European Parliament (EPC) [5-7]. According to the study, rapid ageing of the population of the European Union can be expected as a consequence of the growing life expectancy of men and women. Precalculations assume that the number of births is not going to change significantly (see Table 2).

Table 3 demonstrates the dramatic changes in the number of job-holders: the active part of the population is going to decrease radically. The size of the active population (working-age population aged 15-64 years) will be greatly reduced, which is expected to lead to a reduction in tax payments. On the other hand, pension expenditures are expected to grow in the EU Member States.

Table 4 shows that the ratio of pensioners and working-age people in EU and V4 are likely to grow at the same time.

Table 1. Current and future population of EU and V4 [4].

	2018, million	**2050, million**	**change, %**
European Union	739,49	706,79	-5
Hungary	9,72	8,28	-15
Slovak Republic	5,43	4,89	-10
Poland	38,17	32,39	-15
Czech Republic	10,56	9,964	-6

Table 2. Fertility rate for EU and V4 [5].

	2016	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
European Union	1,55	1,61	1,67	1,71	1,74	1,77	1,80
Hungary	1,48	1,61	1,68	1,72	1,75	1,77	1,80
Slovak Republic	1,40	1,47	1,60	1,68	1,74	1,79	1,82
Poland	1,37	1,45	1,56	1,61	1,65	1,68	1,71
Czech Republic	1,62	1,68	1,74	1,76	1,78	1,80	1,82

Table 3. Working age population, age 15-64, as % of total population for EU and V4 [5].

	2016	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
European Union	65,3	64,1	60,9	57,9	56,1	55,7	55,9
Hungary	67,1	65,0	63,0	60,4	57,4	55,6	56,0
Slovak Republic	70,0	67,7	64,5	61,9	56,8	53,9	54,7
Poland	68,7	66,0	62,6	61,1	55,9	52,4	55,6
Czech Republic	65,9	63,7	62,5	60,3	55,7	54,5	57,0

Table 4. Ratio of pensioners and working-age people in EU and V4 [5].

	2016	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
European Union	29,9	32,5	40,3	48,0	52,3	53,1	52,2
Hungary	27,5	31,3	35,2	41,8	49,1	53,2	52,0
Slovak Republic	21,0	24,9	32,9	39,7	51,5	59,4	56,8
Poland	23,7	28,4	37,3	42,6	55,3	64,9	62,2
Czech Republic	28,1	31,9	36,2	42,6	52,2	55,7	49,7

In order for the PAYG pension system to be maintainable in a society, the number of jobholders needs to be significantly larger than the number of retired citizens – otherwise the system is going to become imbalanced. Table 4 shows the ratio of pensioners and working-

Table 5. Potential GDP (growth rate) for EU and HU [5].

	2016	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
European Union	1,3	1,4	1,2	1,2	1,4	1,5	1,4
Hungary	1,9	1,9	2,1	1,2	1,5	1,3	1,3
Slovak Republic	2,4	2,8	2,8	1,8	1,2	1,2	1,5
Poland	2,7	2,6	1,9	1,2	0,7	1,0	1,0
Czech Republic	2,2	1,9	1,8	1,1	1,1	1,5	1,4

age people. According to the precalculations of EPC, the proportion of younger and older people is not going to change in a positive direction as the population of the elderly is going to increase, while the young (working) population is going to decrease. The fifth table shows the change in GDP. As GDP is expected to fall in V4, funding for pensions will probably entail increasing burdens. Financing pension payments will likely become a heavier burden on countries of the European Union, including V4.

Figure 6 shows the microsimulation modelling of the population. A similar microsimulation model is used in Hungary to estimate the size of the population in the future. Specialized administrative and other organizations are conducting more and more research into how the size of the population will affect macro- and micro-economical processes and the sustainability of the state pension system in the future.

PENSION MODELLING IN EU AND V4

State pension systems are targeting long-term goals and have long-term impacts. [1]. The Hungarian pension system is founded on two main pillars: the first pillar is the PAYG principle, the second is the capital provision principle [12]. In the case of a pension system based on the PAYG principle, the incoming contributions are not capitalized nor invested, but pensions are payed directly from them. The PAYG system is comfortable and might seem attractive while the population and the economy are growing. The recent obligatory social insurance system faces the following three problems that endanger the financial balance of the Hungarian pension system: an ageing population, a low level of employment and the partial payment of contributions. According to demographical data, the population stopped growing a long time ago. Meanwhile, pension payments are continuously growing as statistics show [8]. The PAYG system is undergoing a serious crisis in the European Union and the reforms of pension systems are inescapable. On a macro level an automatic system should be designed for contributions and pension payments that would ensure the long-term balance of the system [9].

A method to simulate the aforementioned problems and pension models with computers is microsimulation. This way there is no need for authoritative decisions – the effects of decisions can be simulated and calculated before the decision is made. The term "micro-simulation" is short for the expression "micro-analytical simulation" [5, 6, 11, 13, 14].
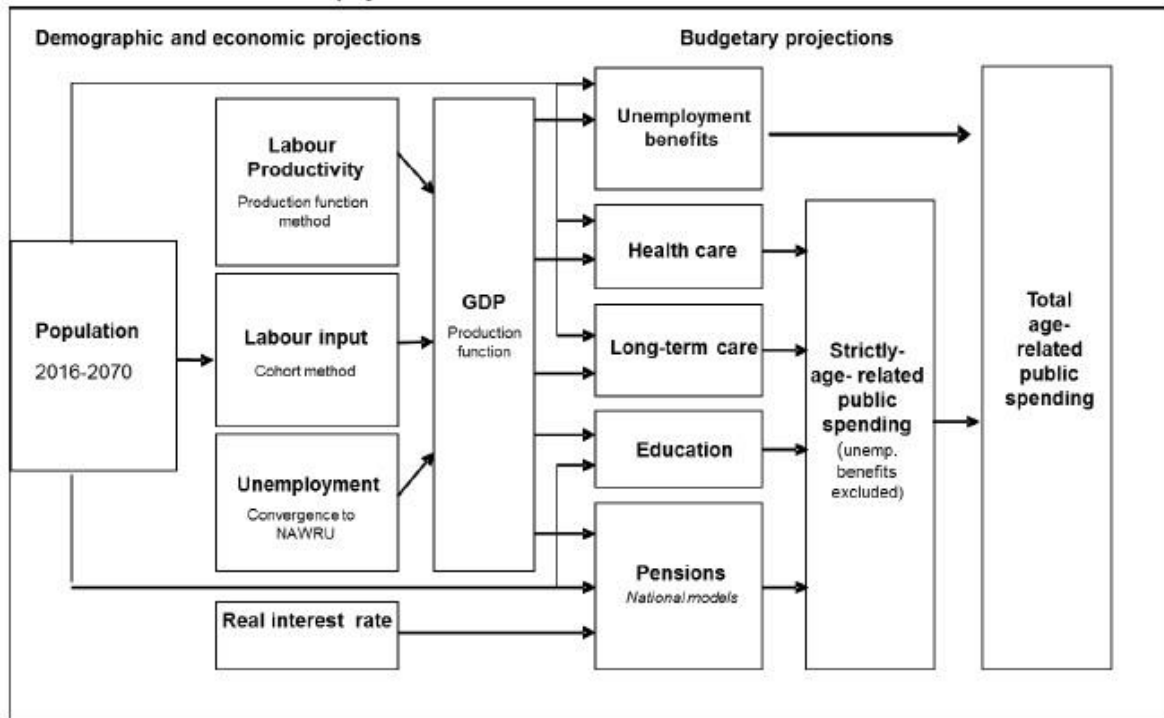
Figure 6. The microsimulation modelling process [5].

Table 6. Tools of modelling pension systems in EU and V4 [8].

Country	Financing	Public pension schemes	Model	Institution
Belgium	PAYG	DB	MIDAS-BE	Belgian Federal Planning Bureau (FPB)
Germany	PAYG	PS	AVID	Ministry of Labour and Social Affaires and the German Pension Insurance (MLSAGPI)
Sweden	PAYG	NDC	SESIM2	Ministry of Health and Social Affairs (MHSA)
Hungary	PAYG	DB	MIDAS-HU	Central Administration of the National Pension Insurance (CANPI)
Slovak Republic	PAYG	PS	IER	Institute for Economic Research (IER)
Poland	PAYG	NDC	ZUS	Polish Social Insurance Institution (PSII)
Czech Republic	PAYG	DB	NEMO	Ministry of Labour and Social Affairs (MLSA)

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 [8]. 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 (see Fig. 6.). This way the changes in the distribution of various incomes (wages, pensions) in time can be modelled Pension systems are for the long term and therefore they have long-term impacts. According to demographic figures, the population has not grown for a long time, and preliminary calculations show that the growth of the economy has stalled and pension expenditures keep increasing [5-9]. Recently, PAYG systems are in a deep crisis

everywhere in the world, therefore the reform of the state-operated pension system has become inevitable. It is essential to assess the impacts of actions, and micro-simulation is an excellent method for this. The task of pension calculation requires the long-term forecast of data and that can be done through modelling (in the U.S. calculations are performed for 75 years, in the EU and in V4 for 50 to 60 years ahead) [8]. In general, we use the following micro-simulation models in the impact analysis of pension systems (see Table 6.) [15]. Dynamic simulation is generally used, where the demographic modules also have to be created. In Hungary the predicted number of births, deaths, marriages and divorces necessary for the modules can be obtained from the statistical service of the state (KSH). Table 6. shows that countries of the EU use different tools for modelling their pension systems. Nowadays dynamic microsimulation models are used in public or semi-public research agencies or ministries in EU member states for policy assessment. Many models form the basis of international scientific publications and are therefore better known. Models developed in public institutions are less extensively documented (in English) and appear less often in international publications.

RESULTS: THE EXAMINATION OF SUSTAINABILITY

Microsimulation can predict the effects of planned measures therefore it can effectively help decision-making. Information is important for an economic entity, be it a state or private organization. Without information there is no progress, no possibility for planning, which results in fall-back and regression [16]. Safety and security are essential elements of the operation of an organization. The financing method of the pension systems (e.g. DB – defined benefit, PS – points, NDC – national accounts) also differ across countries (see Table 6.). While occupational and private pension schemes are usually funded, the degree of their funding relative to the pension promises may differ, due to the fact that future pension benefits can be related either to the salary and career length (defined-benefit system) or to paid contributions (defined-contribution system). Most public pension schemes are financed on a PAYG basis, whereby contribution revenues are used for the payments of current pensions. In most countries, minimum guarantee pensions are covered by general taxes. Earnings-related schemes are often subsidised to varying degrees from general government funds. Some specific schemes, notably public sector employees' pensions sometime do not constitute a well identified pension scheme but, instead, disbursements for pensions appear directly as expenditure in the government budget. On the other hand, some predominantly PAYG pension schemes have statutory requirements for partial pre-funding and, in view of the increasing pension expenditure, many governments have started to collect reserve funds for their public pension schemes. The actual PAYG pension system is still quite popular although it is going to face a serious crisis, therefore it will probably continuing a changed form. Experts suggest a mixed pension system (state pension and self-care forms together) but there is still no model everyone would accept as ideal. Now the sustainability of the state PAYG system will be examined in more detail according to a simplified mathematical model, based on macro and microeconomic aspects [11]. Based on economic activity, human life can be formally divided into three sections: childhood, active age and old age. In the first and third sections people do not do any paid work; in the second section they usually do [1]. At present the social insurance system is PAYG, that is, every year it is mostly the contributions of the workers that covers pension payments [3]. The simplified mathematical model of the PAYG system is the following [11, 16, 17]: Number of contribution payers × Pension contribution rate × Yearly average salary × Number of pensioners × Annual average pension. Table 5. shows that the number of people in paid employment is going to decrease, while the old-age dependency ratio is going to increase, therefore according to the formula the pension

contribution rate will have to be increased to keep the balance. Employees will have to pay more tax and contributions. Fig. 6. shows that in modelling usually the average salary and the average pension can be used, but it is important to take into account that everybody has a different career, salary and pension, if we wish to make actual calculations. In modelling usually the average salary and the average pension can be used, but it is important to take into account that everybody has a different career, salary and pension, if we wish to make actual calculations. When examining the sustainability of the state pension system, we have to examine the above-mentioned simplified mathematical model of the PAYG system. The number of pensioners is forecasted to increase drastically; this cannot be changed. This way the right side of the equation will increase and the balance will be upset. The question is how the balance can be reset. An increase in the number of people paying pension contributions: according to demographic forecasts, this number will not change considerably; what's more, it is likely to decrease. A solution can be to motivate young people to have more children. Increasing the pension contribution rate would mean a further tax burden on employers and employees. Increasing the yearly average salary: it cannot be increased very much because productivity is not high in Hungary. Decreasing the yearly average pension: pensions are low as they are, and further decrease would cost the ruling party many votes. Another   possibility is raising the age of pension eligibility, which was suggested and introduced in many European countries. Wherever we make modifications in the formula, the system becomes imbalanced. The two sides should be macro-economically balanced. Therefore experts suggest the mixed system (public and private). In the current pension system, a supplementary element can be a voluntary pension fund. This may mean that the standard of living we got used to in our active years can be maintained after retirement. There exist other pension saving systems as well, such as pension insurance.

The research focused on the present and future state of the respondents. We wanted to know what customs and processes motivated them to choose the form of self-care, the pension system they chose. We examined the respondents with behavioural economics and factor analysis [18]. The starting point of the research project is that people think of pension with fear and uncertainty. Based on the previous chapters, it can be seen that the pay-as-you-go system is in a crisis, therefore the second pillar of the pension system, self-care, receives more and more attention. To understand the motivations behind the decisions of the respondents, we used factor analysis, which is a widespread method nowadays to map personality [19]. We processed the data of the surveys and carried out the statistical calculations with the SPSS software [20, 21]. The online survey was completed in 2017. The respondents were answering online on kerdoivem.hu (http://www.kerdoivem.hu/kerdoiv/927511662). The number of respondents was 500 altogether ($n = 500$). My basic questions were about pension systems, pension savings, self-care and retirement security because these determine the financial background of our future life, that is, the extent of our self-care. The replies were divided into three groups: 1) knowledge of pension systems (mandatory, voluntary), 2) financial planning (characteristics of various savings plans) and 3) the role of self-care (the mapping of personality). These three groups are analysed separately by the qualitative research. Several statistical characteristics were calculated, such as average and frequency, and we did cross tabulation analysis.

Table 7. shows further relationships, such as savings in the case of different ages. For example, people between 29-48 years of age consider savings important. Table 8. shows further relationships between pension savings and optimism. Pension savings are more important for optimist men than optimist women (shown by the higher number of 324 affirmative responses).

Table 7. The role of age in pension savings.

		Has pension savings?		Total
		Yes	**No**	
Age, years	between 15-19	1	63	64
	between 19-28	48	162	210
	between 29-48	100	73	173
	over 49	33	20	53
Total		182	318	500
Percentage, %		36,4	63,6	100

Table 8. The role of optimism in pension savings.

			Pension savings		Total
			Male	**Female**	
Optimist?	Yes	Number	324	12	336
		Percentage, %	96,4	3,6	100,0
		Pension savings %	67,4	63,2	67,2
		% Total	64,8	2,4	67,2
	No	Number	157	7	164
		Percentage	95,7	4,3	100,0
		Pension savings %	32,6	36,8	32,8
		% Total	31,4	1,4	32,8
Total		Number	481	19	500
		Percentage	96,2	3,8	100,0
		Pension savings %	100,0	100,0	100,0
		% Total	96,2	3,8	100,0

Young people think they have several options to make a foundation for their future financial situation. The state pension system is mandatory, however, as far as voluntary and private funds are concerned, our decisions are usually made according to our income and our emotional decisions. Generally speaking, respondents are most encouraged by the general economic situation and security at work, and the pension and health insurance systems in the future country.

CONCLUSION

According to forecasts, current pension systems are likely to cause severe social and economic problems globally because of the rapid ageing of our societies. Based on forecasts, the current pension regime, and the drastic change in the ratio between active wage earners and pensioners will, with a high degree of probability, cause social, economic and other problems in the future both globally and in our country. The issue of sustainability also highly affects the definition of the possible model. The wide range of tools of microsimulation can be used to model and plan the pension system. As we have presented in the study, using the tools of micro-simulation the concepts of the pension regime can be modelled quite well in advance; such modelling has become increasingly common and successful in the EU and also in V4. In our days planning a pension system requires the possession of skills and application of up-to-date planning methodologies. The sustainability of the PAYG pension system is determined by the ratio of the number of people in employment, or rather the number of people paying contributions and the number of pensioners, since pensioners get their pension from the contributions paid. Experts recommend a mixed pension system, in which self-care has an important role. The respondents think about many possibilities to supplement state pension. State pension is compulsory; therefore it has to be chosen. In the case of supplementary ways of self-care, the

choice of the form or forms of savings is determined by our income and emotional decisions. Of course, research cannot solve all the problems of the pension system but researchers can clearly define and examine possibilities and effective methods for prediction and problem-solving.

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