

# Statistical Measurement of Pension Entitlements

Jaroslav Sixta<sup>1</sup> | *University of Economics, Prague, Czech Republic*

Martina Šimková<sup>2</sup> | *University of Economics, Prague, Czech Republic*

## Abstract

The paper deals with macroeconomic estimates of the impact of population ageing. It shows that the optimal choice of pension system is not a crucial issue. The main emphasis should be put on demographic and economic parameters influencing significantly the share of retirement pensions in our society. Presented approach is based on so-called pension schemes expressing discounted pension entitlements to 2014. It shows the liabilities to current and future pensioners for both men and women aged over 20 years. We present this model in three variants and illustrate its sensitivity to input parameters. This approach allows us to estimate the share of pension liabilities in gross domestic product that accounts for about 230% according to generally recommended approach. Pension entitlements represent a modern topic to be implemented in 2017 in national accounts. Pros and cons of this modern approach are discussed within our paper.

## Keywords

*Ageing of population, national accounts, pension liabilities, pension schemes*

## JEL code

*E17, H55, J14*

## INTRODUCTION

Population ageing is very popular topic in the media even though interpretation and consequences are not sufficiently discussed. The substance of this issue is very often deferred in favour of political or interest groups' preferences. The presentation of the pension systems problem is usually very simplified and key issues are hidden behind. The emphasis is put on the choice of an optimal pension system and its possibilities to satisfy pensioners' needs. But the key problem of this issue lies in deeper elaboration of the situation. Detailed analyses or experts' judgements are not usually widely presented to public. Discussion about stable, sustainable and usable general approach to the population ageing is missing.

Mostly, the discussion is focused on the choice of pension system. Economic fundamentals relying on share of economically active population, fertility, economic growth and productivity are not highlighted. Optimal choice is only a particular issue of the solution of the population ageing problem. It is rather connected with the mix of solidarity and merits than economic solution. On the contrary, frequent changes of pension systems do not provide stable economic environment and it means that the main features of the system need general political support.

<sup>1</sup> University of Economics, Faculty of Informatics and Statistics, Nám. W. Churchilla 4, 130 67, Prague 3, Czech Republic. E-mail: sixta@vse.cz. Author is also working at the Czech Statistical Office, Na padesátém 81, 100 82 Prague 10, Czech Republic.

<sup>2</sup> University of Economics, Faculty of Informatics and Statistics, Nám. W. Churchilla 4, 130 67, Prague 3, Czech Republic. E-mail: martina.simkova@vse.cz. Author is also working at the Czech Statistical Office, Na padesátém 81, 100 82 Prague 10, Czech Republic.

Crucial aspect of population ageing lies in the liabilities of active population to the pensioners. The obligation represents sustainability of the system ensuring pensioners' needs. Statistical estimates of these liabilities can be expressed by pension entitlements covering obligations towards current and future pensioners. It is a modern approach combining national accounts' and demographic data. On this case we illustrate that the choice of the pension system is not very relevant issue from macroeconomic perspective. Both Pay as You Go pension plan (PAYGO) and Fully Funded Pension (FFP) express finally the same. Contributions or benefits defined systems represent redistribution of products between active and inactive population. Generally, it means that pensioners will consume existing goods and services that have to be produced. The liabilities to pensioners are equal irrespective of the selected pension system. The presentation of pension entitlements is expressed as a share of gross domestic product representing the amount of goods and services to be transferred to pensioners. Such information should be used by policy makers to adopt economic environment for future demographic development.

This paper presents our provisional estimates of pension entitlements from the perspective of statisticians. Czech national accounts will include the estimates of pension entitlements in 2017. Presented results come from our computation and are based on slightly simplified approach in comparison with official statistics. The aim of our paper consists in the illustration of significantly different approach to pension liabilities.

## 1 ECONOMIC APPROACH TO POPULATION AGEING AND PENSIONS

The discussion about economic aspects of ageing and the necessity of suitable pension system choice has been discussed in scientific literature for several years. The issue of the choice of pension system is discussed in Vavrejšová et al. (2004). It also proves that the issue of pension reform should not be limited only to ageing and financial matters. All pension systems, both private and public, have their own pros and cons. Combination of different pension benefits, individual savings and prolonged economic activity is presented as an optimal choice. The key target is to ensure adequate living standards and quality of life of elders.

Sivák et al. (2011) described consequences of transition from PAYGO to fund based systems in Slovakia. They emphasised findings that each system is based on the distribution of real income from productive generation to non-productive. Retirees can consume only from produced goods and services in each period. Transition from one system to another leaves aside the main point, demographic situation. The overall increase of wealth of society is not changed. The only difference consists in the different transfer of income between productive and non-productive population.

According to Kubíček (2008) it is not important whether the system is fully or partially private. Again, this question does not tackle the substance, demographic development of our society. It seems that the only possible solution could be found in imposing new taxes to enable sufficient resources. This question of raising taxes is currently discussed also in both media and expert groups.<sup>3</sup> The necessity of pension reform was widely analysed in Rutarová and Slavík (2005). The reform was discussed from the perspective of both economic and demographic point of view. It was emphasised that current pension issues are linked with state based PAYGO system and its affordability. It is pointed out that demographic development should not be used as an argument for the change of the pension system or its reform. Economic substance lies in the inter-generational transfers covering goods and services. Active population has to relinquish a part of its consumption in favour of pensioners. Financial transfers serve as a mean of transfers only.

<sup>3</sup> <[http://idea.cerge-ei.cz/files/IDEA\\_Studie\\_14\\_Zdaneni\\_vysokoprijimovych\\_osob/IDEA\\_Studie\\_14\\_Zdaneni\\_vysokoprijimovych\\_osob.html#p=18](http://idea.cerge-ei.cz/files/IDEA_Studie_14_Zdaneni_vysokoprijimovych_osob/IDEA_Studie_14_Zdaneni_vysokoprijimovych_osob.html#p=18)>.

Fiala and Langhamrová (2015) noticed that one of the most discussed consequences of population ageing is the sustainability of pension systems. Due to the increase of life expectancy, the share of pensioners in population is rising as well as the duration of receiving social benefits. The current system of pensions is threatened by increasing difference between revenues and expenditures. They estimate that such deficit can be decreased by increasing contributions to the state pensions system (social security contribution). Similarly, Janíčko and Tsharkyan (2013) refuse the necessity of pension reform from adverse demographic development only. They argued that the necessity of pension reform should be well-funded by other aspects covering mainly economic, social and political matters. It is necessary to find such parametrical adjustment that minimise the impacts on economy. They also pointed out that the participation of elders in the labour market should be increased. It is conditioned by the adaptation of labour market to older employees.

## 2 MODEL OF PENSION ENTITLEMENTS SCHEMES

Statistical approach to society liabilities is monitored by so-called pension schemes. They became a part of official macroeconomic statistics for the EU (see ESA 2010) and EU countries will be obliged to compile pension entitlement models from 2017.<sup>4</sup> There can be found lots of alternative estimates of pension entitlements in Technical Compilation Guide (see Eurostat, 2011). It all leads to the improved balance sheet for the country. It means that the balance sheet for government sector should include a new type of liabilities.

Currently, there were published few studies dealing with the pension liabilities in European countries (Van Der Wal, 2014; Oksanen, 2004; or Mink, 2010). Since there is no official data up to now, we estimated pension entitlements for the Czech Republic. We applied the adjusted approach that slightly differs from the official statistics since our aim is to estimate overall liabilities (entitlements for the population). It means that we do not treat government employees separately and we respect the population characteristics only. We estimate pension entitlements (PE) for both current pensioners (*CPE*, formula 1) and people older 20 years – future pensioners (*FPE*, formula 2):

$$CPE_t^g = \sum_{x=d_t}^{100} \sum_{s=0}^{100-x} R_{x+s,t+s}^g \cdot B_{x+s,t+s}^g \cdot p \cdot 12 \cdot DF_{t+s}, \quad (1)$$

$$FPE_t^g = \sum_{t+1}^{t+80} \sum_{s=0}^{100-d_t} R_{d_t-s,t+s}^g \cdot B_{d_t-s,t+s}^g \cdot p \cdot 12 \cdot DF_{t+s}, \quad (2)$$

where:

- $R_{x,t}$  the number of retirees in age  $x$  in the year  $t$ ,
- $B_{x,t}$  the average of monthly retirement pension in age  $x$  in the year  $t$ ,
- $p$  index of wage growth,
- $DF_t$  discount factor in the year  $t$ ,
- $s$  counting index reflecting the increase in the age cohorts as well as increase years,
- $t$  year,
- $x$  age,
- $g$  sex,
- $d_t$  retirement age in  $t$ ,
- $x_t$  age in  $t$  and  $x_t > d_t$ .

<sup>4</sup> Actually, this activity may threaten due to the resistance of countries with conservative approach using benefits defined systems.

Pension entitlements are derived by applying actuarial estimation methods based on the Net Present Value (NPV) concept, see Eurostat (2011). They represent future liabilities calculated to 2014 ( $t_b = 2014$ ), so it is necessary to specify the assumption about future demographic development and increase in level of prices and wages.

1. *Discount factor.* It is a tool to measure the actual capital costs for financing future payments:

$$DF_t = \frac{1}{(1+r)^{t-t_b}}, \quad (3)$$

where:

$r$  discount rate,

$t$  year,

$t_b$  the base year.

The denominator of discount factor includes a discount rate, which is the measure of the discount factor level. Its choice need not to be an easy task and determining the appropriate discount rate could result in scientific work nowadays. To illustrate the method in accordance with the European Central Bank (ECB, 2010) we use the discount rate of 5% in nominal terms according to the Guide (mentioned above).

2. *Wage growth.* Assumptions about future development of wages have a significant impact on the level of pension entitlements, despite difficult predictability. Wages have risen by 5% on average in the last ten years. But after the financial crisis in 2007–2008 the wage growth slowed down to 2%. For simplicity and precaution we assume such wage growth in the future (2%). The Ministry of Labour and Social Affairs publishes the average monthly retirement pension by gender. The average retirement pension in 2013 is annually increased by 2% to 2050. We do not consider any special assumptions about required insurance duration.

3. *Inflation.* It has to be considered if future flows are to be projected in nominal or in real values. If nominal term is chosen, both the discount rate and the wage growth rate include future inflation expectations. If the projection is based on real values, inflation expectations are excluded (Eurostat, 2011). For simplicity, we use only nominal.

4. *Demographic development.* The amount of future pension liabilities depends on the future development of the survival probability and life expectancy. All these aspects lead to the increase of the proportion of elderly people in population. The survival probability determines the number of years of receiving retirement pension. The official population projection of the Czech Statistical Office<sup>5</sup> respects the future demographic development, see CZSO (2013). This projection is taken as the basis for the estimate of future number of people receiving retirement pensions. The calculation of pension entitlements is divided by gender because of differences between mortality rates of men and women.

5. *The age of retirement.* All estimations in this paper respect the main points of actual pension reforms, retirement age is increasing. According to the current plans, the age of retirement is going

<sup>5</sup> The projections are generally produced in few variants according to the different sets of fertility, mortality and migration assumptions. Projection of the CZSO has three variants – low (pessimistic), medium (realistic) and high (optimistic). In this paper we use medium variant because it is considered as the most probable. However, the results should be interpreted in the sense of defining the expected development with respect to extreme variants (CZSO, 2013).

to be increased from 62 for men and 60<sup>6</sup> for women with two children in 2013<sup>7</sup> to a common threshold of 67 years in 2041. Then, it will continue to increase without limits. In 2050, the retirement age it will be about 68 years for both men and women (ČSSZ, 2014). However, for comparison, we present also two hypothetical variants of retirement age.

Let's suppose three following variants:

*VAR 1* = hypothetical situation without actual pension reform. Statutory retirement age remains at 62 years for men and 60 for women with two children. This variant allows us to estimate savings from pension reform.

*VAR 2* = actually valid situation respecting actual pension reform.

*VAR 3* = hypothetical situation with the increase of the retirement age to 73 years in 2050. Target value is achieved by linear extrapolation. After 2050, we fixed the retirement age at 73 years. According to our calculation, this is the age (73) maintaining the ratio between economically active persons and economically inactive persons in current proportions (2014). This balance is important for keeping stable financial burden of the pension system stable and for maintaining the satisfactory living standards of older people.

The sum of current household pension entitlements of individual ages represents the total pension entitlements to current pensioners and future pensioners to actual (base) year:

$$PE_t^g = CPE_t^g + FPE_t^g, \quad (4)$$

where:

$CPE_t^g$  pension entitlements for current pensioners,

$FPE_t^g$  pension entitlements for future pensioners.

Even though we take into account the criteria of age and gender, to the relevant criteria can be found there as well. For overall macroeconomic expression of the impact of total pension entitlements on current and future pensioners, such simplification is adequate. However, from individuals' point of view, other criteria like education (Zimmermann et al., 2014) are important. It can be proved that retirement pension will also tend to be higher for individuals with higher education.

### 3 THE RESULTS

The liabilities resulting from pensions are crucially dependent on age. The development of pension entitlement used for the expression of liabilities is shown in Figure 1 that describes distribution of discounted pension entitlements by age to the 2014. Cohorts at the age of retirement (between 60 and 70) have the highest claims for pensions. It is considered that these people contributed to the pension system long time. The claims of older people are decreasing in line with development of mortality. Future pensioners will spend slightly shorter time in pension due to on-going increase of retirement age in comparison with current pensioners. Firstly, future pensioners will be retired at higher age and, secondly, the absolute number of pensioners will be lower because of lower fertility. However, the main reason for lower pension entitlements of future pensioners is discounting. These entitlements are expressed at current prices.

If the retirement age is not increased and remains on 2014 level (*VAR 1*), pension liabilities to future pensioners will be significantly higher. For example, the difference in pension entitlements for 20 years old men takes 18.7 CZK bn. and 21.1 CZK bn. for women (*VAR 2*). If the retirement age is

<sup>6</sup> Exactly, the statutory retirement age is determined according to the year of birth. By 1.1.2013 it is set as 62 years and 6 months for men born in 1950 and 59 years and 4 months for women born in 1953 with two children.

<sup>7</sup> In 2016, statutory retirement age is 63 years for men and 60.3 for women with two children.

increased to 73 in 2050<sup>8</sup> (VAR 3), the savings between (VAR 1) and (VAR 3) is higher. In case of 20 years old men it takes 25.3 CZK bn. and 26.9 CZK bn. for women in 2014.

**Figure 1** Pension entitlements by age in the base year (billion CZK)

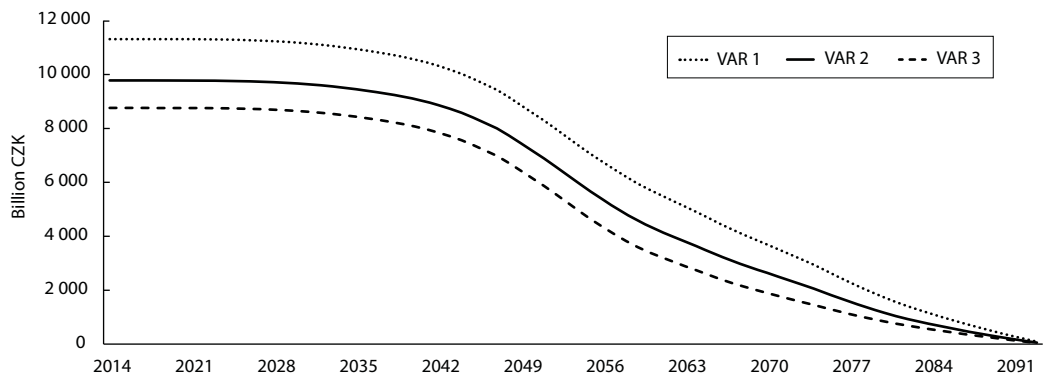


Source: Data CZSO, authors' calculations

Differences in pension entitlements between men and women are not significantly high. Women live longer and therefore their participation in pension system is longer but they usually earn less than men and their average retirement pension is lower. Moreover, retirement age for women will be increased faster to balance it with retirement age of men.

The development of total liabilities of society (formula 4) for retirement pensions is determined by the concept of accrued liabilities to existing and future pensioners, older than 20 years. With using ADL<sup>9</sup> model, total pension liabilities discounted to 2014 accounts for CZK 9 780 bn., see Figure 2. The increase of statutory retirement age to 68 years in 2050 (VAR 2) causes the decrease of liabilities to CZK 1 535 bn. in comparison with VAR 1. Setting alternative statutory retirement age to 73 years in 2050 (VAR 3) would decrease liabilities by CZK 1 020 bn. CZK (difference between VAR 2 and VAR 3).

**Figure 2** Total pension entitlements discounted to 2014 to people older 20 years (billion CZK)



Source: Data CZSO, authors' calculations

<sup>8</sup> The age of 73 years represents the situation where share of active and inactive population is in balance.

<sup>9</sup> ADL (accrued-to-date liabilities) expresses the present value of future retirement pensions, for more detail see Eurostat (2011).

Estimation of entitlements (irrespective of financial or non-financial) shows that the problem is serious and much deeper than the discussion about pension system. The pension system is only a part of the problem and it is rather more connected with personal motivation, equality and responsibility than with macroeconomic stability. The key problems lie in demographic parameters. It is clear that the reduction in pension entitlements will decrease the burden and resources may be spent on different goods and services. Moreover, outstanding issue of ageing is the availability of specific services for elders or further improvements of health care systems. Financial estimates of entitlements interestingly illustrate the situation in mentioned above. Without further limitation of reduction of the share of productive (active) part population, Czech society may face significant problems. It can be assumed that economic growth and the increase of productivity may compensate it but it is not sufficient.

#### 4 SENSITIVITY ANALYSIS OF ADL MODEL OF PENSION ENTITLEMENTS

Setting of general assumption for the estimation of entitlements is necessary otherwise even rough estimates of liabilities cannot be computed. However, these assumptions may vary in time and the total value of liabilities may significantly change. Despite the dependency on parameters, total value of liabilities represents important information (Holzmann et al., 2001).

Parameters covering discount rate, rate of growth of wages and statutory retirement age significantly influence statistical expression of liabilities. Initial parameters of our computation were set as 2% nominal wage growth, discount rate of 5%<sup>10</sup> and increase of statutory retirement age in line with actually implemented pension reform. With these assumptions the total amount of pension liabilities takes 230% of gross domestic product in 2014. This amount covers both existing pensions and possible future claims on pensions.

When using lower discount rate, the amount of pension liabilities is rising. On the contrary, using lower growth rate of wages leads to the decrease of pension liabilities. These parameters crucially influence the results of our estimates even though it is necessary to set them ex-ante. Eurostat Manual was prepared and issued in different economic environment that is prevails today. Recommendation on the real discount rate about 3% is not adequate today. The price of money is very low; market interest rates are sometimes negative.<sup>11</sup> Unfortunately, it has substantial effects on the estimates of future liabilities. Very low market interest rates and prices of low risk assets (used as a discount factor) lead to higher discounted liabilities. The dependency on discount rate is stronger than on demographic factors. It means that these computations have to be discussed very carefully; they mostly provide indicative overview of the situation. For example, 3% of discount rate increases discounted pension liabilities by 140 p.p. of GDP in 2014.

**Table 1** Total pension entitlements discounted to 2014 according to level of the wage growth and discount rate

		Growth rates of wages					
		0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
Discount rate	1%	17 809	20 783	24 432	28 932	34 505	41 438
		418%	488%	573%	679%	810%	973%
	3%	10 650	12 055	13 738	15 764	18 215	21 195
		250%	283%	322%	370%	427%	497%
	5%	7 154	7 896	8 762	<b>9 780</b>	10 982	12 409
		168%	185%	206%	<b>230%</b>	258%	291%

Source: Data CZSO, authors' calculations

<sup>10</sup> We assume constant discount rate and growth of wages.

<sup>11</sup> <<http://www.kurzy.cz/cnb/ekonomika/statistika-financnich-trhu/kapitalovy-trh/vynosy-statnich-dluhopisu/AEBA>>.

Pension entitlements are also dependent on the statutory retirement age. Demographic projection prepared by the CZSO shows that in 2050 there will be 2.75 million people retired. If there was not any reform adopted, this number would be by 935 thousand people higher. Adequately, economically active populations would decrease in the same proportion. The following Table 2 describes the impact of statutory retirement age on the value of pension liabilities. When computing pension liabilities for according to adopted reform (VAR 2), total amount counts 230% of GDP (CZK 9 780 bn.) in 2014. Pension reform provided savings of 36 p.p. of GDP, compared to 266% without any (VAR 1). Alternative approach with the statutory retirement age of 73 (VAR 3) would decrease this amount to 206% of GDP in 2014.

**Table 2** Total pension entitlements discounted to 2014 according to retirement age

	VAR 1	VAR 2	VAR 3
Billion CZK	11 315	9 780	8 761
	-	1 535	1 020
% from GDP	266%	230%	206%
	-	36	24

Source: Data CZSO, authors' calculations

The amount of pension liabilities is dependent on future demographic development and the distribution of law of mortality law incorporated in the CZSO's projection. The sensitivity analysis showed huge differences when using different parameters. It is clear that the primary dependency is on the discount rate due to high number of projected years. We expect that such computations will be harmonised between European countries for acceptable international comparability. High sensitivity on input parameters decreases usefulness of this model. Again, the results should be used as indicative for policy-making. For example, actually available estimates show high variance. Pension liabilities for Austria and Germany are estimated for 360%, 269% respectively. In the United Kingdom they are estimated as 360% GDP (Mink, 2010).

## CONCLUSION

Population ageing is a serious problem with lots of consequences in different areas of our society. Unfortunately, it is very often limited to the discussion about pension system or its reform. Even though, the issue of funding pension system is important and relevant, it is not the core of the problem. The core is hidden in demographic structure and its development. The choice of optimal pension system is rather more connected with personal motivation, equality and responsibility than with macroeconomic stability.

The substance lies in the share of economically active and inactive people and the possibilities of society for ensuring sufficient resources. Pensioners will consume real goods and services. The main issue is to satisfy their needs irrespective of the pension model. It is not important whether the system is based on contributions or benefits organised by state or private funds. The most important is a general political agreement with ensured stability. Parameters of the system can be adjusted time to time. The impact of the choice of the system is negligible, the real transfer of goods and services only matters. Total pension liabilities are not dependent on the system; the share on the GDP is not affected.

It is obvious that statutory retirement age will have to be increased but this has some contradictions. The increase of healthy life expectancy is slower than the increase of life expectancy and it means that some people will not be able to work and they will be more or less dependent on other types of social benefits.

Economic description of population ageing via pension entitlements will be incorporated into national accounts. The balance sheet of government sector will be enlarged. The usability of this information is clear. It provides data for the policy makers that should help in adopting optimal regulations



in economic and social affairs. Of course, the results have to be carefully discussed; pension entitlement models use lots of parameters and assumptions. Negative feature of these computations lie in the very high sensitivity on input parameters and variance of results. Of course, our computation was aimed at liabilities only; the issue of possible increase of assets was not taken into account. It is clear that due to the development of our society and potential increase of productivity will be relevant factors. But the main aim of our paper was to illustrate the size of the problem even though that recording of future debts to potential pensioners is always a bit speculative. Despite that, the results are alarming.

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