# *The Sustainability of Pension Systems through the Assessment of the Pension Base Calculation*

# *Dlouhodobá udržitelnost důchodových systémů ve světle zohlednění skutečně získaných příjmů ve výši důchodu*

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**Abstract**

The objective of the paper is to present the possibility of the assessment reference earnings (calculation basis) which are taken into account by the calculation pension. In this paper is present the way of the assessment and treating with reference incomes in earnings-related pension schemes. The author subsequently put forward various proposals for the adjustment of the Czech public pension scheme. The paper focuses principally on the method of assessment of the reference period, length of the reference period, method of income indexation pre-retirement incomes falling into the reference period. The paper also provides model calculations of the pension amount based on the variable assessment reference period and the variable method of income indexation. The author also presents microeconomics and macroeconomics impacts of variable combinations of assessment reference period and method of income indexation.

**Keywords**

pension schemes, assessment of reference period, indexation of income, pension insurance

**Abstrakt**

Příspěvek přináší přehled o tom, z jakého rozhodného období lze v důchodových systémech zjišťovat příjmy pro výpočet důchodu a jakým způsobem může být zohledněna výše těchto příjmů při výpočtu důchodu. Příspěvek se zabývá možnými změnami právní úpravy v českém základním důchodovém pojištění. Příspěvek se zaměřil na získání poznatků zejména o následujících oblastech: způsob stanovení rozhodného období, délka rozhodného období a způsob valorizace příjmů, spadajících do rozhodného období. V příspěvku je na modelových příkladech počítána výše důchodu při různě stanoveném rozhodném období a při různě zvolené metodě valorizace předdůchodových příjmů. Jsou spočítány mikroekonomické a makroekonomické dopady různých kombinací stanovení rozhodného období a způsobu valorizace předdůchodových příjmů.

**Klíčová slova**

důchodové systémy, stanovení rozhodného období, valorizace příjmů, důchodové pojištění

## Introduction

All developed countries face the process of demographic ageing. The pension schemes of these countries therefore generally face serious problems caused by adverse demographic trends, high unemployment, insufficient economic growth, the large range and cost of social programmes and, finally, increasing administrative costs (Musil, 1996). The total cost of pensions paid in the majority of Western European countries already exceeds 10% of GDP and makes up more than 25% of total public spending (Rutarová, Slavík, 2005). Social security systems are facing huge deficits due to a lack of funds to cover the increasing statutory requirements of pensioners and the other social groups concerned. In short, the cost of social security is rising. In order to guarantee the financial sustainability of their pension systems the majority of European countries have launched reforms in recent years. Such reforms have generally concentrated on strengthening the link between pension contributions and benefits. Certain countries have introduced DC schemes (either funded or notional account components) into their pension systems in which one of the characteristics is a close link between contributions paid and pension benefit received. Other countries have retained a defined contribution pension system, but even in these countries the above link has been strengthened in a large number of cases. This has been achieved through parametric reforms which have introduced the extension of the period of insurance required to qualify for a full pension, the tightening up of actuarial bonuses / reductions in case of deferred / early retirement as well as through the introduction of the calculation of pension benefits from lifetime income rather than income recorded during the years immediately preceding retirement. Thus, when assessing the level of pension benefit, the amount of contributions to the system during the insured's entire working life is accurately reflected.

As far as the Czech Republic is concerned, under current legislation pension entitlement[1] depends on the income of the insured since 1986. The reference period is automatically prolonged each year to up to 30 years; this will be achieved in 2016. Nevertheless, the target length of the reference period will not cover the significant part of a worker's productive life. This may adversely affect the pension rights of certain groups of workers who enjoyed relatively high income during the first part of their careers and relatively low income as they approached the end of their working lives. This may well cause problems with regard to the impact of a reduction in working time during the final years before reaching retirement and may have a disproportionate affect on future pension benefits especially for low-income groups (Šlapák, 2007).

Adjustments to the length of the reference period or income counted within the reference period, including the valorisation of income credited, might be considered an additional tool for making parametric modifications to the pay-as-you-go system currently in operation in the Czech Republic. A definition of the income taken into account and ways of valorization of such income make up important tools for determining the expenditure

1 *The pension in the Czech Republic consists of two components, a basic amount (flat rate) which is the same for all types of pensions and a percentage-based assessment based on the insured period and earnings achieved. The calculation basis results from the reduced personal assessment base which is equal to the average annual monthly base for the reference period.*

side of the pension system as a result of their relationship to the calculation of benefit assessment calculation. The basic aim of this paper is to contribute towards the debate on the reform of the Czech pension system, in particular the possible parametric adjustment of the current system. The paper focuses on an analysis of the reference period and the potential impact of its adjustment on the pension system, on individual pension entitlements as well as its overall long-term financial sustainability.

## 1 Possible changes in determining the reference period from which the pension is determined

In principle, two potential major adjustments can be made when determining the reference period – a change in the length of the reference period and a change to the method employed for the valorisation of income within the reference period or a combination of the two. A change in the length of the reference period might be based on existing models used to determine the reference period in various European countries. As a result of a comparison of the current, historical and potential (planned pension system reforms) variants discovered as a result of this analysis the author arrived at the following options for change. The first basic option is to determine the reference period by means of years of affiliation accompanied by an individual's maximum income years (his/her "best" years). These years can either be measured separately over the insured's entire working life or as a set of consecutive years. The second basic option for determining the reference period from which an individual's pension rights are then calculated is to take into account a number of years of contribution immediately leading up to retirement.

This chapter is divided into two main parts; the first is devoted to an analysis of various reference period set lengths in the Czech Republic and the second concerns the methods to be employed with regard to determining income valorisation subject to the reference period.

## 2 Adjustment of the length of the reference period - methods and data

In considering potential changes to the reference period in the Czech Republic the author considered for the purposes of this paper model cases of best earnings for 5-, 15-, 20-, 25-, 30- and 35-year periods. The selection of these periods was due to two main reasons – the data structure[2] of an individual's lifetime income and the frequent use of these figures in existing pension schemes. The author's model considers one option, where the reference period is any 5 best years. In the pension schemes compared, however, the reference period is quite often a consecutive number of best years[3]. It was decided not to include this method for determining the reference period principally because of the inadequacy of the relevant data. With regard to a reference period dependent upon the years running up to retirement, the author decided to include the last 5-, 22-, 30-, 35-, 40-, 42- and 44-year periods. A reference period of the final 22 years is intended to serve as a basic (zero) op-

2 *Closer to the data file, see below.*

3 ***This method of determining the reference period with a sufficiently high number of years taken into consid****eration approximates to the variant reflecting incomes in recent years as an equally long period.*

tion reflecting, with respect to 2008, income earned since 1986. The final 30-year variant is included because it is enshrined in law; the limit in this case will be reached in 2016. With regard to the significance of reference periods of 35, 40, 42 and 44 years it is important to note that the final 40-year option coincides with the typical lifetime income for women[4]. The 42-year option covers the typical lifetime income of men and women combined the 44-year option typically covers the lifetime income of men.

A further option for determining the reference period is a combination of the two methods outlined above i.e. to take into account lifetime income excluding a certain number (usually determined as a percentage) of the revenue-weakest years. The author has included variants of lifetime income which exclude the revenue-worst four years for men and the five worst earnings years for women.

## 3 Lifetime income data file

An individual's lifetime earnings records were required for the purposes of making model data calculations. However, since such data does not exist[5], the author decided to use data from the Information System on Average Earnings (ISPV) operated by the Ministry of Labour and Social Affairs[6]. Data from this system provides an overview of the earnings of men and women in both the private and public sectors in a given year. While the author is aware of the difficulties involved with using such data, it seems the most appropriate for use in the model. Further, the author used a simplification in the design of the model i.e. by considering the distribution of income in a given year between various age groups to represent the distribution of the lifetime income of the average individual. Consequently, the author was able to examine the impact of changes in the length of the reference period of an individual pension.

The author constructed tables which simulated an individual's lifetime income using average income obtained from the ISPV survey data. Income was distributed separately for the private and public sectors and according to gender. Income was obtained according to the five-year age groups, starting with 0-19 and ended with 60-64 age group.

Since income was determined from one specific year thereby reflecting current value, valorisation was not necessary. Along with income details income summary charts were then compiled which were subsequently used to model different types of reference period. Based on such data the individual calculation basis was determined for each type of individual and the amount of pension calculated (according to the rules for the granting of a pension in 2008). The average duration of insurance was set at 44 years for men, 40 years for women and 42 years for men and women combined. Non-contributory periods were taken into account to the extent identified in: "Analysis of non-contributory

*4 Lifetime income was determined based on the average period of insurance, which in 2004 in the CR was 44.4 for men, 39.8 years for women and 42.1 years on average.*

*5 Even if there were, it would be inappropriate for the calculation in the model due to social changes which have taken place since 1989.*

*6 Output sub-analysis of wage surveys, published by the CSO, based on ISPV sample surveys e.g. Structure of Earnings Survey 2004, CSO, Prague.*

periods in the CR and recommendations for monitoring and registration" (Holub, 2004). The range of each was adjusted to the length of each relevant reference period. Non-contributory periods were included of 3 246 days for men, 3 016 days for women and 3 144 days for both sexes combined. Earnings thresholds for 2008 (the first of 10 000 CZK and the second of 24 800 CZK) were used in determining the calculation basis.

## 4 Changes in the length of the reference period – results

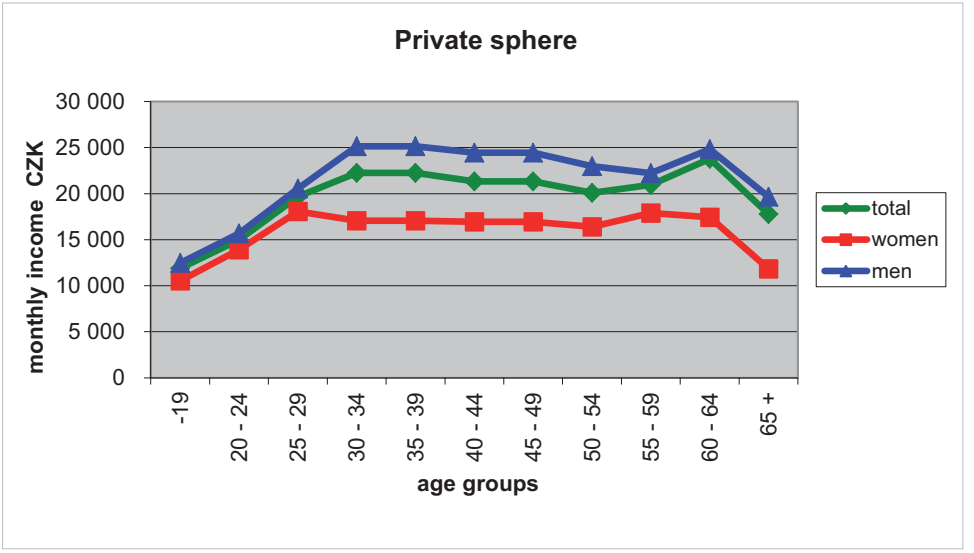
**Table 1:** Distribution of income by economic sector, gender and age group (2004)

| private sector | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | age groups | | | | | | | | | | |
| | - 19 years | 20 - 24 years | 25 - 29 years | 30 - 34 years | 35 - 39 years | 40 - 44 years | 45 - 49 years | 50 - 54 years | 55 - 59 years | 60 - 64 years | 65 + years |
| total | 11 900 | 14 983 | 19 702 | 22 247 | 22 247 | 21 333 | 21 333 | 20 087 | 20 949 | 23 779 | 17 793 |
| women | 10 545 | 13 912 | 18 070 | 17 052 | 17 052 | 16 959 | 16 959 | 16 390 | 17 888 | 17 426 | 11 835 |
| men | 12 464 | 15 684 | 20 545 | 25 135 | 25 135 | 24 447 | 24 447 | 22 970 | 22 221 | 24 835 | 19 653 |
| **public sector** | | | | | | | | | | | |
| | age groups | | | | | | | | | | |
| | - 19 years | 20 - 24 years | 25 - 29 years | 30 - 34 years | 35 - 39 years | 40 - 44 years | 45 - 49 years | 50 - 54 years | 55 - 59 years | 60 - 64 years | 65 + years |
| total | 10 427 | 15 292 | 18 306 | 19 373 | 19 373 | 20 028 | 20 028 | 20 431 | 21 402 | 23 300 | 19 294 |
| women | 10 760 | 14 796 | 17 126 | 17 080 | 17 080 | 18 448 | 18 448 | 18 767 | 20 066 | 20 796 | 15 979 |
| men | 9 771 | 16 240 | 19 971 | 23 473 | 23 473 | 24 491 | 24 491 | 24 610 | 23 794 | 25 084 | 21 941 |
| **national economy** | | | | | | | | | | | |
| | age groups | | | | | | | | | | |
| | - 19 years | 20 - 24 years | 25 - 29 years | 30 - 34 years | 35 - 39 years | 40 - 44 years | 45 - 49 years | 50 - 54 years | 55 - 59 years | 60 - 64 years | 65 + years |
| total | 11 382 | 15 091 | 19 211 | 21 237 | 21 237 | 20 874 | 20 874 | 20 208 | 21 108 | 23 611 | 18 321 |
| women | 10 647 | 14 333 | 17 620 | 17 065 | 17 065 | 17 669 | 17 669 | 17 522 | 18 926 | 19 032 | 13 809 |
| men | 11 845 | 15 812 | 20 413 | 24 753 | 24 753 | 24 457 | 24 457 | 23 347 | 22 583 | 24 893 | 20 180 |

*Source: Survey ISPV (2004), own calculations.*

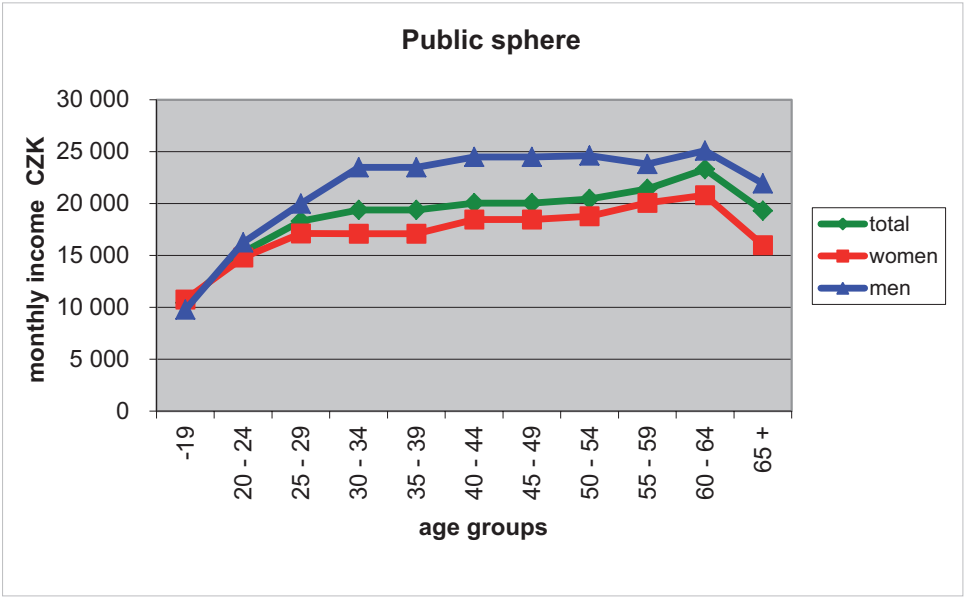
The above-mentioned tables compiled as part of the ISPV survey show the distribution of gross monthly income between the private and public sectors of the national economy by gender and age category in total. The most noticeable difference is that between the private and public sectors. Remuneration in the private sector is based on the labour productivity development of individuals whilst reward in the public sector is based on the principle of seniority (merit) - the more senior the position, the higher the salary. These two varying methods of remuneration, together with the relative representation of these two sectors within the national economy should be borne in mind when planning possible changes and in the interpretation of results. The following graphs illustrate the distribution of income in the national economy.

**Graph 1:** Gross earnings and numbers of people (structure) by gender, age category and total



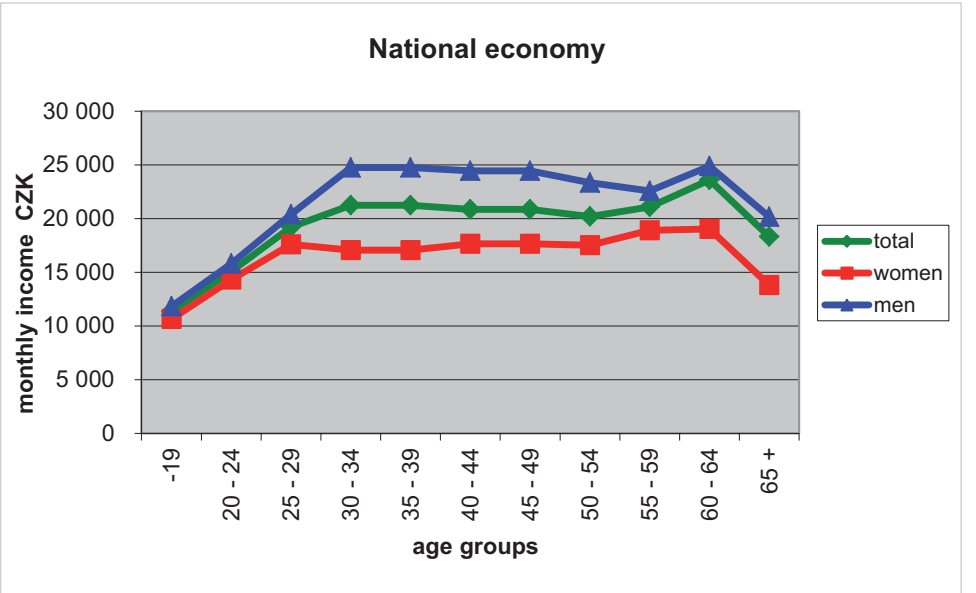

*Source: Survey ISPV (2004), own calculations.*

**Graph 2:** Gross earnings and numbers of people (structure) by gender, age category and total




*Source: Survey ISPV (2004), own calculations.*

**Graph 3:** Gross earnings and numbers of people (structure) by gender, age category and total




*Source: Survey ISPV (2004), own calculations.*

The results of the proposed options for changing the length of the reference period compared with the zero option i.e. 22 years, presented in the table below, show that a change in the reference period has a marginal influence on an individual's pension. This is due mainly to the earnings thresholds which are used in the recalculation of income earned in the reference period. Earnings thresholds were set at 10 000 CZK for the first earnings threshold and 24 800 CZK for the second. The income from a given period is fully included up to the first earnings threshold, income exceeding the first earnings threshold but not reaching the second earnings threshold is included from 30% and income exceeding the second earnings threshold is included only from 10%. Consequently one cannot expect significant changes in an individual's pension due to extension of the reference period. The extension of the reference period to lifetime earnings will influence most notably the pensions of women in the public sector with average earnings whose pension would decrease by 274 CZK (2.5%). The same extension of the period would cause a drop in income for men in the public sector of 215 CZK (1.9%). As in the public sector, extending the reference period to lifetime income would cause a drop in the pension of individuals working in the private sector. The decrease, however, would not be as noticeable as in the public sector. A decrease in men's pensions of 143 CZK (1.2%) would be higher than that of women at 128 CZK (1.2%). On the other extreme, the reference period model which takes into account the best 5 years of earnings would see the average men's pension increase by 122 CZK (1.1%) and that of women with an average income working in the private sector by 284 CZK (2.7%). With a reference period consisting of the 5 best years, the increase in the pension for men in the public sector would not be as significant as for men in the private sector; those in the public sector would see a rise of only 29 CZK (0.3%). Women's pensions would increase by 232 CZK (2.13%). Women working in the public sector

could expect to see the same increase in pension with a reference period consisting of the last 5 years of earnings; in this case the last 5 years corresponds with the best 5 years. The small increase in pension for men working in the public sector when considered with a reference period consisting of the best 5 years is closely tied to the development of income in this sector; income achieved from the age of 39 years (income is taken into account for the default/zero option from this age) proves to be almost constant i.e. without any significant development. If one considers the average earning individual, irrespective of gender and the national economic sector in which they operate, extending the reference period to include lifetime income would cause a fall in pension of 187 CZK (1.7%). Were the reference period to consist of the best 5 years, the pension would increase by 89 CZK (0.8%).

Very interesting results would ensue should the reference period be extended to 30 years as contained in the Pension Insurance Act. Such an extension would, for individuals on an average income, irrespective of gender and the sector of the national economy, mean a pension increase of 3 CZK (0.03%). Such an increase would be due mainly to the private sector which would increase the pension for women by 34 CZK (0.3%) and men by 32 CZK (0.3%). Conversely, women in the public sector would receive a pension reduced by 84 CZK (0.8%) and men by 19 CZK (0.2%). All the variants described above can be seen in the following table. Selected options can be observed in the graph below.

**Table 2:** Pension amount variants (in CZK) according to method of determining the reference period

| calculation basis number of years | man private sector | woman private sector | man and woman private sector | man public sector | woman public sector | man and woman public sector | man and woman total |
|---|---|---|---|---|---|---|---|
| last 22 | 11 553 | 10 550 | 11 348 | 11 610 | 10 906 | 11 279 | 11 324 |
| last 30 | 11 585 | 10 584 | 11 366 | 11 591 | 10 822 | 11 255 | 11 327 |
| last 35 | 11 555 | 10 531 | 11 336 | 11 550 | 10 740 | 11 223 | 11 297 |
| last 40 | 11 449 | 10 422 | 11 268 | 11 481 | 10 632 | 11 057 | 11 194 |
| last 44 (42)* | 11 410 | | 11 235 | 11 395 | | 10 955 | 11 199 |
| last 5 | 11 477 | 10 564 | 11 321 | 11 586 | 11 138 | 11 357 | 11 334 |
| best 15 | 11 659 | 10 692 | 11 418 | 11 629 | 11 009 | 11 300 | 11 377 |
| best 20 | 11 649 | 10 661 | 11 405 | 11 616 | 10 939 | 11 287 | 11 364 |
| best 25 | 11 623 | 10 640 | 11 389 | 11 601 | 10 870 | 11 270 | 11 348 |
| best 30 | 11 593 | 10 612 | 11 366 | 11 591 | 10 823 | 11 255 | 11 327 |
| best 35 | 11 555 | 10 531 | 11 336 | 11 550 | 10 740 | 11 223 | 11 297 |
| best 5 | 11 675 | 10 834 | 11 443 | 11 639 | 11 138 | 11 357 | 11 413 |
| lifetime career without worst ** | 11 449 | 10 531 | | 11 481 | 10 740 | | |

* last 44 equals lifetime earnings for men, 40 equals lifetime earnings for women, 42 together

** for men 4 worst-earnings years, for women 5 worst-earnings years

*Source: own calculations based on ISPV survey (2004).*

**Table 3:** Difference in pensions (in CZK) according to method of determining the reference period

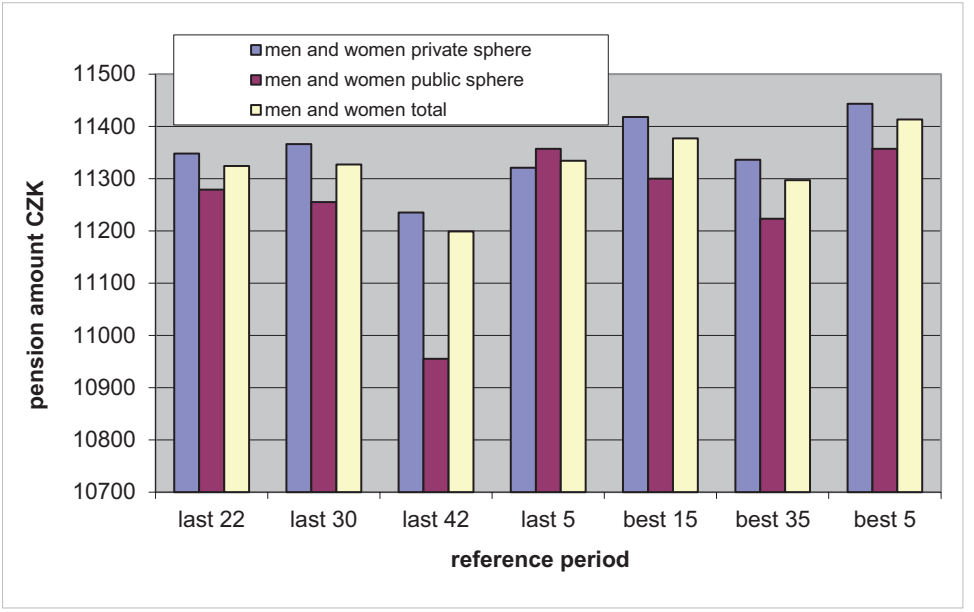
| calculation basis number of years | man private sector | woman private sector | man and woman private sector | man public sector | woman public sector | man and woman public sector | man and woman total |
|---|---|---|---|---|---|---|---|
| last 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| last 30 | 32 | 34 | 18 | -19 | -84 | -24 | 3 |
| last 35 | 2 | -19 | -12 | -60 | -166 | -56 | -27 |
| last 40 | -104 | -128 | -80 | -129 | -274 | -222 | -130 |
| last 44 (42)* | -143 | | -113 | -215 | | -324 | -187 |
| last 5 | -76 | 14 | -27 | -24 | 232 | 78 | 10 |
| best 15 | 106 | 142 | 70 | 19 | 103 | 21 | 53 |
| best 20 | 96 | 111 | 57 | 6 | 33 | 8 | 40 |
| best 25 | 70 | 90 | 41 | -9 | -36 | -9 | 24 |
| best 30 | 40 | 62 | 18 | -19 | -83 | -24 | 3 |
| best 35 | 2 | -19 | -12 | -60 | -166 | -56 | -27 |
| best 5 | 122 | 284 | 95 | 29 | 232 | 78 | 89 |
| lifetime career without worst ** | -104 | -19 | | | -129 | -166 | |

* last 44 equals lifetime earnings for men, 40 equals lifetime earnings for women, 42 together

** for men 4 worst-earnings years, for women 5 worst-earnings years

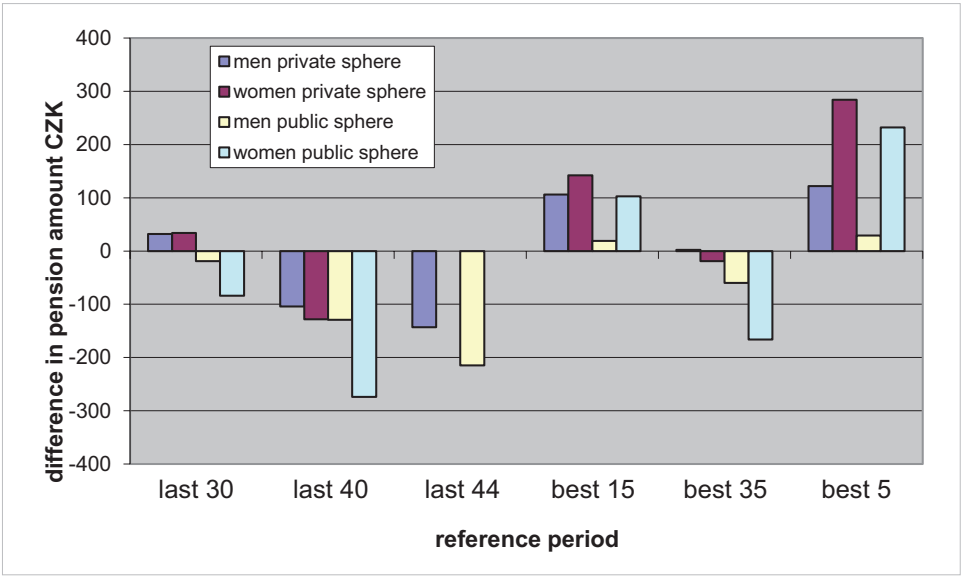
*Source: own calculations based on ISPV survey (2004).*

**Graph 4:** Amount of pension (in CZK) according to method of determining the reference period




*Source: own calculations based on ISPV survey (2004).*

**Graph 5:** Difference in pensions (in CZK) according to method of determining the reference period




*Source: own calculations based on ISPV survey (2004).*

In order to exclude the effect of the earnings thresholds applied in calculating the pension on the variation in the amount of the pension caused by changes in the length of the reference period it was necessary to make a further comparison. The author therefore compared the impact of changes in the length of the reference period on the personal calculation base of individuals with average incomes. As a result of this model comparison the following results were obtained: by extending the reference period to lifetime income the personal calculation base of individuals with average earnings, irrespective of gender and sector of the national economy, would see a decrease of 1 860 CZK (7.1%). Modification of the reference period to the best 5 years would lead to an increase in the personal calculation base of 1345 CZK (5.1%).

The most obvious difference in the personal calculation base can be seen in the case of a man working in the public sector. The extension of the reference period to lifetime income would decrease his personal calculation base by 3 246 CZK (10.6%). The same extension would decrease the personal calculation base of a woman in the public sector by 1 383 CZK (5.6%). As far as the private sector is concerned, by extending the reference period to lifetime income most men would come off worse; their personal calculation base would decrease by 2 161 CZK (7.3%). Extending the reference period to lifetime income would lead to a reduction in the women's personal calculation base of 652 CZK (3.1%). The option of a reference period consisting of the 5 best years would again be favourable for all those receiving an average wage. The greatest gain could be expected by women working in the private sector; their personal calculation base would increase by CZK 1432 (6.7%), followed by men in the private sector, whose personal calculation base would increase by 1858 CZK (6.3%). By determining the reference period as the best 5 years women in the public sector could expect an increase in their personal calculation base of 1173 CZK (5.1%) and men in the public sector of 457 CZK (1.5%). An overview of changes in the personal calculation base caused by changes in the length of the reference period can be found in the following tables and graphs.

**Table 4:** Individual calculation base variants (in CZK) according to method of determining the reference period (part 1)

| calculation basis number of years | man private sector | woman private sector | man and woman private sector | man public sector | woman public sector | man and woman public sector | man and woman total |
|---|---|---|---|---|---|---|---|
| last 22 | 29 672 | 21 363 | 26 573 | 30 533 | 23 157 | 25 529 | 26 206 |
| last 30 | 30 168 | 21 531 | 26 850 | 30 243 | 22 733 | 25 170 | 26 260 |
| last 35 | 29 704 | 21 262 | 26 388 | 29 627 | 22 320 | 24 759 | 25 816 |
| last 40 | 28 108 | 20 711 | 25 351 | 28 587 | 21 774 | 23 918 | 24 847 |
| last 44 (42)* | 27 511 | | 24 857 | 27 287 | | 23 404 | 24 346 |
| last 5 | 28 530 | 21 432 | 26 160 | 30 171 | 24 330 | 26 703 | 26 351 |
| best 15 | 31 274 | 22 079 | 27 628 | 30 821 | 23 678 | 25 848 | 27 002 |
| best 20 | 31 123 | 21 920 | 27 436 | 30 622 | 23 326 | 25 647 | 26 807 |
| best 25 | 30 735 | 21 814 | 27 181 | 30 402 | 22 975 | 25 387 | 26 551 |
| best 30 | 30 289 | 21 672 | 26 850 | 30 243 | 22 737 | 25 170 | 26 260 |

**Table 4:** Individual calculation base variants (in CZK) according to method of determining the reference period (part 2)

| calculation basis number of years | man private sector | woman private sector | man and woman private sector | man public sector | woman public sector | man and woman public sector | man and woman total |
|---|---|---|---|---|---|---|---|
| best 35 | 29 704 | 21 262 | 26 388 | 29 627 | 22 320 | 24 759 | 25 816 |
| best 5 | 31 530 | 22 795 | 28 011 | 30 990 | 24 330 | 26 703 | 27 551 |
| lifetime career without worst ** | 27 511 | 20 711 | | 27 278 | 21 774 | | |

* last 44 equals lifetime earnings for men, 40 equals lifetime earnings for women, 42 together

** for men 4 worst-earnings years, for women 5 worst-earnings years

*Source: own calculations based on ISPV survey (2004).*

**Table 5:** Individual calculation base differences (in CZK) according to method of determining the reference period

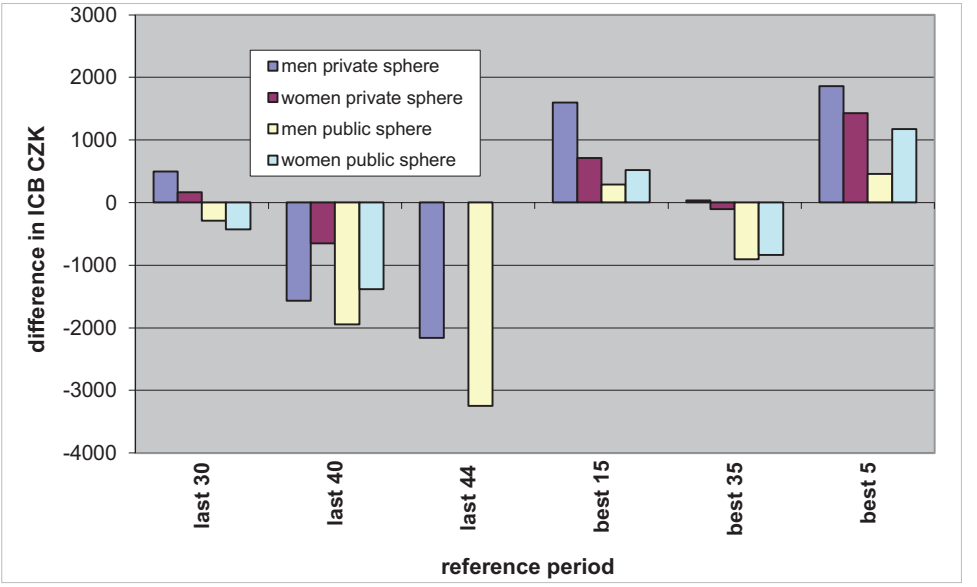
| calculation basis number of years | man private sector | woman private sector | man and woman private sector | man public sector | woman public sector | man and woman public sector | man and woman total |
|---|---|---|---|---|---|---|---|
| last 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| last 30 | 496 | 168 | 277 | -290 | -424 | -359 | 53 |
| last 35 | 32 | -101 | -185 | -906 | -837 | -770 | -391 |
| last 40 | -1 564 | -652 | -1 222 | -1 946 | -1 383 | -1 611 | -1 359 |
| last 44 (42)* | -2 161 | | -1 716 | -3246 | | -2 125 | -1 860 |
| last 5 | -1 142 | 69 | -413 | -362 | 1 173 | 1 174 | 145 |
| best 15 | 1 602 | 716 | 1 055 | 288 | 521 | 319 | 796 |
| best 20 | 1 451 | 557 | 863 | 89 | 169 | 118 | 601 |
| best 25 | 1 063 | 451 | 608 | -131 | -182 | -142 | 344 |
| best 30 | 617 | 309 | 277 | -290 | -420 | -359 | 53 |
| best 35 | 32 | -101 | -185 | -906 | -837 | -770 | -391 |
| best 5 | 1 858 | 1 432 | 1 438 | 457 | 1 173 | 1 174 | 1 345 |
| lifetime career without worst ** | -1 564 | -101 | | | -1 383 | -770 | |

* last 44 equals lifetime earnings for men, 40 equals lifetime earnings for women, 42 together

** for men 4 worst-earnings years, for women 5 worst-earnings years

*Source: own calculations based on ISPV survey (2004).*

**Graph 6:** Individual calculation base (in CZK) according to method of determining the reference period




*Source: own calculations based on ISPV survey (2004).*

The impact of changes in determining the reference period for the overall pension system, namely the macro-economic dimension is captured in the table below. The author calculated the impact of changes in the length of the reference period on the overall balance of the pension system. The calculation employs a simple expenditure model which is based on the following assumptions. The number of newly granted pensions each year is a constant 90 000. An abstraction was made from wage and price level development as well as from the extension of the reference period for each year. Paradoxically, in contrast with the expected results, that any extension of the reference period would reduce the cost of the pension system, by extending the reference period to 30 years pension costs would in fact increase.

The reason for such a development is that extending the reference period increases the relationship between paid contributions and pension benefit. Paid contributions therefore depend on the development of the lifetime income of the model individual. Extending the reference period from the current 22 years to 30 whilst considering the average retirement age to be 59 years, includes the period of highest earnings for the model individual (for earnings between 29-59 years see Chart 11). Such relatively high levels of income will clearly increase the personal calculation base and so the pension. Therefore it is necessary to bear this in mind when planning further changes to the length of the reference period as part of the pension reform process. Any proposal for change must be prepared to reflect both the current situation and the distribution of the lifetime income of individuals. The greatest savings in terms of pension system total expenditure would be provided by extending the reference period to lifetime income. By introducing such an extension the resulting savings with regard to newly granted pensions would amount to 202 million

CZK; after 5 years savings would amount to 1 billion CZK and after 20 years a significant 4 billion CZK. Conversely, a change in the reference period to the 5 best years would lead to an increase in expenditure within the pension system of nearly 2 billion CZK.

If the savings resulting from the extension of the reference period to lifetime earnings are expressed as a percentage of total expenditure on pensions, after 20 years of implementation a saving would accrue totalling 1.5% of total expenditure. Results are summarised in the following table.

**Table 6:** Cumulative pension savings by changing the length of the reference period

| calculation basis number of years | cumulative savings 1st year | cumulative savings 5th year | cumulative savings 15th year | cumulative savings 20th year |
|---|---|---|---|---|
| last 30 | -3.24 | -16.2 | -48.6 | -64.8 |
| last 40 | 140.40 | 702.0 | 2 106.0 | 2 808.0 |
| last 44 (42) | 201.96 | 1 009.8 | 3 029.4 | 4 039.2 |
| best 5 | -96.12 | -480.6 | -1 441.8 | -1 922.4 |
| | savings as % of pension expenditure | | | |
| last 30 | 0.00 | -0.01 | -0.02 | -0.02 |
| last 40 | 0.05 | 0.26 | 0.79 | 1.05 |
| last 44 (42) | 0.08 | 0.38 | 1.14 | 1.52 |
| best 5 | -0.04 | -0.18 | -0.54 | -0.72 |

*Source: own calculations based on ISPV survey (2004).*

## 5 Methods of income valorisation within the reference period - methods and data

A further tool available for influencing the pension is the way in which income subject to the reference period is valorised. A comparison of foreign systems shows that the most favoured methods are to either valorise income according to wage development (or according to the increase in the general calculation base from which contributions to the pension insurance system are paid) or to valorise according to general price level development. The least common method is a combination of the two options. Other valorisation methods are employed sporadically such as that related to the total cost of newly granted pensions. In the Czech Republic, reference incomes are indexed according to the development of the general calculation base. On the practical level valorisation is determined as a function of the so-called growth rate general calculation basis (GRGCB). The GRGCB is determined using general calculation bases which are set by the government for the period up to 30 September of the following calendar year. The general calculation basis responds to the average monthly wage for the calendar year, identified by the Czech Statistical Office (CSO), multiplied by the conversion rate set by government decree. The growth rate of the general calculation base is determined as a proportion of the general assessment base for the calendar year, two years prior to the payment of pensions, multiplied by the conversion rate, and the general assessment base for the calendar year for which the annual reference income is calculated. For the purposes of this study, the author calculated to what extent the amount of pension for individuals receiving an average

wage would change depending on the method employed for the valorisation of reference incomes – according either to the growth of the general calculation basis or that of the general price level. The calculation procedure was as follows: data on the growth of the general price level was taken from the CSO and, in the same way as the growth rate of the general calculation base is calculated, estimation was made of the growth rate of the general price level (GRGPL). Using this rate, the author then modified the average-income individual and, according to the conditions of 2008, calculated his/her pension benefit, assuming the valorisation of income within the reference period was performed using an increase in the general price level. Pensions were calculated for both men and women and for both sexes combined. Average wages since 1986 and the development of the general price level since that year were used as the calculation base. The reference period was set at 22 years and the average period of insurance for men at 44 years, for women 40 years and at 42 years for both sexes combined. Non-contributory periods were taken into account to the extent identified in the study „Analysis of non-contributory periods in the CR and recommendations for monitoring and registration" (Holub, 2004). Their range was adjusted to the length of each relevant reference period. Non-contributory periods were considered to be 1 508 days for men, 1 785 days for women and 1 647 days for both sexes. The pension benefit thus calculated was then compared to the pension benefit computed according to existing rules, i.e. valorisation of income according to the growth of the general calculation base. Replacement ratios were calculated for both types of pensions (the pension from income valorised by an increase in the general calculation base and that from income valorised by the growth of general price levels). Finally the author computed the impact of macroeconomic changes on the pension system caused by the method of valorisation chosen.

## 6 Methods for the valorisation of income within the reference period – results

When one evaluates the development of key macroeconomic indicators and compares the development of the general price level and nominal wage growth it is evident that since 1996 in all but one year nominal wage growth has been greater than that of the general price level. The difference between inflation and the growth rates of nominal wages (i.e. real wage growth) together with other macroeconomic indicators can be found in this table.

**Table 7:** Main macroeconomic indicators (%)

| indicator | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| growth of GDP | 4.0 | -0.7 | -0.8 | 1.3 | 3.6 | 2.5 | 1.9 | 3.6 | 4.5 | 6.3 | 6.8 | 6.6 |
| growth of nominal wages* | 18.3 | 9.9 | 9.2 | 8.4 | 6.4 | 8.7 | 7.3 | 6.6 | 6.6 | 5.3 | 6.5 | 7.3 |
| inflation | 8.8 | 8.5 | 10.2 | 2.1 | 3.9 | 4.7 | 1.8 | 0.1 | 2.8 | 1.9 | 2.5 | 2.8 |
| growth of real wages | 9.5 | 1.4 | -1.0 | 6.3 | 2.5 | 4.0 | 5.5 | 6.5 | 3.8 | 3.4 | 4.0 | 4.5 |

* Average gross nominal wages

*Source: CSO, Main macroeconomic indicators 2008.*

The development of these indicators shows that should valorisation be performed according to growth of the general price level or by a combination of wage growth and general price level development it would decrease the personal calculation base of individuals as well as their pensions, and thus the overall expenditure of the pension system (assuming other parameters to be unchanged). The difference between the growth rate of the general calculation base and that of general price levels is shown in the following table.

**Table 8:** Growth rate of the general calculation base and of the general price level

| year | GRGCB | GRGPL | difference |
|---|---|---|---|
| 1986 | 7.2739 | 4.5941 | 2.6798 |
| 1987 | 7.1248 | 4.5895 | 2.5353 |
| 1988 | 6.9660 | 4.5803 | 2.3857 |
| 1989 | 6.8012 | 4.5171 | 2.2841 |
| 1990 | 6.5611 | 4.1177 | 2.4434 |
| 1991 | 5.6856 | 2.6294 | 3.0562 |
| 1992 | 4.6425 | 2.3667 | 2.2758 |
| 1993 | 3.7063 | 1.9592 | 1.7471 |
| 1994 | 3.1264 | 1.7811 | 1.3453 |
| 1995 | 2.6382 | 1.6325 | 1.0057 |
| 1996 | 2.2282 | 1.5005 | 0.7277 |
| 1997 | 2.0157 | 1.3829 | 0.6328 |
| 1998 | 1.8438 | 1.2493 | 0.5945 |
| 1999 | 1.7037 | 1.2236 | 0.4801 |
| 2000 | 1.5982 | 1.1776 | 0.4206 |
| 2001 | 1.4727 | 1.1248 | 0.3479 |
| 2002 | 1.3723 | 1.1049 | 0.2674 |
| 2003 | 1.2857 | 1.1038 | 0.1819 |
| 2004 | 1.2057 | 1.0737 | 0.1320 |
| 2005 | 1.1462 | 1.0537 | 0.0925 |
| 2006 | 1.0753 | 1.0280 | 0.0473 |
| 2007 | 1.0000 | 1.0000 | 0.0000 |

*Source: own calculations based on MLSA and CSO data.*

Changing the method used for the valorisation of past earnings from wage valorisation to price valorisation leads to a decrease in the pensions of individuals and thus a decline in the profitability (from the individual's point of view) of the PAYG-financed pension system. The valorising of income according to wage growth (i.e. by the growth of the total payroll, thus the sum of population and wage growth) should provide a comparable rate of return for PAYG pension systems with funded pension schemes (provided that the interest rate is the same as the sum of population and wage growth)[7]. Wage valorisation of reference incomes is better for the individual, but is in conflict with the financial sustainability of the pension system as a whole since it is, quite simply, more expensive than using price valorisation. The effects of changes in the method of valorisation from wage valorisation

7 *Closer to this issue, see Aaron's rule.*

to that according to price level development on the individual pension of individuals with different levels of income – set out as multiples of the average wage – and the impact on replacement rates is shown in the following table.

**Table 9:** Effect of changes in indexation on individual income

| | | GRGCB | | | GRGPL | | |
|---|---|---|---|---|---|---|---|
| | | man | woman | total | man | woman | total |
| multiple of average wage | average insurance period | 44 | 40 | 42 | 44 | 40 | 42 |
| | NP–days within 22 years | 1 508 | 1 785 | 1 647 | 1 508 | 1 785 | 1 647 |
| 0,5 | pension (CZK) | 8 954 | 8 400 | 8 678 | 7 919 | 7 690 | 7 766 |
| | replacement rate | 78.2% | 73.3% | 75.8% | 69.1% | 67.1% | 67.8% |
| | last salary (CZK) | 11 456 | 11 456 | 11 456 | 11 456 | 11 456 | 11 456 |
| 1 | pension (CZK) | 11 350 | 10 543 | 10 948 | 10 051 | 9 443 | 9 749 |
| | replacement rate | 49.5% | 46.0% | 47.8% | 43.9% | 41.2% | 42.5% |
| | last salary (CZK) | 22 912 | 22 912 | 22 912 | 22 912 | 22 912 | 22 912 |
| 2 | pension (CZK) | 13 105 | 12 209 | 12 659 | 12 082 | 11 238 | 11 661 |
| | replacement rate | 28.6% | 26.6% | 27.6% | 26.4% | 24.5% | 25.4% |
| | last salary (CZK) | 45 824 | 45 824 | 45 824 | 45 824 | 45 824 | 45 824 |
| 3 | pension (CZK) | 14 860 | 13 876 | 14 371 | 13 325 | 12 419 | 12 874 |
| | replacement rate | 21.6% | 20.2% | 20.9% | 19.4% | 18.1% | 18.7% |
| | last salary (CZK) | 68 736 | 68 736 | 68 736 | 68 736 | 68 736 | 68 736 |
| 0,5 | Difference in pension wage-price | 1 035 | 710 | 912 | 11.6% | 8.5% | 10.5% |
| 1 | Difference in pension wage-price | 1 299 | 1 100 | 1 199 | 11.4% | 10.4% | 11.0% |
| 2 | Difference in pension wage-price | 1 023 | 971 | 998 | 7.8% | 8.0% | 7.9% |
| 3 | Difference in pension wage-price | 1 535 | 1 457 | 1 497 | 10.3% | 10.5% | 10.4% |

Note: NP – non-contributory periods

*Source: own calculations based on MLSA and CSO data.*

It is evident that a change in the method of valorisation of income within the reference period from wage growth valorisation to that reflecting changes in the price level would lead to a decline in the pension for the model individual i.e. with income equal to a multiple of the average wage. The decrease would be in the range 8% to 11% depending on the wage.

The macroeconomic expression of savings made from changes to the valorisation method used for reference earnings – from reflecting growth in the general calculation base (wage) to valorisation reflecting growth in price levels is shown in the table below. From this table it is apparent that accumulated savings from newly granted pensions (assuming a constant number of new pensions granted of 90 000 each year) would amount to 1.3 billion CZK in the year of introduction and close to 26 billion CZK after 20 years.

**Table 10:** Cumulative pension savings by changing from wage to price valorisation (in millions CZK)

| newly granted pensions | 1st year | 5th year | 20th year | 50th year |
|---|---|---|---|---|
| 90 000 | 1 295 | 6 475 | 25 898 | 64 746 |

*Source: own calculations based on MLSA and CSO data.*

## 7 The synergic effect of extending the reference period and changing the reference income valorisation method

With regard to total pension system savings one might intuitively guess that the best option would be to change the extent of the reference period as well as the method used for the valorisation of income subject to the reference period. If one wishes to assess the impact of the synergic effects created by introducing changes to the methods of indexing and extending the length of the reference period, one would need data on lifetime income and valorisation method as well as on price level development for the entire period of insurance. Since such data is not available for the Czech Republic (due to the specific conditions pertaining before 1989), it is necessary to adopt certain simplifying conditions. For the purposes of lifetime income, data (2004) presenting the current distribution of income across the population, broken down by age group was used. The author assumes the simplification that the distribution of income is identical with the development of lifetime income for the average individual. The average period of insurance (42 years) was taken as the reference period. Inflation before 1986 was taken into account at a constant rate of 2% and growth in nominal wages at 4%. The GRGCB was then calculated from this input data from which lifetime incomes were „discounted". The resultant reconstructed lifetime incomes were then valorised according to the development of the general price level. The results are presented in the following table.

**Table 11:** Amount of pension (in CZK) by extending the reference period to 42 years, changing from wage to price valorisation and combination of these changes

| | current state | extending of reference period | changing method of valorisation | extending period + changing valorisation |
|---|---|---|---|---|
| Amount of pension | 11 324 | 11 199 | 9 749 | 9 015 |

*Source: own calculations based on MLSA and CSO data.*

It can be seen that the extension of the reference period for lifetime income together with a change in the valorisation of income within the reference period would cause a significant reduction in income compared with individual changes only. The method used for the valorisation of reference income has the biggest effect on the amount of the pension resulting in a reduction of 1 575 CZK. The extension of the reference period to lifetime income alone would reduce the model pension by a mere CZK 125. If the two changes were to be made at the same time it would lead to a decrease in the pension of 2 309 CZK due to the attendant synergic effect.

The macroeconomic expression of the synergy-effect savings i.e. the effects of a change in the valorisation method and a change in the reference period to include lifetime income can be seen in the table below. It is apparent that accumulated savings from newly granted pensions (assuming a constant number of new pensions granted of 90 000 each year) would amount to 2.5 billion CZK in the year of introduction and to almost 50 billion CZK after 20 years.

**Table 12:** Cumulative pension savings by combination of extending reference period and simultaneously changing valorisation method from wage to price valorisation (in millions CZK)

| newly granted pensions | 1st year | 5th year | 20th year | 50th year |
|---|---|---|---|---|
| 90 000 | 2 494 | 12 467 | 49 874 | 124 686 |

*Source: own calculations based on MLSA and CSO data.*

## Conclusions and policy recommendations

In most European countries, a long-term trend of extending the reference period from which the pension is calculated can be observed. The income valorisation method used within the reference period varies from country to country, however a general shift from wage development valorisation to general price level development valorisation can be observed.

When the length of the reference period is changed, the impact on different groups of insured persons should always be taken into consideration. The extension of the length of the reference period will generally have a more negative impact on individuals whose income gradually increases throughout their career while it will have hardly any effect on the retirement benefit of individuals whose incomes are almost constant over time.

The extension of the reference period to lifetime income would have only a small impact both on a hypothetical individual with average income and on total pension system expenditure in the current Czech pension system. This is due mainly to the structure of an individual's lifetime income which, in terms of the national economy, commences (age group to 19 years) at 11 382 CZK. Therefore, even if one takes into account potential lifetime income it will have no significant effect on the amount of pension because of the earnings thresholds used in the pension system. Because the first threshold is so low, any income above this threshold influences the final pension only minimally. In the Czech pension system earnings thresholds represent a strong element of (income) solidarity and any attempt to strengthen the principle of equivalence by extending the reference period encounters this barrier[8].

8 *In 2008 earnings thresholds were set at 10 000 CZK for the first earnings threshold and 24 800 CZK for the second. Income from a given period is fully included up to the first earnings threshold, any income exceeding the first earnings threshold but not reaching the second is included at 30% and income exceeding the second earnings threshold is included only at 10%. This system makes the effect of extending the reference period on the pension of a hypothetical individual with average income insignificant.*

The analysis herein has focused on changes to the length of the reference period and shows that extending the reference period to lifetime income would most affect women on an average income working in the public sector – her pension income would decrease by 2.5% (274 CZK). From the perspective of the national economy extending the reference period to lifetime income would decrease the pension of a hypothetical individual on average income by 1.65% (187 CZK). If the reference period were set at the best 5 years of the working life, women on average income working in the private sector would benefit the most with a prise in their pension of 2.7% (284 CZK). The respective increase in pension for individuals in terms of the whole economy would be 0.8% (89 CZK). The distribution of income in the public sector indicates that for women a reference period consisting of the last 5 years before retirement would be the same as the 5 best year's option. Interesting results are obtained if one compares the extension of the reference period from the current 22 years to 30 years (the target set by the Pension Insurance Act). If one applies a reference period of 30 years to the current distribution of lifetime income, the extension would result in an increase in the pension of the average individual of 0.03% (3 CZK); this increase is the result principally of the private sector in which the increase in the pension of women would be 0.3% (34 CZK) and for men also 0.3% (32 CZK). On the other hand, the pension of women in the public sector would fall by 0.8% (84 CZK) and of men by 0.2% (19 CZK).

In order to exclude the effect of earnings thresholds on the results of the reference period models, the author made a comparison of the effects of changes in the length of the reference period on an individual calculation basis. In this case an extension of the reference period to lifetime income would most affect men in the public sector whose individual calculation basis would fall by 10.6% (3 246 CZK); in the national economy as a whole the individual calculation basis for an average individual would decrease by 7.1% (1 860 CZK).

Moreover the extension of the length of the reference period to 30 years would paradoxically cause an increase in pension system expenditure instead of the expected reduction. This is the result both of the fact that an extension to the reference period increases the interrelationship between pension benefits and paid contributions derived from individual income and of the development of an individual's lifetime income. The extension of the reference period from the current 22 years to 30 years covers the period in which an individual earns his/her maximum income during his/her potential working lifetime i.e. 15-59 years (considering an average retirement age of 59 years; see Graph 11). Higher income would logically increase the individual calculation basis and thus the pension. This should be borne in mind when considering further changes to the length of the reference period. Each potential modification must reflect the initial situation and the distribution of an individual's lifetime income. The highest savings in terms of total pension system expenditure would be provided by an extension of the reference period to lifetime income; in the year of implementation such a modification would lead to savings in newly granted pensions of 202 million CZK, after 5 years savings would reach 1 billion CZK and after 20 years 4 billion CZK.

Changing the method of income valorisation within the reference period from that based on the development of the general calculation base (wage increases) to that based on general price level development would lead to a decline in a model individual's pension of between 8% and 11% depending on income. Basing income valorisation on general

calculation base development is more beneficial for the insured (less beneficial in terms of total expenditure) since it ensures higher pension benefits within the PAYG system for individuals. Conversely, income valorisation based on price level development would be more beneficial for the pension scheme (less beneficial for the insured) as the increase in the price level is slower than that of wages and would assist in maintaining the financial sustainability of the pension scheme as a whole. A change in the method of valorisation from wage valorisation to that according to price level growth would provide savings of 26 billion CZK in the 20th year of operation of the new method.

The highest savings in the pension system would amount to nearly 50 billion CZK after 20 years as a result of the synergic effect of a combination of the change from wage valorisation to price level valorisation and the extension of the reference period to lifetime income.

Differences in income growth between men and women (incomes rise faster for men than for women in the Czech Republic) mean that the income valorisation method is less beneficial for individuals whose income grows faster than the average (men in terms of the Czech Republic) but more beneficial for individuals whose income increases more slowly than the average. This should be taken into account should an extension of the reference period be implemented and the income valorisation method retained since in fact it represents a certain strengthening of the principle of solidarity and the suppression of the principle of equivalence within the pension system.

In order to strengthen the principle of equivalence in the Czech pension system the author would recommend extending the reference period from which the pension is calculated to include total work life income which would lead to a strengthening of the link between paid contributions and pension benefits. The reference period could be extended gradually up to and even after 2016; it would not be limited to a maximum of 30 years as is the case under existing legislation. The author would recommend maintaining the beginning of the reference period at 1986. However, the impact of such measures on equivalence within the pension system is severely limited and extending the reference period to lifetime income would have almost no effect on the overall level of the pension because of earnings thresholds and their current settings. Earning thresholds form a strong element of (income) solidarity within the Czech pension system and lead to a high degree of granted pension levelling. Given the reduction in reference income above the earning thresholds which in turn are relatively low it might be appropriate to consider the replacement of the existing scheme by a tax-financed basic minimum pension in the form of a flat rate benefit with supplementary income pension scheme with benefits based on insurance. With such supplementary benefits there would be greater opportunity to apply the principle of equivalence as well as to extend the reference period.

Should one wish to pursue the aim of maintaining the return rate of the PAYG pension system for the insured in the Czech Republic, an appropriate solution would be to adopt a method of income valorisation within the reference period based on the development of wages. When one evaluates the current situation in the Czech Republic from the point of view of the long-term financial sustainability of the pension scheme (thus pursuing the objective of reducing expenditure on the pension system) a suitable solution would be to change the method used to valorise income within the reference period according

to price level development. In this case, the author would suggest replacing the general calculation basis growth coefficient by the general price level growth coefficient – as was implemented in Austria in 2005; such a change would be effective since it would mean a change of indexation method. The effect of such a measure would be enhanced by further extension of the reference period. Given the synergic effect, the difference between price level and wage valorisation and thus the overall impact of such measures on the amount of pension paid out as well as on pension system balance would be significant. The financial effect of such measures would be manifested stepwise and would peak around the time of the highest predicted deficits within the system[9].

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