Ministry of Finance
Department for Financial Policy

Pension projections

of the Czech Republic

December 2014

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1 Czech pension system

The first section of the fiche concerns the facts about pension system in the Czech Republic. It consists of three parts. In the first one all the pension pillars are described, in the second part we provide an overview of recent reforms incorporated in the projections and finally in the third part we state some "constant policy assumptions" which are taken and should make the projections transparent.

1.1 Description of the system

The Czech pension system consists of three pillars – main mandatory state PAYG system, pension savings scheme and voluntary private fully funded system. There is no occupational pension scheme.

1.1.1 Mandatory PAYG system

The first pillar is a mandatory basic pension insurance scheme, based on the pay-as-you-go financing and defined benefits (DB). It covers all economically active persons and it does not contain any special pension scheme for any economic sector. The only exceptions are so-called armed forces (e.g. soldiers, policemen, fire fighters), whose pension insurance is administered by the respective ministries in charge. All others are administered by Czech Social Security Administration.

The basic pension insurance covers the whole population (except the ones in the period of education) regardless of the actual economic activity of a person. A wide range of so-called non-contributory periods allows gaining pension entitlement at the time of person's non-activity at the labour market (one does not have any income from which the contribution is derived). Thus the system does not exclude those, whose career has been interrupted for many reasons (unemployment, childcare period etc.) Besides the solidarity of economically active persons with non-active ones, there is another type of solidarity within a generation – income solidarity.

Income solidarity is achieved through the formula used to calculate pension benefits. It leads to higher replacement rates for lower-income persons compared to those with higher income through the reduction thresholds. The personal calculation base (which is understood as a pensionable earning in the projections) is determined by the income and the income is divided by reduction thresholds to several reduction brackets. The lowest part (up to 1st bracket) is taken whole and each other part of the income only by decreasing percentage (e.g. from 2015 onwards, the lowest part 100%, the second lowest part 26% and 0% above). It is equivalent to sharp progressive taxation. For concrete values of reduction brackets as well as reduction coefficients see below Table 1.1.

Table 1.1: Reduction brackets (RB) and relevant income for pension calculations (i.e. reduction coefficients)

	2011a	2011b	2012	2013	2014	2015
Relevant income up to 1st RB	100%	100%	100%	100%	100%	100%
Relevant income between 1st and 2nd RB	30%	29%	28%	27%	26%	26%
Relevant income between 2nd and 3rd RB	10%	13%	16%	19%	22%	0%
Relevant income above 3rd RB	10%	10%	8%	6%	3%	0%
1st RB as % of average gross wage	44%	44%	44%	44%	44%	44%
2nd RB as % of average gross wage	116%	116%	116%	116%	116%	400%
3rd RB as % of average gross wage	400%	400%	400%	400%	400%	:

The pension insurance contributions are the only receipts of this scheme. It is calculated by multiplying the assessment base by a contributory rate. The assessment base for employees consists of all the benefits paid by employer to the employee, which are also subject to personal income tax. There is, however, an upper limit set amounting to 48 times the monthly wage per calendar year. This limit is valid for employees as well as for self-employed persons. The contributory rate for pension insurance is 28%, which is paid partly by employee (6.5%) and partly by employer (21.5%).

Self-employed persons have their own assessment base amounting to 50% of the difference between incomes and expenses. Minimum base is, however, 25% of the average gross monthly wage in the national economy (or 10% for the secondary activity). Maximum base is the same as for employees. The contributory rate for self-employed persons is 28%.

The state pension system covers three main benefits – old-age pension, disability pension and survivor's pensions. To be entitled to an **old age pension** a person has to reach an insurance period of at least 35 years and a retirement age specified by a law; or at least 20 years of insurance and the age 5 years higher than is the statutory retirement age. Non-contributory periods are also included in the insurance period. Statutory retirement age is only specified with regard to person's date of birth and for generations born in 1936 and younger is continuously postponing without any limits. The speed of increase has been set with respect to increase of life expectancy[1] and also in order to unify retirement ages for men and women, regardless number of children raised. The unification will be completed in 2041 for people born in 1975. For more details please see Annex C.

A person is allowed to retire up to 3 years prior the statutory retirement age under the condition the statutory retirement age is lower than 63 years. This period of 3 years will gradually lengthen up to 5 years prior the statutory retirement age if the condition of insurance period is fulfilled. However, in the latter case the statutory retirement age must be at least 63 years and actual age of the person higher than 60 years. This means that only a person with statutory retirement age at least 65 years may retire 5 years earlier. In such case of earlier retirement the person is excluded from the right to receive a proper old-age pension and thus obtains permanently reduced early old age pension. Retirement in ages higher than the statutory retirement age is awarded by additional bonuses.

Table 1.2: Statutory retirement age, earliest retirement age and penalties/bonuses for early/late retirement

		2013	2020	2030	2040	2050	2060
Men (with 20 contribution years)	*statutory retirement age*	67y+8m	68y+8m	70y	71y+6m	72y+10m	74y+4m
	earliest retirement age	67y+8m	68y+8m	70y	71y+6m	72y+10m	74y+4m
	penalty in case of earliest retirement	:	:	:	:	:	:
	bonus in case of late retirement	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Men (with 40 contribution years)	*statutory retirement age*	62y+8m	63y+8m	65y	66y+6m	67y+10m	69y+4m
	earliest retirement age	59y+8m	60y	60y	61y+6m	62y+10m	64y+4m
	penalty in case of earliest retirement	12,2%	18,9%	27,9%	27,9%	27,9%	27,9%
	bonus in case of late retirement	6,0%	6,0%	6,0%	6,0%	6,0%	6,0%
Women (with 20 contribution years)	*statutory retirement age*	64y+8m	68y+8m	70y	71y+6m	72y+10m	74y+4m
	earliest retirement age	64y+8m	68y+8m	70y	71y+6m	72y+10m	74y+4m
	penalty in case of earliest retirement	:	:	:	:	:	:
	bonus in case of late retirement	1,5%	1,5%	1,5%	1,5%	1,5%	1,5%
Women (with 40 contribution years)	*statutory retirement age*	59y+8m	61y+8m	64y+8m	66y+6m	67y+10m	69y+4m
	earliest retirement age	56y+8m	58y+8m	60y	61y+6m	62y+10m	64y+4m
	penalty in case of earliest retirement	12,2%	15,9%	24,9%	27,9%	27,9%	27,9%
	bonus in case of late retirement	6,0%	6,0%	6,0%	6,0%	6,0%	6,0%

Note: Penalties apply to earnings related component only leaving flat rate component unchanged. Bonuses are cumulated to yearly value and apply to persons who continue working without drawing pension benefit.

Disability pensions receive the persons whose ability to work is reduced by at least 35% and are divided into three ranges: (i) First degree of disability – when a person has experienced a decline in his/her working capacity of at least 35% but not more than 49%; (ii) second degree of disability – a decline of at least 50% but not more than 69%; (iii) third degree of disability – a decline of at least 70%. The required insurance period is at least 5 years[2] (it is derived from the ten year period prior to the occurrence of disability).

Disability pension belongs to a person until he/she reaches entitlement for the old age pension given by statutory retirement age. Subsequently a person is transferred from the disability pension scheme to the old age pension scheme.

Survivor's pensions are paid out to a widow/widower or an orphan (dependent child) if a deceased person has met eligibility conditions for the old age or disability pension or he/she died due to job-relating injury. After one year of receiving the survivor's pension, the widow/widower must meet other conditions stipulated by the law, otherwise the entitlement lapses (the entitlement continues when the widow/widower cares for a dependent child or disabled child, parents or relatives aged 80 and higher; or when a widow/widower is disabled in the third degree of disability or retired; or he/she has reached the age, which is 4 years lower than statutory retirement age of men of the same year of birth). The entitlement is also renewed when at least one of these conditions is met within 2 years from the last

[1] However, there is not an automatic rule stipulated by law.

[2] This applies for persons above the age of 28. Younger people are required to reach shorter insurance period.

entitlement termination. Orphan's entitlement to survivor's pension lasts until he/she is dependent. If the adoption is made by only one person, the orphan loses that part of the pension after the person now replaced (i.e. if an orphan is adopted only by a woman, the orphan loses pension on behalf of absent mother).

Pension calculations

The basic act that determines calculation of pension benefits is the Pension Insurance Act (No. 155/1995). Pensions[3] consist of two main parts:

Flat rate component is the same for all pensions regardless of the insurance period acquired and earnings achieved. The flat rate amounts to 9% of average monthly wage per month for all kinds of pensions. Thus every time the average wage changes, the flat rate changes hereby automatically.

Earnings related component is derived from the insurance period and earnings achieved. It is calculated as a percentage of personal calculation base, which takes into consideration person's income from the nineteenth year of his/her life to his retirement age (this means that earnings during virtually whole career are taken into account); however the years before 1986 are not taken into account.

Minimum amount of a pension is set by both the flat rate component (which is the same for everyone) and the minimum earnings related component. Another instrument that also prevents people from the poverty is the institute of the subsistence level.[4] Both these instruments are set by the government and are revaluated on irregular basis. There is not any special minimum pension scheme besides this one inbuilt in all pension types.

Earnings related component of **old age pension** amounts to 1.5% of person's calculation base for every completed year of acquired insurance period. Minimum earnings related component is now 770 CZK per month (approx. 30 EUR); maximum amount is not determined.[5] Bonus for longer career is 1.5% of person's calculation base for every additional completed 90 calendar days.[6] Early retirements are subject to penalization, which is 0.9% of person's calculation base for every period of 90 calendar days before the statutory retirement age up to 360 days, 1.2% from 361st day to 720th day and 1.5% from the 721st day. But resulting earnings related component must not be lower than 770 CZK.

Disability pension's earnings related component is 0.5% for the first degree, 0.75% for the second degree or 1.5% for the third degree of their calculation base for every completed year of acquired insurance period. This period makes the difference in case of disability pensions. If a person becomes disabled before he/she reaches the necessary insurance period it is presumed, that a disabled person has already reached the retirement age (added imaginary insurance period as he/she would work till retirement age).[7] If a person becomes disabled before his/her age of 18, earnings related component amounts to 45% of calculation base.

In case of **widow's/widower's pensions,** the earnings related component amounts to 50% of earnings related component of a spouse's old age or disability pension of the 3rd degree at the time he/she died.

Calculation of earnings related component for **orphan's pensions** is the same as in case of the widow's/widower's pension, but here the rate of 40% is applied instead.

In case of widow's/widower's or orphan's pension in concurrence with old-age/disability pension[8] the earnings related component consists of full earnings related component of the higher pension (be it old-age/disability pension or survivor's pension) and 50% of earnings related component of the lower pension.

Pension indexation

Pension indexation proceeds on a regular basis (every January). Indexation represents an inflation growth (measured by the aggregate consumer price index) plus a third of the growth in real average wage.[9] The indexation must firstly guarantee that the flat rate will be 9% of gross average wage and the earnings-related component will be adjusted to

[3] Pensions include old age pension, disability pensions and also survivor's pensions.

[4] A person whose income is lower than the subsistence level has a claim for social support benefits.

[5] However maximal value is implicitly bounded by ceilings on personal assessment base, amounting to four-times average wage, from which a pension is calculated.

[6] Alternatively 1,5% for every additional completed 180 days if the person draws half of old-age pension or 0,4% for every additional completed 360 days if the person draws whole old-age pension.

[7] For this period of inactivity is used a general calculation base, which is determined by the government upon an average gross income.

[8] In case of pensions in concurrence, a recipient receives flat rate component for one of the two pensions only.

[9] Official statistic of Czech Statistical Office is used.

fulfil the condition of indexation formula. If the inflation rate exceeds 5%, there is special adjustment of pension benefits added. This can occur any time of year.

1.1.2 Pension savings scheme

The pension savings scheme has been effective since the 1st of January 2013. This scheme is primarily designed for the people under 35 who can choose to join the scheme whenever they want. Persons over 35 years have had only limited time (6 months from the time they first become pension insurance payers after the reform's initiation) to join. It is not allowed to change the decision taken by an insured person. The obligation of paying concerns just those periods when a participant pays social contributions to PAYG system, i.e. there are no payments from state budget for so called state insures to the pension savings pillar. However, if the participant does not pay social contributions, he/she is treated according to the law for PAYG scheme.

The accumulation phase

Financing of the pension savings pillar is provided by funds transferred from participants in the first pillar in an amount of 3p.p. from the total contribution rate of 28%. In addition to this, each insured person has to pay an additional 2p.p. from his or her own sources. The total contribution rate is thus increased to 30%, of which 25p.p. is directed into the existing PAYG system and the remaining 5p.p. into the pension savings pillar.

The pay-out phase

The pay-out phase for the saved funds from the pension savings pillar should be provided by a life insurance company selected by each participant. It is possible to draw the paid benefit in the 3 ways of annuity (life-long with or without survivor's pension for his/her heirs or 20-year long).

Impact on PAYG system according to the Act 426/2011

Participation in the pension savings pillar has of course an impact on the contribution rate on the revenue side (see above) and on the amount of an old age pension regarding the expenditure side. Outlays for other pensions, i.e. disability and survivors' pensions are not affected.

In case of participants of pension savings pillar, their accrual rate from the first pillar is reduced from 1.5% to 1.2% for the period of their active participation.[10] The flat rate component remains the same for all.

1.1.3 Voluntary fully funded private system

This pillar (known as the third pillar) is voluntary, supplementary, fully funded and state-subsidized pension scheme based on defined contribution (DC). It also includes life insurance as a product of commercial insurance companies. The insurance can be contracted by any Czech or other EU citizen aged 18 and over, who participates in the state pension system or the public health insurance scheme in the Czech Republic. Compare to the 1st pillar and with respect to pension sustainability and adequacy, the 3rd pillar plays rather minor role.

Besides the state subsidy, any employer can support his employees with additional contribution to employee's fund. Both, employer's and employee's contributions are subject to additional tax allowances. Moreover, a so-called preretirement scheme has been established since 2013, which enables those subscribing to an additional insurance pension (the 3rd pillar) to already draw funds 5 years before reaching the statutory retirement age without imposing any sanctions. However, preretirement is conditional upon having a minimum amount of accumulated funds in the private 3rd pillar so as to provide a monthly pension amounting to at least a third of the average wage. The old-age pension will not be subsequently reduced for the years when the pre-pension is drawn. The possibility to draw preretirement was only used by 274 persons before the end of 2013. As to the sustainability of the pension system, the impact of this measure is absolutely negligible.

1.2 Recent reform measures

In the last 20 years the pension system has undergone some parametrical changes of PAYG system. Most of them had already been included in previous rounds of projections. The most recent ones were implemented to be effective from September 30th 2011.

[10] Active participation means that persons are employed and contribute to the pension savings pillar.

In addition to this reform (mainly prolonging the working life and extending the contributory period needed to be entitled for old-age pension) there was approved temporary change in indexation rule. This measure should have been valid from 2013 to 2015. However, new government has cancelled this rule and returned to the old rule one year earlier, i.e. from 2015. The indexation of pensions should be from 2015 onwards again CPI plus 1/3 of real wage growth and without the discretion possibility for the government (strict rule).

Currently the expert committee is working on the proposals for the long-term sustainability including the reform measures in pension system. There are both the parametric changes and changes in the capital pension pillars contemplated. There are no results of this committee yet.

1.3 Constant policy assumptions

Indexation: The indexation rule effective from 2016 is designed again as a strict rule, therefore from 2016 onwards we use the indexation rule strictly CPI plus 1/3 of real wages growth. For the year 2015 there is an exception in the law that pensions are indexed by 1.8%.

Early retirement versus pre-retirement: Despite the fact that the pre-retirement scheme is scarcely drawn, we assume increasing popularity as this is financially more advantageous than early retirement scheme. On the other side, pre-retirement scheme requires quite high capital savings. This is why we assume that people 5 years prior to statutory retirement age will draw upon these schemes less than in 100%. This is reflected in the lower coverage in particular age cohorts.

Pension savings pillar: Our previous estimates of two highest deciles to enter the pension savings pillar has turned out to be overly optimistic. Various reasons, mainly the uncertainty about the future of this scheme, resulted in very low participation (around 85 thousand people). The decrease in the social insurance revenue (as well as expected decrease in future public spending on pensions) is absolutely negligible (less than 0,006% of GDP or just nearly 0.1% of the total amount collected in pension insurance). As the effect on sustainability is negligible, we do not include the pension savings scheme in projections.

Wage profiles: Observed wage profile across the ages from 15 to 65+ shows relatively high inertia. This enables us to assume constant wage profile in the future. We assume the shift in the age specific wage profile from 2013 onwards with respect to postponement of retirement age and thus constant relationships to average wage. This means that the average gross wage at retirement grows exactly in the same pace as the average wage given by the AWG assumptions and is approximately by 7.7% higher than economy wide average wage.

Age specific profiles of disability rates and probabilities to retire: In order to meet commonly agreed assumptions (mainly in terms of inactive population coverage), there are some model adjustments, which aim at harming constant policy assumption to the lowest possible extent. For detailed explanation, see Annex B.

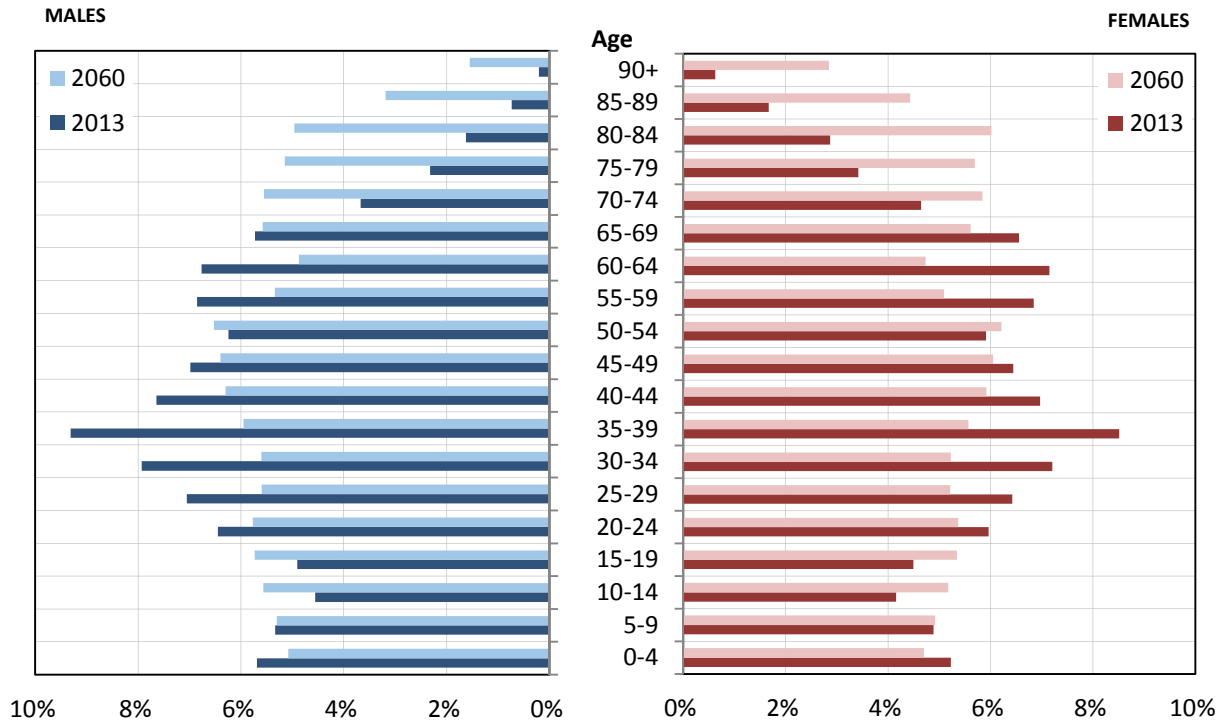
2 Demographic and labour forces projections

This section illustrates important assumptions about demographic and labour force projections. Both are exogenous of pension projection model. Demography is provided by EUROSTAT and labour force projections as well as all macroeconomic assumptions are result of Cohort Simulation Model (CSM). We fully employ all these assumptions in the pension model.

2.1 Demographic development

Czech population is relatively young, with great majority of people in productive ages. This is mainly thanks to baby boom generations born in 1970s. Therefore, currently quite a lot of children are born in absolute terms. However, the reproduction itself does not seem to be sufficient to fully compensate the number of active population at later stage. Thus the age pyramid somehow flattens during the next almost 50 years.

Figure 2.1: Age pyramid comparison: 2013 vs 2060



Although the number of population increases, reaching its peak in 2055, the old-age dependency ratio comparing elderly (65+) with active population (15-64) more than doubles over projection horizon, reaching slightly more than 50%. This is not only due to continuous decrease in the number of active population but also because of increase in longevity – share of population 80+ over 65+ raises from 22.8% to 40.8% – as life expectancy increases by 8.2p.p. for men and 6.7p.p. for women. Rates of survivor improve over time.

Table 2.1: Main demographic variables evolution

Demography	2013	2020	2030	2040	2050	2060	Peak year
Population *(thousands)*	10 514	10 655	10 783	10 916	11 077	11 078	2055
Population growth rate	0,0	0,2	0,1	0,2	0,1	-0,1	2015
Old-age dependency ratio (pop65/pop15-64)	25,1%	31,7%	35,3%	40,8%	48,4%	50,1%	2058
Ageing of the aged (pop80+/pop65+)	22,8%	20,7%	29,7%	31,8%	30,7%	40,8%	2060
Men - Life expectancy at birth	75,1	76,5	78,3	80,1	81,7	83,3	2060
Men - Life expectancy at 65	15,7	16,6	17,8	19,0	20,1	21,2	2060
Women - Life expectancy at birth	81,2	82,3	83,8	85,3	86,6	87,9	2060
Women - Life expectancy at birth	19,2	20,0	21,2	22,4	23,5	24,5	2060
Men - Survivor rate at 65+	80,6	82,8	85,6	87,9	89,9	91,5	2060
Men - Survivor rate at 80+	44,1	49,0	55,5	61,5	66,9	71,7	2060
Women - Survivor rate at 65+	90,7	91,8	93,0	94,1	95,0	95,7	2060
Women - Survivor rate at 80+	65,7	69,3	74,0	78,0	81,5	84,5	2060
Net migration	-1,3	28,0	35,8	40,7	25,5	21,2	2039
Net migration over population change	-0,4	1,4	3,9	2,0	3,0	-3,4	2056

However, the migration balance seems rather positive, overall changes in demographic structure will affect the pension system. That is why the system incorporated the rule of continuous increase in retirement age, which, despite the absence of a strict link to life expectancy, evolves well in line with life expectancy increase (Figure 2.2). This means that years spent in pension are constant over time (Figure 2.3). The reason why years spent in pension up to 2031 decline faster for women is in temporarily faster increase of retirement ages in order to equalize retirement age for both sexes. Further constant difference is due to differences in life expectancies.

Figure 2.2: Retirement age vs. life expectancy

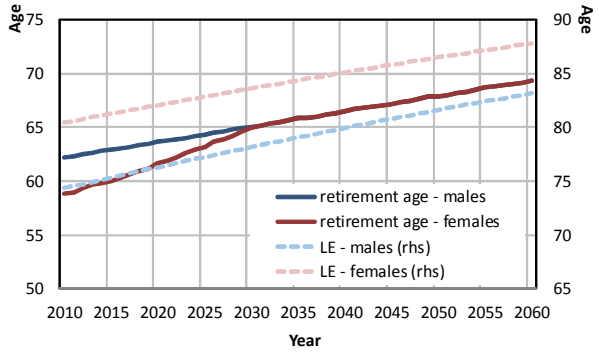
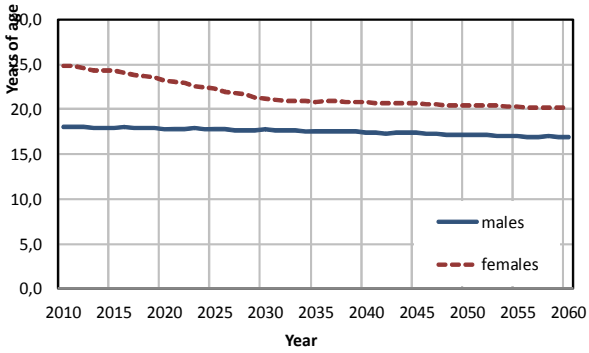


Figure 2.3: Years spent in pension



2.2 Labour forces

Labour force projections are result of common CSM model and assumptions made for particular country. Characteristics of labour market situation for older cohorts summarized in Table 2.2 show overall positive development as participation rates increase over time. These rates for cohort 55—64 increase from recent 55.1% to 78.3% and for people aged 65—74 triples over the horizon. Consequently the share of older workers in the labour force increases. This is a result of changes in population structure and, importantly, of retirement age postponement.

Table 2.2: Participation rate, employment rate and share of workers for the age groups 55—64 and 65—74

	2013	2020	2030	2040	2050	2060	Peak year
Labour force participation rate 55-64	55,1%	58,0%	65,9%	68,0%	74,8%	78,3%	2060
Employment rate for workers aged 55-64	51,9%	54,9%	62,7%	64,9%	71,3%	74,8%	2060
Share of workers aged 55-64 on the total labour force	94,2%	94,7%	95,1%	95,4%	95,4%	95,5%	2055
Labour force participation rate 65-74	8,0%	9,6%	12,8%	18,1%	19,9%	24,1%	2059
Employment rate for workers aged 65-74	7,9%	9,4%	12,6%	17,8%	19,6%	23,8%	2059
Share of workers aged 65-74 on the total labour force	98,4%	98,5%	98,6%	98,6%	98,6%	98,6%	2033
Median age of the labour force	40	42	44	44	42	43	2026

The magnitude of increase in participation rates is mainly driven by assumptions about effective entry and exit ages from the labour market. Average effective working career is prolonging by some 2 years over next fifty years. Average contributory period is the only variable in Table 2.3 that does not depend on CSM, but is primarily result of the pension model. Its development over time reflects postponement of statutory retirement age rather than the assumed effective retirement age. The reason lies in the pension system, where people acquire pension rights (contributory periods) also when not active on the labour market. It happens through partly reduced contributory periods[11] and partly through voluntary social contributions. Another effect is the extension of contributory period for the whole career. The description of driving forces applies equally for both, males and females.

Table 2.3: Labour market entry age, exit age and expected duration of life spent at retirement

Males	**2013**	**2020**	**2030**	**2040**	**2050**	**2060**	**Peak year**
Average effective entry age (CSM) (I)	22,4	22,3	22,3	22,3	22,3	22,3	2013
Average effective exit age (CSM) (II)	64,3	63,4	64,1	64,9	65,6	66,3	2060
Average effective working career (CSM) (II)- (I)	41,8	41,1	41,8	42,6	43,3	43,9	2060
Contributory period	44,4	45,4	46,4	46,4	47,4	48,4	2057
Contributory period/Average working career	1,1	1,1	1,1	1,1	1,1	1,1	2029
Duration of retirement **	16,3	18,0	18,5	19,0	19,3	20,4	2060
Duration of retirement/average working career	39,0	43,8	44,3	44,6	44,6	46,4	2060
Percentage of adult life spent at retirement***	26,1	28,4	28,6	28,8	28,8	29,7	2060
Early/late exit****	2,0	2,1	2,2	1,9	1,5	3,5	2059
Females	**2013**	**2020**	**2030**	**2040**	**2050**	**2060**	**Peak year**
Average effective entry age (CSM) (I)	24,8	25,7	25,7	25,7	25,7	25,7	2018
Average effective exit age (CSM) (II)	63,5	61,4	62,7	64,4	65,6	66,3	2060
Average effective working career (CSM) (II)- (I)	38,8	35,7	37,0	38,7	39,9	40,5	2060
Contributory period	41,5	43,5	44,5	46,5	47,5	48,5	2057
Contributory period/Average working career	107,1	122,1	120,2	120,1	119,1	119,7	2017
Duration of retirement **	20,0	23,5	23,0	23,2	22,6	23,6	2021
Duration of retirement/average working career	51,6	65,9	62,1	59,9	56,7	58,2	2021
Percentage of adult life spent at retirement***	30,5	35,1	34,0	33,3	32,2	32,8	2021
Early/late exit****	1,5	1,9	2,7	2,0	1,5	3,2	2059

*** Duration of retirement is calculated as the difference between the life expectancy at average effective exit age and the average effective exit age itself. *** The percentage of adult life spent at retirement is calculated as the ratio between the duration of retirement and the life expectancy diminished by 18 years. **** Early/late exit, in the specific year, is the ratio of those who retired and aged less than the statutory retirement age and those who retired and are aged more than the statutory retirement age.*

Because the statutory age (important and legislated for the pension system) grows at a faster pace than effective age (used by CSM) the share of contributory period on average working career increases over time. However, this difference poses a pressure on pension system and also touches the question how to understand constant policy setting.[12]

[11] Reduced contributory periods are those so called non-contributory periods as described at the beginning of the Section 1.1.1.

[12] For detailed discussion of differences in assumption between CSM and pension model please see Annex B.

Duration of retirement as calculated using assumption of CSM about effective age increases by 4.1p.p. for men and 3.6p.p. for women, and so do other indicators: the share of retirement duration over average working career and percentage of adult life spent at retirement. However, the legislated increase of statutory retirement age and penalizations for early retirement prevent the system from dramatic inflows of old age pensioners. Regardless the assumption that people will, for some reason, leave the labour market, part of them will not be able to draw an old-age pension (not even the early pension). Thanks to these parameters of the pension system, when retirement age is set according to life expectancy, the real duration of retirement is stable over projection horizon as shown in Figure 2.3.

Calculations in Table 2.3 referring to CSM show the average effective working career[13] important for labour market and consequently for the whole set of macroeconomic assumptions. Both demographic and macroeconomic assumptions enter the pension model exogenously without any feedback, i.e. pension model fully employs all original assumptions and does not apply any changes to them.

On the other hand, contributory periods in fourth rows in each part of Table 2.3 show periods that are used by pension model solely to calculate pension benefits of all pension types. It is clear that they differ from effective working career assumed by CSM from the beginning, i.e. from 2013 for which real data are mentioned in the Table 2.3. This statistics shows such high values even when our legislation currently recognizes years of career back to 1986 only. According to the law, this lower limit applies for the future too, but as time goes by the length of recognized career will be extending to the whole career. This single effect will contribute to the increase of contributory period in the future.

The reason why these “contributory periods” or better say “period covered by insurance” can be higher than average effective working career assumed by CSM is in fact that people can acquire those periods (pension rights) until they start to receive an old-age pension. This can happen even when a person is not active on the labour market. Thus these periods include both, “real” contributory periods when a person pays contributions from his/her income and so-called non-contributory periods (defined by law) when a person does not contribute into the system. However, this period is recognized by the pension system and as such it enters to the “period covered by insurance” and into the pension formula for pension benefits calculation. Moreover, there are also people contributing voluntarily into the system to have pension rights (in case the law does not cover these periods as non-contributory).

[13] It can be found in third rows in each part of Table 2.3.

3 Pension projection results

The third section presents results of national pension model that applies current policy settings (Section 1) based on AWG assumptions (Section 2).

3.1 Extent of the coverage of the pension schemes in the projections

Pension projection exercise focuses on mandatory social security pensions as the most important scheme. It fully covers all type of pensions – i.e. old age, disability and survivors' with respect to current legislation. Special schemes for armed forces are not covered as they are administered by respective ministries, financed by their budgets and not from social security contributions. These schemes are of minor importance and do not pose additional pressures on public finances with changes in population structure.

Projections also exclude pension savings pillar established from 1st January 2013. Data for early years show very low participation of people and thus the impact on public finances is only negligible. The third pillar, voluntary fully funded private scheme similarly plays very minor role. Moreover, detailed data for contribution side are not available and expenditure side is not possible to analyse as benefits have a form of lump sum in many cases.

Therefore, pension projections fully cover and respect all settings of the pay-as-you-go pillar described in Section 1.1.1 and disregard pillars introduced in Sections 1.1.2 and 1.1.3.

The comparison of the past showing the differences in pensions as a share of GDP in fact does not mean that different data are used for the projection. The difference stems from exclusion of armed forces in AWG projections due to lack of data and due to the fact that these marginal schemes are not financed from social security system but rather from budgets of respective ministries.

Table 3.1: Eurostat (ESSPROS) vs. Ageing Working Group definition of pension expenditure
(% GDP)

	2006	2007	2008	2009	2010	2011	2012
1 Eurostat total pension expenditure	8,0	7,9	8,2	9,1	9,2	9,7	9,9
2 Eurostat public pension expenditure	8,0	7,9	8,1	9,0	9,2	9,6	9,8
3 Public pension expenditure (AWG)	7,7	7,6	8,1	8,8	8,8	9,3	9,4
4 Difference (2) - (3)	0,3	0,3	0,1	0,2	0,4	0,3	0,4

3.2 Overview of projection results

Social security scheme is the major source of benefits for elderly generation based on pay-as-you-go system. With the population ageing the expenditure pressures will rise to some extent with the old-age pension as the most demanding type of pension. This increase is caused by changes in population structure and longevity, resulting in higher number of pensions over time as illustrated on Figure D.14 in Annex D.

Pension benefits are not taxed in absolute majority of cases. This is due to relatively high threshold up to which income of pensioners is tax exempt. Only pensioner's income exceeding 36times minimum wage[14] is subject to 15% Personal Income Tax. Currently only a negligible number of pensioners (not even 1% of them) pays taxes. Moreover, such negligible personal income tax revenue is a source of the state budget and not of the social security system itself. For these reasons tax calculations are not part of projection exercise and therefore gross and net pensions are equal.

[14] Minimum gross wage is set from 1st August 2013 to be 102,000 CZK per year (approx. 3,926 EUR).

Table 3.2: Projected gross and net pension spending and contributions
(% of GDP)

Expenditure	2013	2020	2030	2040	2050	2060	Peak year
Gross public pension expenditures	9,5	9,5	9,4	9,4	10,1	10,2	2057
Occupational pensions	:	:	:	:	:	:	:
Private pensions	:	:	:	:	:	:	:
Mandatory private	:	:	:	:	:	:	:
Non-mandatory private	:	:	:	:	:	:	:
Gross total pension expenditure	9,5	9,5	9,4	9,4	10,1	10,2	2057
Net public pension expenditure	9,5	9,5	9,4	9,4	10,1	10,2	2057
Net total pension expenditure	9,5	9,5	9,4	9,4	10,1	10,2	2057
Contributions	**2013**	**2020**	**2030**	**2040**	**2050**	**2060**	**Peak year**
Public pension contributions	8,3	8,3	8,3	8,3	8,3	8,3	2013
Total pension contributions	8,3	8,3	8,3	8,3	8,3	8,3	2013

Public pension contributions are paid by working population from their wages that develop in line with GDP over the horizon. We also assume constant contribution rate in line with no policy change assumption. This results in the constant share of contributions on GDP in all projection years.

In the light of the most recent population and macroeconomic assumptions, pension expenditures are expected to increase from current 9.5% to 10.2% of GDP. The greatest part is taken by old-age pensions being mostly affected by changes in population structure. However, the increase is somewhat limited, due to the postponement in retirement. Thus the overall increase between years 2013 and 2060 is expected to be 0.8p.p.

Table 3.3: Projected gross public pension spending by scheme
(% of GDP)

Pension scheme	2013	2020	2030	2040	2050	2060	Peak year
Total public pensions	9,5	9,5	9,4	9,4	10,1	10,2	2057
of which earnings related:							
Old age and early pensions	7,7	7,9	7,9	7,8	8,4	8,5	2056
Disability pensions	1,1	0,9	0,9	0,9	0,9	1,0	2014
Survivors' pensions	0,7	0,7	0,7	0,8	0,8	0,8	2058
Other pensions	:	:	:	:	:	:	:
of which non-earnings related:							
minimum pensions and minimum income guarantees	:	:	:	:	:	:	:

There are two opposite effects driving future development of disability pensions. First, positive effect is related to legislative changes that introduced three levels of disability (instead of previous two) from 2010 onwards and more strict eligibility conditions for any of disability types. Also comparing to last projection round, when only rough estimates of impacts were available, experience from past four years shows positive impact of this reform.[15] Second, negative effect stems from the fact that postponement of retirement age brings more disabled persons in preretirement ages due to their higher disability rates.[16] Although numbers of disability pensions increases over time, the expenditures as a share on GDP do not seem to be higher that much due to indexation lower than nominal GDP growth. Disabled people of any type are automatically transferred to old age pensions at the age of 65 or at statutory retirement age if higher.

There is not any special minimum pension scheme. Minimum amount of benefit is ensured by flat rate component same for every pension type and minimum earnings related component. For details of pension calculations see system description in Section 1.1.1.

[15] Impact of the reform on the number disability pensions is shown in Figure D.15—Figure D.17.

[16] Illustration of disability profiles development can be found in Annex D.

3.3 Main driving forces behind the projection results and their implications

Table 3.4 shows results of the public pension decomposition. It is apparent that the main contribution to the increase of pension expenditure by 0.8p.p. over time has the ageing population that will change the ratio between the elderly and active population.

Opposing to that, coverage ratio will decrease over time. The main reason should be seen in continuous postponement of the retirement age that takes place during the projection horizon. This will reduce the number of pensioners and together with the increase of population aged 65+ will influence the ratio. It is the case of both, early-age and old-age ratios, because all these cohorts are affected by the statutory age increase. The early-age coverage decline is bigger being more affected by the retirement age increase at the beginning. The issue of the decrease in coverage ratio is addressed in detail in Annex B.

Table 3.4: Factors behind the change in public pension expenditures between 2013 and 2060 – pensions
(in percentage points of GDP)

	2013 - 2020	2020 - 2030	2030 - 2040	2040 - 2050	2050 - 2060	2013 - 2060	Average annual change
Public pensions to GDP	0,0	-0,1	0,0	0,7	0,1	0,8	0,017
Dependency ratio effect	2,3	1,2	1,4	1,8	0,5	7,2	0,153
Coverage ratio effect	-1,7	-0,7	-0,8	-0,7	-0,2	-4,1	-0,095
Coverage ratio old-age	-0,8	-0,2	-0,5	-0,3	-0,1	-1,8	-0,040
Coverage ratio early-age	-1,9	-2,6	-0,6	-0,2	-0,4	-5,7	-0,131
Cohort effect	-2,1	0,6	-1,3	-2,7	-0,6	-6,1	-0,145
Benefit ratio effect	0,0	-0,5	-0,4	0,1	0,1	-0,7	-0,016
Labour Market/Labour intensity effect	-0,4	0,0	-0,1	-0,4	-0,2	-1,1	-0,023
Employment ratio effect	-0,3	0,0	0,1	-0,3	-0,1	-0,6	-0,016
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,0	0,003
Career shift effect	-0,1	0,0	-0,2	-0,1	0,0	-0,4	-0,010
Residual	-0,2	-0,1	-0,1	-0,1	0,0	-0,5	-0,003

Benefit ratio will decline mainly in several early decades thanks to the assumed indexation. Indexation of pensions is represented by an inflation growth (measured by the aggregate consumer price index) plus a third of the growth in real average wage. For the future, the indexation rule is set to be strict without possible discretions. Second effect that drags the benefit ratio down is assumed additional increase of early retirement pensions comparing to observed data in order to improve coverage of inactive people determined by CSM.[17] Early retirement pension benefits are subject to permanent penalization and thus are quite substantially lower than regular pension benefit. This mostly happens in medium term, which can be also inferred from replacement rates of old age pension benefits in Figure D.21. Also disability pensions contribute to lower benefit ratio (see replacement rates in Figure D.22—Figure D.24), because of lower inflows of new pensioners with higher benefits. Paid out pensions are devaluated by indexation, which is lower than wage growth.

Labour market effects help to limit pension expenditure growth mainly through employment ratio effect. The share of working population (cohort 20—64) increases due to the assumed higher effective retirement age (as a result of statutory retirement age postponement).

[17] Details can be found in Annex B.

Table 3.5: Factors behind the change in public pension expenditures between 2013 and 2060 – pensioners
(in percentage points of GDP)

	2013 - 2020	2020 - 2030	2030 - 2040	2040 - 2050	2050 - 2060	2013 - 2060	Average annual change
Public pensions to GDP	0,0	-0,1	0,0	0,7	0,1	0,8	0,017
Dependency ratio effect	2,3	1,2	1,4	1,8	0,5	7,2	0,153
Coverage ratio effect	-1,6	-0,6	-0,7	-0,7	-0,3	-3,8	-0,088
Coverage ratio old-age	-0,6	0,0	-0,3	-0,1	-0,1	-1,1	-0,023
Coverage ratio early-age	-1,7	-2,4	-0,6	-0,2	-0,4	-5,4	-0,123
Cohort effect	-2,1	0,6	-1,3	-2,7	-0,6	-6,1	-0,145
Benefit ratio effect	-0,1	-0,6	-0,5	0,0	0,1	-1,0	-0,022
Labour Market/Labour intensity effect	-0,4	0,0	-0,1	-0,4	-0,2	-1,1	-0,023
Employment ratio effect	-0,3	0,0	0,1	-0,3	-0,1	-0,6	-0,016
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,0	0,003
Career shift effect	-0,1	0,0	-0,2	-0,1	0,0	-0,4	-0,010
Residual	-0,2	-0,1	-0,1	-0,1	0,0	-0,5	-0,003

Not surprisingly Table 3.5, focusing rather on pensioners instead of pensions, shows quite similar results. The difference between pensions and pensioners is caused solely by widow's/widower's pensions in concurrence, which is not considered among the number of pensioners. Dependency ratio and Labour market effect are exactly the same in the two tables, as number of pensions or pensioners do not play any role here. Coverage ratio effect decreases less here simply because there are fewer pensioners than pensions in the nominator. Benefit ratio changes during decades are comparable.

Table 3.6: Replacement rate at retirement (RR) and coverage by pension scheme
(in %)

	2013	2020	2030	2040	2050	2060	Peak year
Public scheme (RR)	32,2	35,6	32,5	32,8	34,5	33,7	2014
Public scheme (BR)	42,8	43,8	41,0	38,9	39,1	39,5	2014
Coverage	100%	100%	100%	100%	100%	100%	2013
Public scheme old-age earnings related (RR)	43,3	46,8	43,3	42,5	47,1	49,3	2014
Public scheme old-age earnings related (BR)	42,6	44,5	42,0	39,9	40,2	40,7	2014
Coverage	67%	68%	68%	68%	69%	69%	2052
Private occupational scheme (RR)	:	:	:	:	:	:	:
Private occupational scheme (BR)	:	:	:	:	:	:	:
Coverage	:	:	:	:	:	:	:
Private individual scheme (RR)	:	:	:	:	:	:	:
Private individual scheme (BR)	:	:	:	:	:	:	:
Coverage	:	:	:	:	:	:	:
Total (RR)	32,2	35,6	32,5	32,8	34,5	33,7	2014
Total (BR)	42,8	43,8	41,0	38,9	39,1	39,5	2014

Benefit ratio represents relationship between average pension benefit and economy wide average wage, while the replacement rate (RR) is a share of average newly granted pension benefit on average gross wage at retirement. Both wages develop in line (for details see explanation in Section 1.3). Table 3.6 shows evolution of these ratios over time for public scheme. As this is the only scheme covered in the projections, it does not differ from total numbers in the last row. Public scheme in the first two rows include average pension benefit over all types of pensions, i.e. old-age, disability and survivor's.

Naturally, the highest pension benefits are paid out to old-age pensioners, therefore the replacement rate for such old-age earnings related pension is higher than that for the whole public scheme. Average new pension benefits that

are in nominator of RR are every year calculated in the same way from pensionable earning which correspond to wages.[18] Therefore average replacement rate tends to be constant over time. Unfortunately, it is not the case of old-age pensions, where also other factor plays role. It depends on distribution of number of people retiring around statutory retirement age. The more people retire early before statutory retirement age, the higher penalization applies to more pensioners, and thus the lower resulting average pension benefit. This effect is behind quite erratic evolution of replacement rate,[19] because it depends on number of people assigned with early old-age pension in order to cover assumed number of inactive people. This reason applies also for explanation of the evolution of RR (and also BR) over time. These ratios fall mainly because of additional coverage of inactive people as explained in Annex B. The biggest part of additionally covered people with an early old age pension is in the period up to 2040. The more people retire early before statutory retirement age, the higher penalization applies to more pensioners, and thus the lower resulting average pension benefit and consequently RR (and BR). All replacement rates are illustrated on Figures in Annex D (Figure D.20—Figure D.26).

In case of benefit ratio, not only newly granted pensions play role, but also those paid out matter. All types of pensions are losing over time in comparison with wage due to indexation of CPI plus one third of real wage growth. Quite stable new pension's inflows prevent the ratio from falling. Same effects on average pension benefit apply in case of benefit ratio[20] as well.

In fact all pensions in the Czech Republic are covered by the social security pension scheme, therefore public scheme coverage is 100% and also old age pensions constantly represent great part of the system – around 67—69%. When it comes to pensioners, public scheme coverage remains at 100% and the latter ratio amounts to ca 80%.

Similarly to old-age dependency ratio, also the dependency in the pension system measuring share of pensioners (receivers of pension benefits) over employees (contributors to the system) increases from recent 58.7% to 67.6% over time. However, the increase is not as dramatic as in case of demographic dependency (which more than doubles). It is mainly due to increase in retirement age that helps to stabilize the system. At the end of projection horizon the retirement age is around 69 years of age, so well above the considered group of elderly (65+). As a result, we can observe a decline in the difference between the two dependencies, denoted as "system efficiency".

Table 3.7: System Dependency Ratio and Old-age Dependency Ratio

	2013	2020	2030	2040	2050	2060	Peak year
Number of pensioners (I)	2 882	2 876	3 023	3 152	3 311	3 315	2059
Employment(II)	4 935	4 875	4 827	4 778	4 698	4 696	2013
Pension System Dependency Ratio (SDR) (I)/(II)	58,4	59,0	62,6	66,0	70,5	70,6	2058
Number of people aged 65+ (III)	1 797	2 153	2 403	2 697	3 041	3 128	2058
Working age population 15 - 64 (IV)	7 149	6 802	6 797	6 619	6 285	6 247	2013
Old-age Dependency Ratio (ODR) (III)/(IV)	25,1	31,7	35,3	40,8	48,4	50,1	2058
System efficiency (SDR / ODR)	2,3	1,9	1,8	1,6	1,5	1,4	2013

Shares of pensioners on inactive population (in Table 3.8 for both sexes and in Table 3.10 for women) include two effects. Due to the continuous increase in retirement age, the share decreases in relevant cohorts since they are no longer allowed to retire. It is mainly the case of age groups of 60—64. On the other hand, there is, of course, an increase in disability pensions due to higher disability rate in these higher ages. However, the disability rates (probability of becoming disabled) do not fully offset the old age pensions. Moreover, also participation rates are very

[18] Calculation of pensionable earning from wage through reduction brackets using reduction coefficients is described at the beginning of Section 1.1.1 and also in equation (4.20).

[19] Although it seems that replacement rate for old-age pension increases over time, it is more due to values in denoted years in the table. The reason for erratic development in case of new pensions is in retirement age postponement that happens every couple years. As we work with yearly model, we are not able to capture the smooth pattern of retirement increase. If we smooth the line we would see much stable development with rather minor decreases in replacement rates due to described effect. Some intuition can be drawn from Figure D.21.

[20] It is worth noting why the benefit ratio for the whole public scheme is higher than benefit ratio for old age pensions (with higher average pension) in some years. In case of old-age pensions there is no difference between pensions and pensioners. On the other hand calculation of benefit ratio for the whole public scheme uses a share of all pension expenditures (including outlays for pensions in concurrence) on number of pensioners (which is lower than number of pensions). Therefore comparison of the two benefit ratios may be misleading.

low in these ages.[21] These factors drive the share of pensioners over inactive people down for a certain period of projection.[22]

In the projection all persons that fulfil the minimum age limit for even early retirement pension are covered. The age specific share of old-age pension allowed for early pensions (in cohorts of age-3 and age-5 at a later stage) stemming from observed data is kept constant over time (constant regarding the distance from retirement age for respective generation). It is visible in all years we have data for that huge penalizations for early retirement are effective and that lower share of people retires in early ages. The share increases as the statutory age approaches. However, as we want to incorporate the CSM assumption about lower effective retirement age and increase the coverage, we made additional adjustments described in Annex B. So the model recalculates the number of old-age pensions with increased share of early pensions beyond what data say so that the more inactive people are covered. While doing this we respected the fact that the demand for early retirement increases as retirement age approaches. The rest of inactive people that could possibly retire will be covered by so-called preretirement scheme described in Chapter 1.1.3. All people at the statutory retirement age and older are old-age pensioners automatically. Consequently, declining share of pensioners to inactive people in the age groups 60-64 and 65-69 are fully explained by the fact that people from these cohorts are gradually losing eligibility for (early) old-age pensions as well as for preretirement scheme.

Table 3.8: Pensioners (public schemes) to inactive population ratio by age group
(in %)

	2013	2020	2030	2040	2050	2060	Peak year
Age group -54	10,9	11,0	11,2	10,4	9,7	10,4	2028
Age group 55-59	124,4	91,2	86,0	98,4	111,5	115,0	2013
Age group 60-64	116,5	99,5	89,2	72,7	68,5	69,6	2013
Age group 65-69	109,8	100,0	100,0	100,0	98,9	92,0	2013
Age group 70-74	106,9	100,0	100,0	100,0	100,0	100,0	2013
Age group 75+	100,6	100,0	100,0	100,0	100,0	100,0	2013

The same effect plays role also when comparing pensioners to the whole population. The result is here only more pronounced, because there is no compensation of labour market through participation rates.

Table 3.9: Pensioners (public schemes) to population ratio by age group
(in %)

	2013	2020	2030	2040	2050	2060	Peak year
Age group -54	4,3	4,4	4,7	4,5	4,4	4,6	2029
Age group 55-59	26,3	19,1	15,6	15,7	16,2	16,1	2013
Age group 60-64	79,5	63,4	48,7	33,3	24,3	20,9	2013
Age group 65-69	98,8	85,4	80,1	73,1	64,8	54,3	2013
Age group 70-74	101,5	96,0	94,9	93,7	93,1	92,4	2013
Age group 75+	100,4	100,0	100,0	100,0	100,0	100,0	2013

In fact, same comments as for overall numbers work for female pensioners as well. The drop in coverage rate is, comparing to males, only bit more pronounced and affects also age cohort of 55—59. The former is caused by faster increase in their retirement age comparing to males and the latter because women have currently lower retirement age.

[21] Another explanation concerning so called pre-retirement scheme is described in Section 1.

[22] Pension projections respect assumptions about labour force and inactive people and cover major share of these "residual" people with a pension. For detailed discussion of the problem please see Annex B.

Table 3.10: Female pensioners (public schemes) to inactive population ratio by age group
(in %)

	2013	2020	2030	2040	2050	2060	Peak year
Age group -54	10,4	10,7	10,9	9,9	9,2	10,0	2028
Age group 55-59	116,8	79,8	73,6	91,9	112,7	114,9	2013
Age group 60-64	117,6	100,0	85,8	69,4	69,5	72,8	2013
Age group 65-69	108,4	100,0	100,0	100,0	98,9	91,4	2013
Age group 70-74	107,1	100,0	100,0	100,0	100,0	100,0	2013
Age group 75+	102,4	100,0	100,0	100,0	100,0	100,0	2013

Table 3.11: Female pensioners (public schemes) to population ratio by age group
(in %)

	2013	2020	2030	2040	2050	2060	Peak year
Age group -54	4,6	4,8	5,1	4,9	4,6	4,9	2028
Age group 55-59	34,2	24,7	18,6	18,7	19,1	19,0	2013
Age group 60-64	94,9	72,9	53,9	35,8	25,9	23,3	2013
Age group 65-69	100,1	88,3	83,3	76,3	66,8	55,1	2013
Age group 70-74	102,7	96,6	95,6	94,5	93,8	92,6	2013
Age group 75+	102,3	100,0	100,0	100,0	100,0	100,0	2013

New old-age pension expenditures (first lines in each section of Table 3.12) are multiple of number of new pensions and average newly granted pension benefit. The Table 3.12 disaggregates this calculation more into main driving factors. One of the main inputs in pension benefit calculation is a statistic of distribution of new pensions according i) personal calculation base and ii) contributory period. It allows for calculating not only the average contributory period, but also the average pensionable earning in the base year. We assume that this distribution will be shifted in accordance with postponement of retirement and the extension of acknowledged contributory periods for the whole career. Therefore the average contributory periods increase over time.

Average pensionable earning develops in line with wage development, so its share on economy wide average wage is rather constant over time. Pensionable earning is considered to be economy wide average wage "transformed" into personal calculation basis through reduction brackets using reduction coefficients as described at the beginning of Section 1.1.1 and also in equation (4.20). Because wage is the base for the calculation, and also reduction brackets develop in line with wages, the share is constant. The only minor changes in the first projection years are due to specific reduction brackets and reduction coefficients up to 2015 as shown in Table 1.1.

Value of average accrual rate is legislated to be 1.5%. Numbers in the Table 3.12 are slightly higher, which is caused by the calculation of new pension benefit. It consists of flat rate and earnings related component. Accrual rate applies in case of calculation of the latter only,[23] while the first is set by certain amount and develops with wages. Simplified calculation in Table 3.12 does not describe this in detail. To reach the correct sum of the two components of pension benefits from pensionable earning thus requires the higher accrual rate.[24] As the model works with yearly data and uses yearly statistics (averages of new pensions over year), we work with full year of 12 months.

Pension formula is the same for both sexes, so same driving factors work for all parts of the Table 3.12. Only minor differences can be seen in recent shorter careers of women and their lower income.

[23] See equation 4.20.

[24] It is only the issue of illustration in the Table 3.12. Model, of course, works with the legislated accrual rate of 1.5%.

Table 3.12: Projected and disaggregated new public pension expenditure

(old-age and early earnings-related pensions)

Total	2013	2020	2030	2040	2050	2060	Peak year
Projected new pension expenditure (millions EUR)	445	802	1 059	1 874	2 572	3 096	2059
I. Average contributory period	43,0	44,5	45,5	46,4	47,4	48,4	2057
II. Monthly average pensionable earnings ('000 EUR)	0,6	0,7	1,0	1,4	2,0	2,9	2060
III. Average accrual rates	1,8%	2,0%	1,8%	1,7%	1,9%	1,9%	2014
IV. Number of new pensioners ('000)	83,4	115,8	112,7	139,5	119,5	96,1	2042
V. Average number of months paid the first year	12	12	12	12	12	12	2013
VI. Sustainability/Adjustment factor	:	:	:	:	:	:	:
Monthly average pensionable earnings/Monthly economy-wide average wage	59,6%	57,7%	57,7%	57,7%	57,7%	57,7%	2014
Males	**2013**	**2020**	**2030**	**2040**	**2050**	**2060**	**Peak year**
Projected new pension expenditure (millions EUR)	256	411	557	971	1 364	1 623	2059
I. Average contributory period	44,4	45,4	46,4	46,4	47,4	48,4	2057
II. Monthly average pensionable earnings ('000 EUR)	0,6	0,7	1,0	1,5	2,2	3,1	2060
III. Average accrual rates	1,8%	1,9%	1,7%	1,7%	1,8%	1,8%	2014
IV. Number of new pensioners ('000)	44,3	57,6	55,9	67,9	61,0	49,0	2042
V. Average number of months paid the first year	12	12	12	12	12	12	2013
VI. Sustainability/Adjustment factor	:	:	:	:	:	:	:
Monthly average pensionable earnings/Monthly economy-wide average wage	63,4%	61,3%	61,3%	61,3%	61,3%	61,3%	2014
Females	**2013**	**2020**	**2030**	**2040**	**2050**	**2060**	**Peak year**
Projected new pension expenditure (millions EUR)	189	391	502	903	1 208	1 473	2059
I. Average contributory period	41,5	43,5	44,5	46,5	47,5	48,5	2057
II. Monthly average pensionable earnings ('000 EUR)	0,5	0,6	0,9	1,3	1,9	2,7	2060
III. Average accrual rates	1,8%	2,1%	1,8%	1,7%	1,9%	2,0%	2021
IV. Number of new pensioners ('000)	39,1	58,2	56,8	71,5	58,5	47,1	2042
V. Average number of months paid the first year	12	12	12	12	12	12	2013
VI. Sustainability/Adjustment factor	:	:	:	:	:	:	:
Monthly average pensionable earnings/Monthly economy-wide average wage	55,3%	53,5%	53,5%	53,5%	53,5%	53,5%	2014

3.4 Financing of the pension system

The only income of the pay-as-you-go system itself stems from pension insurance contribution (28%) paid from employees' income.[25] Therefore numbers of contributors and employment equal. Contribution burden is shared between employee (6.5%) and employer (21.5%). In the same way the total revenues of the system from public contributions in Table 3.13 are split between the two groups. State does not take part in the system, not even in case of unemployed people, students or women on maternity leave. The only relief for these people is in the fact that they acquired pension rights through so called non-contributory periods without paying contributions.

[25] For details see Section 1.1.1.

Table 3.13: Revenue from contribution (million), number of contributors in the public scheme (in 1000), total employment (in 1000) and related ratios (%)

	2013	2020	2030	2040	2050	2060	Peak year
Public contribution	12 456	15 203	22 100	31 808	45 268	64 646	2060
Employer contribution	9 565	11 674	16 970	24 424	34 760	49 639	2060
Employee contribution	2 892	3 529	5 130	7 384	10 509	15 007	2060
State contribution	:	:	:	:	:	:	:
Number of contributors (I)	4 935	4 875	4 827	4 778	4 698	4 696	2013
Employment (II)	4 935	4 875	4 827	4 778	4 698	4 696	2013
Ratio of (I)/(II)	100%	100%	100%	100%	100%	100%	2013

Public pension fund has been created in 2004 and is part of the state budget. Therefore possible deficits would need to be taken care of by the government. During more favourable times it is designed to create surpluses from excess of contributions over expenditures. Since 2012 also part of VAT income has been forwarded to the pension account. From that year onwards the investments into securities were stopped and funds are moving to bank accounts as securities mature.

Following Figure 3.1 shows evolution of main balances. Social security system balances illustrate yearly differences between income from contributions and expenditures paid out to all types of pensioners. Pension account balance variable shows the balance at the end of every year (it is the flow variable). Besides the social contributions, the particular share of VAT (7.2 %) is transferred to pension account by law and on the top of that some ad hoc inflows, e.g. from dividends paid by state-owned companies are transferred too. Moreover, the system has some assets which have been accumulated in the past for the future pension reform and cannot be spent (this is stock variable). This prevents the assets to be depleted and the deficits are covered from other government revenues in the State budget. Thus the assets are real on the one hand, but on the other hand they are preserved just according to law but virtually would be already depleted. This is assumed for the future as this reflects the economic reality of the pension account. The system itself does not accumulate assets anymore. As the system currently runs deficits, the same is projected into the future (see Figure 3.2).

Figure 3.1: Social security and pension account balances

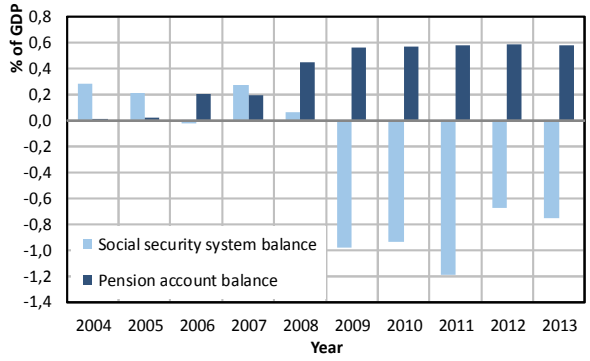
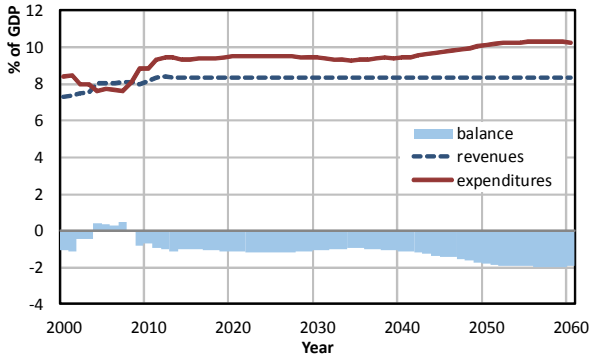


Figure 3.2: Revenues, expenditures and balance



3.5 Sensitivity analysis

Besides the baseline scenario discussed in all other parts of this document, several sensitivity analysis have been carried out. In the system with one pillar the effects on public pensions and total pensions are the same.

Higher life expectancy shows higher expenditures simply because pensioners live longer and thus the pay-out period of pension is extended comparing to baseline. Pension system does not include any automatic compensation mechanism for longevity that would reduce this effect.

Higher labour productivity is slightly more demanding from the level of total expenditures point of view. But the opposite is true looking at the GDP ratios. This scenario creates higher GDP (higher denominator for per GDP spending) and somewhat higher wages. However the newly granted pensions will be higher, the indexation rule will translate only 1/3 of this positive effect into the growth of the pension benefit.

Lower labour productivity works symmetrically to the previous scenario. Thus despite of savings on total expenditures, the effect of lower GDP predominates.

Higher employment rate is marginally lower in terms of expenditures comparing to the baseline. Also as in case of higher productivity, the GDP as the denominator is somewhat higher dragging the share down.

Higher employment of older workers slightly lowers pension expenditures by contributing to higher GDP and results in very similar outcomes comparing to higher employment rate scenario.

Under the assumption of **lower migration** the increase in pension expenditures is somewhat higher. The reason is solely in lower employment and lower GDP that raises the ratio. The level of total expenditures is lower in this scenario comparing to the baseline.

TFP risk scenario affects GDP and wages in a negative way. The level of pension expenditures is lower, but as in the case of higher labour productivity the effect of lower GDP dominates and thus the resulting expenditure shares are higher comparing to the baseline.

Table 3.14: Public and total pension expenditures under different scenarios
(deviations from the baseline)

	2013	2020	2030	2040	2050	2060	Peak year
Public Pension Expenditure							
Baseline	9,5	9,5	9,4	9,4	10,1	10,2	2057
Higher life expectancy (2 extra years)	0,0	0,0	0,1	0,3	0,4	0,6	2060
Higher lab. productivity (+0.25 pp.)	0,0	0,0	-0,1	-0,2	-0,3	-0,3	2013
Lower lab. productivity (-0.25 pp.)	0,0	0,0	0,1	0,2	0,3	0,3	2060
Higher emp. rate (+2 pp.)	0,0	-0,1	-0,2	-0,2	-0,2	-0,2	2013
Higher emp. of older workers (+10 pp.)	0,0	-0,7	-0,8	-0,4	0,0	0,3	2060
Lower migration (-20%)	0,0	0,0	0,1	0,2	0,3	0,4	2059
TFP risk scenario	0,0	0,0	0,1	0,2	0,3	0,4	2060
"Policy" scenario*	0,0	-0,2	-0,6	-0,6	-0,7	-0,7	2013
Total Pension Expenditure							
Baseline	9,5	9,5	9,4	9,4	10,1	10,2	2057
Higher life expectancy (2 extra years)	0,0	0,0	0,1	0,3	0,4	0,6	2060
Higher lab. productivity (+0.25 pp.)	0,0	0,0	-0,1	-0,2	-0,3	-0,3	2013
Lower lab. productivity (-0.25 pp.)	0,0	0,0	0,1	0,2	0,3	0,3	2060
Higher emp. rate (+2 pp.)	0,0	-0,1	-0,2	-0,2	-0,2	-0,2	2013
Higher emp. of older workers (+10 pp.)	0,0	-0,7	-0,8	-0,4	0,0	0,3	2060
Lower migration (-20%)	0,0	0,0	0,1	0,2	0,3	0,4	2059
TFP risk scenario	0,0	0,0	0,1	0,2	0,3	0,4	2060
"Policy" scenario*	0,0	-0,2	-0,6	-0,6	-0,7	-0,7	2013

*Note: * For explanations, see Box 1.*

Analysis of the **"policy" scenario** shows lower expenditure shares on GDP. This happens through very fast increase in retirement age (faster than life expectancy growth) and better assumption about effective retirement age, which brings higher and longer participation of older workers. However, in case of this scenario, it is crucial to look more closely at its assumptions (exogenous for pension model). For details see following Box.

Box 1: Exogenous assumptions of "policy" scenario in comparison with the baseline

Analysis of the "policy" scenario aims at showing the impact of linking the statutory retirement age to the life expectancy gains. As mentioned in Section 2.1 the increase of statutory retirement age in the Czech pension system is set with respect to life expectancy and goes even beyond that for women whose age increases even more in order to catch up with men (Figure 2.2). However, the "policy" scenario assumptions surprisingly suggest higher retirement age (mainly for men) than in the baseline scenario. This is the reason why it is necessary to look more in detail at the assumptions about linking retirement age to life expectancy in both scenarios and, of course, show the consequences.

The reason lies in different reference values of life expectancy. The pension system and illustrations of Figure 2.2 and Figure 2.3 compare the increase of retirement age to life expectancy at the age of 65, i.e. that of generation close enough around the retirement age in respective calendar year. On the other hand, the higher retirement age suggested by the "policy" scenario considers the life expectancy at birth in respective calendar years. Because gains in life expectancy in case of new-borns are higher,

proposed retirement age is higher too (in case of women the age grows even bit more than that!). Comparison of the statutory retirement ages for the two scenarios is illustrated in Figure 3.3. When we compare the number of years spent in pension in Figure 3.4 (here equally deducting from life expectancy at 65 for both scenarios), we can see that under "policy" scenario years in pension decline over the horizon. In 2060, women will spent in retirement 19.8 years instead of current 24.4 in 2013 (which is similar in both scenarios) and men 14 instead of 18 years now. **So the "policy" scenario assumptions suggest unprecedentedly higher retirement age than would stem from life expectancy increase.**

Figure 3.3: Retirement age: baseline vs "policy" scenario

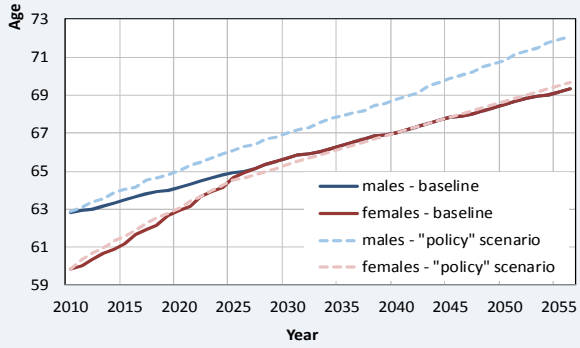
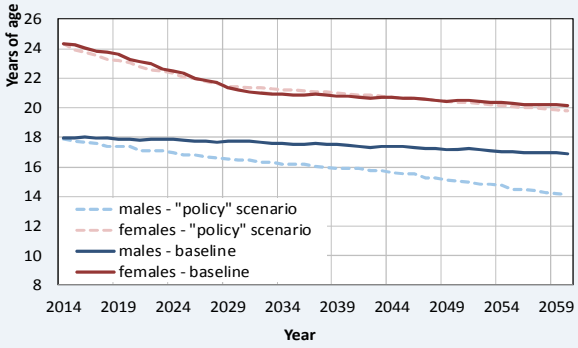


Figure 3.4: Years in pension: baseline vs "policy" scenario



There is another aspect that is worth mentioning. It is the difference in assumption of effective retirement age, which affects mainly men. Annex B mentions that the link of effective retirement age to the statutory age is assumed to be weakened as the retirement age reaches higher levels, i.e. the higher the retirement age the lower the effect on effective age increase. Therefore a line depicting the difference between statutory and effective age should be upward sloping. The slope of the line should be driven by the respective levels of retirement age (pace of retirement age increase in our case, while starting from the same point in 2013). We can observe from the graphs below that the differences for men (Figure 3.5) grow practically at the same pace despite much higher retirement age in the "policy" scenario in all projection years (see Figure 3.3). **This shows on stronger link of effective on statutory age than in the baseline.** In case of women, statutory retirement is approximately the same in both scenarios and also the gap in Figure 3.6 develops more or less in line.

Figure 3.5: Difference: statutory – effective ret. age (*males*)

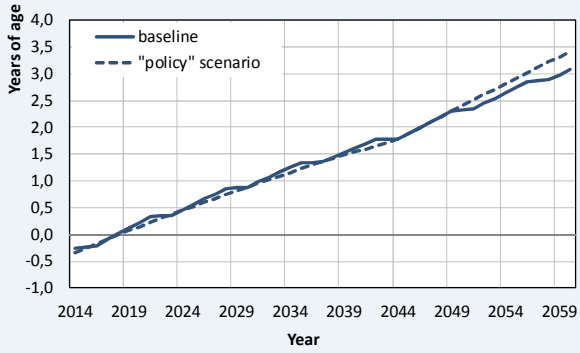
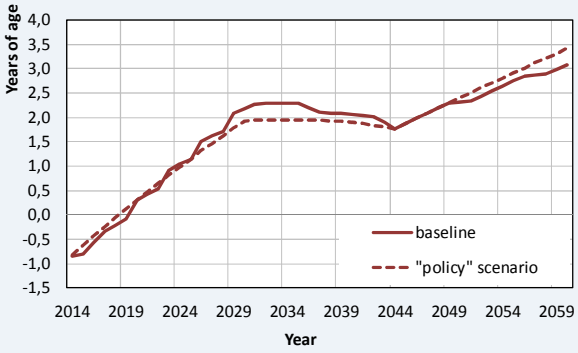


Figure 3.6: Difference: statutory – effective ret. age (*females*)



Therefore the "policy" scenario further lowers pressures on pension system as it generates lower number of old-age pensioners. There is higher number of disability pensioners (as disability rates increase with age), but they do not fully offset old-age pensioners. Moreover, their pension benefits are lower. Higher retirement age affects positively also the labour market through higher participation and employment rates and therefore it consequently generates higher GDP. It is, on the other hand, redeemed by more dramatic increase in retirement age and continuous decrease of life spent in pension for future generations, which is supported by somewhat better assumption on effective retirement age.

In result, the "policy" scenario does not answer the question, what would be the pension expenditure if the increase of retirement age is linked to the life expectancy gains. Such interpretation would be misleading! The results are solely driven by exogenous assumptions of dramatically higher retirement age and much more favourable situation on the labour market, which assumes closer link of statutory and effective retirement ages than in the baseline. It is clear from Figure 2.2 and Figure 2.3 that legislated increase of retirement age is slightly higher than increase of life expectancy. Therefore strict link of these two variables should definitely lead to higher pension expenditure pressures in the future.

3.6 Description of the changes in comparison with previous projection rounds

Current projections, fourth in a row, again bring better results than the previous ones. Results in 2009 were better comparing to 2006 mainly due to delay of the statutory retirement age (up to 65, still differentiated for women with children) and also due to more favourable demographic outlook. 2012 projections further improved the situation through parametric changes in the system. Sizable impact has mainly further postponement of retirement age and reform in disability pensions.

Table 3.15: Decomposition of the difference between 2012 and the new public pension projection
(% of GDP)

	Public pensions to GDP	Depend. ratio	Coverage ratio	Empl. effect	Benefit ratio	Labour intensity	Residual (incl. interact. effect)
2006 *	5,58	10,46	-3,46	-0,28	-0,56	:	-0,58
2009 **	3,27	9,55	-3,51	-0,47	-1,21	:	-1,08
2012 ***	2,73	9,25	-4,64	-0,58	-0,21	0,01	-1,10
2015****	0,78	7,17	-4,09	-0,65	-0,73	0,01	-0,93

Past projection rounds also limit public expenditure as a share on GDP. Demography is one factor that improved dependency ratio. Also macroeconomic assumptions are more favourable.[26] Overall, change in assumptions improved results by approx. 1p.p. at the end of horizon. Minor improvements have been done in terms of modelling, where we had much closer look on the issue of early and late retirement and calculation of respective penalization and bonuses. This relates to the issue of coverage as discussed in Annex B, where we more precisely defined additional adjustments in order to fulfil no policy change assumptions.

Policy related changes are those connected to disability pensions. There have not been any reform since last projections, however, recently we have more data and can better assess the impact of the reform effective from 2010. Three years ago, when the three-tier disability system replaced the two-tier one, we had to work with one year observations only. Now we can use data for past four years, which definitely allows more accurate calculation of disability probabilities.

Table 3.16: Decomposition of the difference between 2012 and the new public pension projection
(% of GDP)

	2013	2020	2030	2040	2050	2060
Ageing report 2012	8,7	8,7	8,9	9,7	11,0	11,8
Change in assumptions	0,7	1,2	1,4	0,6	-0,3	-1,0
Improvement in the coverage or in the modelling	0,0	-0,2	-0,4	-0,4	-0,2	-0,2
Change in the interpretation of constant policy	0,0	0,0	0,0	0,0	0,0	0,0
Policy related changes	0,0	-0,2	-0,4	-0,4	-0,4	-0,4
New projection	9,5	9,5	9,4	9,4	10,1	10,2

[26] It is worth noting that also change in exchange rate assumption plays role here. Our projections are originally carried out in Czech Korunas (CZK), but GDP comes from AWG macroeconomic assumptions in Euros. For the last projection round it was assumed the exchange rate amounting to 25.284 CZK/EUR (value from 2010 using for years of projections), while recent results are calculated using the rate 25.980 CZK/EUR. This "depreciation" of some ca 3% has an impact on expenditure to GDP shares, which tend to be somewhat lower.

4 Pension projection model

This Section aims at introducing the technical tool for computation and main data used for projection. In order to better understand the results presented in previous Section, we try to explain all steps of calculations and illustrate them with semi-results that are for practical purposes and reader's convenience moved to annexes.

4.1 Institutional context

The pension model has been built in the Ministry of Finance, which maintains, updates and uses the model. The model is a semi-aggregated simulation model written and run under the MATLAB application. It enables to make long-term projections and simulate the impact of changes in all the relevant parameters of the current system.

Presented projection results are prepared primarily for 2015 Ageing Report. AWG platform is in fact the main and the only "formal" reviewer of these projections. However, Ministry of Finance (MoF) cooperates with Ministry of Labour and Social Affairs (MoLSA) – that runs own long term projections – and consults these results on collegial basis. Results of the two institutions are comparable and differences explainable. They mainly stem from i) characteristics of models; MoLSA runs micro-simulation model while MoF uses macro-model and ii) assumptions about demography and macroeconomic framework used.

4.2 Assumptions and methods applied

Pension projections fully respect commonly agreed AWG assumptions. The model aims at incorporating all features of the pension system as described in Section 1.1.1. For detailed description of methods, see Chapter 4.5.

4.3 Data used

The model makes use of data since year 2000. Most of them come from the Czech Social Security Administration, which is in charge of collecting social security contributions and disbursing all pension benefits. The model makes use of the information on:

- the number of pensions disaggregated by type of pension, single age and gender
- the number of new pensions (by type of pension, single age and sex),
- average pension benefit (by type of pension, single age and sex),
- average newly granted pension benefit (by type of pension, single age and sex),
- matrix of the number of new pensions (by type of pension) for a given combination of personal calculation basis and contributory period.

Apart from the above mentioned data running the model requires a population projection (disaggregated by single age and sex), assumption on the average wage and labour market. All these data are taken from AWG assumptions.

Publicly available data on wage statistics from Czech Statistical Office are used for calculation the share of pre-retirement wage on average wage. The share is then applied to AWG wage assumptions.

4.4 Reforms incorporated in the model

The model fully applies current legislation. There has not been additional reform since the last projection round that would require changes in modelling approach or other adjustments because of legislation changes.

4.5 General description of the model

The model makes distinction among various pension benefits (old-age, disability, widows'/widowers' and orphans'), sexes (males, females) and generations (the year of birth).

In accordance with the Czech legislation the model explicitly differentiates several types of pensions:

- Old-age pensions (including early retirement old-age pensions that can be granted up to three years prior to statutory retirement age);
- Disability pensions (distinguishes between all three types: 3rd degree (when working capacity is reduced by at least 70%), 2nd and 1st degree (with working capacity reduced by 50 - 69% and 35 - 49% respectively);

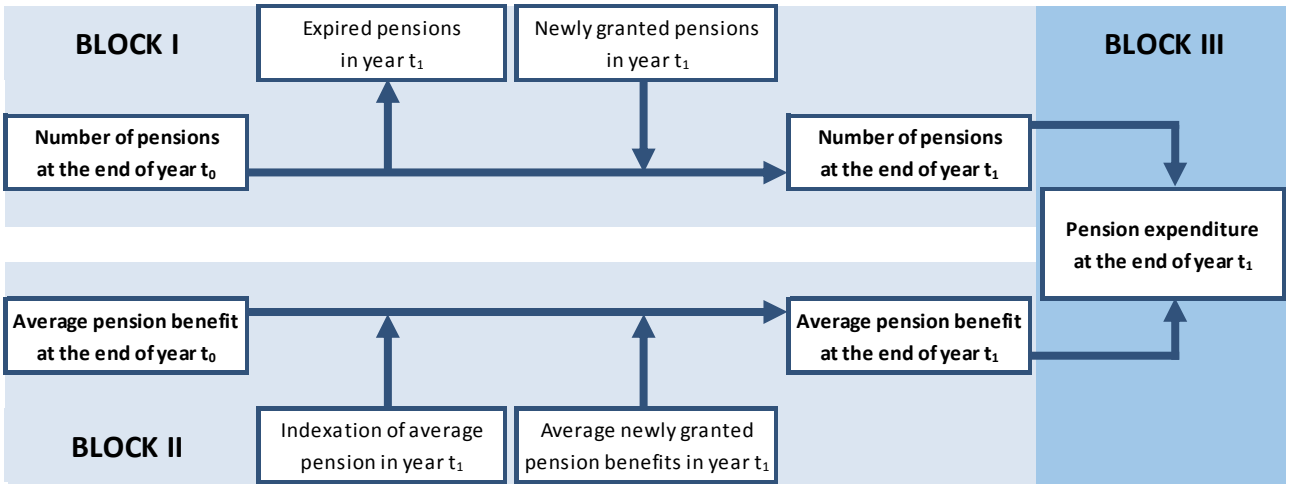
– Widow's/widower's pensions solo;
– Widow's/widower's pensions in concurrence with other pensions (disability, old-age);
– Orphan's pensions.

The distinction between males and females is important since they differ in their earnings profiles, length of their career and contribution periods. These differences result in different level of pension benefits. It is also important to apply cohort approach since the cohorts (generations) are not homogenous. Generations (identified by the year of birth) differ in some important characteristics, e.g. mortality rates (impacts for instance the number of survivors´ pensions or the average lengths of receiving an old-age pension), disability rates (impacts the number of disability pensions) and affiliation with a generation is also decisive for determination of the statutory retirement age.

The model primarily works with the number of pensions, not with the number of pensioners. The number of pensioners is somewhat lower than the number of pensions since some pensioners may be entitled to receive more (two) types of pension benefits. According to the Czech pension legislation recipients of disability or old-age pensions may under given conditions receive widow's/widower's pension at the same time. Thus, the number of pensioners can be obtained by subtracting the number of widow's/widower's pensions in concurrence with other pensions from the total number of pensions.

The model consists of three main building blocks, which is illustrated on Figure 4.1. The first block calculates the number of pensions and flow of new pensions. The second one computes the level of new pension benefits. The third block combines the information on the stock and flow of pensions with the projection of new pension benefits, which give the evolution of an average pension benefit and spending on all pension benefits in the projection horizon. All blocks work directly with generational data, so we are still able to distinguish between males, females, single ages, years of birth and calendar years.

Figure 4.1: Simplified structure of the model



4.5.1 Block I – number of pensions[27]

The number of pensions is calculated on the basis of the cohort methodology. The computation rests on the idea, that there is a certain probability that an individual of given age and sex and from given cohort retires, becomes disabled or becomes orphan/widow/widower.

Old-age and disability pensions

First of all, we stem from observed age specific shares and probabilities and assume their evolution in the future. Age specific shares of respective pension (*pen_s*)[28] is given by number of each pensions (*pen*) on population (*pop*) for each calendar year (*t*), age (*a*) and sex (*s*).

$$pen\_s_t^{a,s} = \frac{pen_t^{a,s}}{pop_t^{a,s}}. \qquad (4.1)$$

[27] Graphs showing developments of numbers of pensions are in Annex D (Figure D.13—Figure D.19).

[28] *pen* represents here old-age (*oa*) and disability pensions of all three types (*dis3*, *dis2*, *dis1*); _s denotes share.

This allows us to calculate conditional probability of becoming receiver of respective pension (*pen_p*)

$$pen\_p_t^{a,s} = \frac{pen\_s_t^{a,s} - pen\_s_{t-1}^{a-1,s}}{1 - pen\_s_{t-1}^{a-1,s}}. \tag{4.2}$$

In case of some pensions (usually any except old-age) the pensioner changes its status since he/she can stop receiving e.g. disability pension due to renewed working capacity or becoming entitled to old-age pension.[29] The conditional probability that a person ceased to be a pensioner can be expressed as follows

$$pen\_p_t^{a,s} = 1 - \frac{pen\_s_t^{a,s}}{pen\_s_{t-1}^{a-1,s}}. \tag{4.3}$$

Such shares and probabilities for the base year are then transformed from dimension age/calendar year into age/generation

$$pen\_s_t^{a,s} \Rightarrow pen\_s_t^{g,s}, \qquad pen\_p_t^{a,s} \Rightarrow pen\_p_t^{g,s} \tag{4.4}$$

and projected into the future.[30] While projecting probabilities, we must take into account continuously increasing development of statutory retirement age. Therefore in case of old-age, each generation with higher retirement age[31] than the base generation takes the probability of retirement from a person who is as many years younger as the difference in their retirement ages, i.e. in such case

$$pen\_p_{g+a+\left(ret^{g,m} - ret^{1951,m}\right)}^{g,m} = pen\_p_{1951+a}^{1951,m} \text{ for males } (m) \text{ and } pen\_p_{g+a+\left(ret^{g,f} - ret^{1954,f}\right)}^{g,f} = pen\_p_{1954+a}^{1954,f} \tag{4.5}$$

for females (*f*). We stem from the generations that retire in the base year 2013 (generation of men born in 1951 has retirement age equal to 62 years, i.e. 2013 = 1951 + 62, whereas the generation of women born in 1954 reached the statutory retirement age, 2013 = 1954 + 59). Such splitting is done for a convenient, usually in ages where probability profiles are flat point (depending on the type of pension).

Using projected probabilities are then used to calculate shares on population for all future generations by

$$pen\_s_{t+1}^{g,s} = pen\_s_t^{g,s} \cdot \left(1 - pen\_p_t^{g,s}\right) + pen\_p_t^{g,s}, \tag{4.6}$$

Or in accordance with (4.3)

$$pen\_s_{t+1}^{g,s} = pen\_s_t^{g,s} \cdot \left(1 - pen\_p_t^{g,s}\right). \tag{4.7}$$

Having derived this, it is easy to get pensions' numbers of old-age and all three disability types as a product of respecting shares and population

$$pen_t^{g,s} = pen\_s_t^{g,s} \cdot pop_t^{g,s}. \tag{4.8}$$

If we sum over generations and sexes, we arrive at total number of pensions for a calendar year.

$$pen_t = \sum_{g,s} pen\_s_t^{g,s} \cdot pop_t^{g,s}. \tag{4.9}$$

Widows'/widowers' pensions

Somewhat different approach from the one outlined in equations above has been used to calculate the number of survivors' pensions. The probability of receiving widow's/widower's pension (*wid_p*) depends on the marital status, probability of spouse to die in a given year and compound probability of the couple to die within the same year. This can be formally expressed as:

$$wid\_p_t^{g,f} = \left(\varepsilon_t^{g,m} - \varepsilon_t^{g,m} \cdot \varepsilon_t^{g,f}\right) \cdot \frac{mpop_t^{g,f}}{pop_t^{g,f}}, \tag{4.10}$$

[29] After the statutory retirement age all disability pensions are considered to be old-age pensions. As a result disability pensions disappear behind the statutory retirement age.

[30] For illustration of age specific shares, see Annex D (Figure D.1—Figure D.12).

[31] For information about the development of retirement age in the model see Section 0.

ε stands for mortality rate and *mpop* is the number of married population. The same relation similarly holds for men. Since married couples are not necessarily of the same age, ε of the other sex should be viewed as an average mortality rate of the other sex around the given age a (= $t - g$).

The number of widow's pensions (*wid*) can be derived from equation (4.10) and the assumption on the ratio of married population in a given starting age ($a_0 = t_0 - g$). Before the age a_0 [32] we assume (on the basis of fairly stable mortality rates) that the profile of widow's/widower's pension is the same as in the base year. The ratio of widow's pensions after age a_0 is calculated as follows:

$$\frac{wid_t^{g,f}}{pop_t^{g,f}} = \frac{wid_{t-1}^{g,f}}{pop_{t-1}^{g,f}} + \varepsilon_t^{g,m} \cdot \left(\frac{mpop_{t_0}^{g,f}}{pop_{t_0}^{g,f}} - \frac{wid_{t-1}^{g,f}}{pop_{t-1}^{g,f}} \right). \tag{4.11}$$

This equation is used to calculate the total number of widow's/widower's pension. It is further split into the solo pensions (*wids*) and pensions in concurrence (*widc*) with other pensions (old-age and disability) according to the probability that the person is a recipient of old-age or disability pension, which is given by the fraction of population that receives old-age (*oa*) or disability pension (*dis = dis1 + dis2 + dis3*).

$$wids_t^{g,s} = wid_t^{g,s} \cdot \left(1 - \frac{oa_t^{g,s} + dis_t^{g,s}}{pop_t^{g,s}} \right), \tag{4.12}$$

$$widc_t^{g,s} = wid_t^{g,s} - wids_t^{g,s}. \tag{4.13}$$

Orphans' pensions

The number of orphan's pensions (*or*) is projected simply on the basis of the existing profile (age and sex specific ratio of orphan's pensions to population) since mortality rates for those aged less than 26 are not subject to any major changes. With respect to their limited importance this seems to be a good approximation, i.e. shares on population are same in all years as in base year

$$or\_s_t^{a,s} = or\_s_{2013}^{a,s}. \tag{4.14}$$

The number of pensions is calculated similarly for other pension types

$$or_t^{a,s} = or\_s_t^{a,s} \cdot pop_t^{a,s}. \tag{4.15}$$

Newly granted pensions (for all types of pensions)

The number of new pensions (*npen*) in generation g and sex s is consistent with the stock of pensions (*pen*), from which it is computed with the use of the probability of survivorship derived from sex and generation specific mortality rate (ε)

$$npen_t^{g,s} = pen_t^{g,s} - pen_{t-1}^{g,s} \cdot \left(1 - \varepsilon_t^{g,s}\right). \tag{4.16}$$

Unfortunately, there is no such straightforward relationship in the case of disability pensions since a disability benefit is withdrawn when the working capacity is restored. Thus the number of new pensions computed according to (4.16) would be underestimated and spending on disability benefits and an average benefit would be lower (under the assumption of indexation lower than the wage growth).

$$ndis_t^{g,s} = k_{g+a}^{g,s} \cdot dis_t^{g,s}, \tag{4.17}$$

$$k_{g+a}^{g,s} \equiv k^{a,s} = \frac{ndis_{2013}^{a,s}}{dis_{2013}}. \tag{4.18}$$

The model assumes a fixed relationship between the number of new pensions and the stock of pensions in a given age (a) and the ratio was calibrated on the basis of 2013 data[33].

[32] After this age the entitlement for widow's/widower's pension is permanent (i.e. till the end of one's life) as opposed to the age before when the entitlement is only temporary (it lasts a year). The legislation sets the age to be four years before the statutory retirement age and as such it will rise with the postponement of this benchmark.

[33] That is, the model assumes a constant probability of restoring the working capacity.

4.5.2 Block II – average newly granted pension benefits

This block enables to (i) assess the impact of the government decisions (pertaining to the indexation of the main parameters of the pension formula) on the level of newly granted pensions in the short run and (ii) simulate the impact of changes in the pension formula in the long run.

The changes in pension formulae are simulated in a matrix with two dimensions – assessment basis and contribution period. It is a matrix, which gives the number of pensions for a given combination of personal calculation basis (average earnings during the contributory period) and contributory period. We assume that the distribution of pension numbers within this matrix will be shifted in terms of contributory periods in accordance with postponement of retirement and the extension of acknowledged contributory periods for the whole career.

Having such distribution, it is possible to compute a pension benefit for each cell of the matrix for each projection year on the basis of the pension formula (equations 4.19 – 4.21). Weighing the pension benefits by the number of recipients gives the average newly granted pension.

$$npen\_v = frc + erc\,, \tag{4.19}$$

$$erc = \begin{Bmatrix} \min(pcb, rb_1)\cdot rc_1 + \\ +\max[\min(pcb - rb_1, rb_2 - rb_1), 0]\cdot rc_2 + \\ +\max[\min(pcb - rb_2, rb_3 - rb_2), 0]\cdot rc_3 + \\ +\max[pcb - rb_3, 0]\cdot rc_4 \end{Bmatrix} \cdot \frac{cp_1 + 0.8\cdot cp_2}{365}\cdot ar\,, \tag{4.20}$$

$$pcb = \frac{\sum_{y=Y-1-\min(car,Y-1-1986)}^{Y-1} ycb_y \cdot \prod_{t=y}^{Y-1}\frac{w_{t+1}}{w_t}}{\min(car, Y-1-1986) - \frac{ncp}{365}}\,. \tag{4.21}$$

npen_v stands for newly granted pension benefit, *frc* for flat rate component (currently in 2013 amounts to 2,330 CZK ≈ 90 EUR), *erc* earnings related component, *pcb* personal calculation basis, *rb* reduction brackets (currently rb_1 = 11,389 CZK ≈ 438 EUR, rb_2 = 30,026 CZK ≈ 1,156 EUR and rb_3 = 30,026 CZK ≈ 1,156 EUR),[34] *rc* reduction *coefficient* (currently rc_1 = 100% up to rb_1, rc_2 = 27% up to rb_2 , rc_3 = 19% up to rb_3 and rc_4 = 6% above rb_3)[35], *cp contribution* period up to the statutory retirement age in days (including non-contributory periods assessed as if contributory but only up to 80%), *ar* accrual *rate* (1.5%), *car* years of career, *Y* year of *retirement*, *ycb* yearly calculation basis[36] in present value calculated on the basis of index derived from the growth rate of average wage in the economy (*w*) and *ncp* is for excluded non-contributory periods.

The description concerns mainly old-age pensions. In fact, the same procedure is used for other pension benefits with minor changes in the pension formula. For details of calculation, see description in Section 1.1.1.

4.5.3 Block III – average pension and total pension spending

In the base year the average pension benefit (for all types of pensions) is reported for each age and sex by the Czech Social Security Administration. It then enters the equation computing total pension expenditure. Total spending on a given type of pension (*pen_e*) in equation 4.22 is a function of the average pension benefit (*pen_v*) from the previous year indexed in accordance with the pension legislation (*index*), the value of newly granted average pension benefit (*npen_v*) calculated in the Block II of the model, and the number of pensions (*pen*) and newly granted pensions (*npen*) from the Block I.

$$pen\_e_t = \sum_{g,s}\left(pen_t^{g,s} - npen_t^{g,s}\right)\cdot pen\_v_{t-1}^{g,s}\cdot\left(1+index_t\right) + npen_t^{g,s}\cdot npen\_v_t^{g,s}\,. \tag{4.22}$$

Total pension expenditure is simply a sum of the pension spending on all the pension types.

[34] rb_1 and rb_2 are assumed to develop with wages, rb_3 will be zero since 2015 onwards according to the legislation.

[35] From 2015 onwards there will be only three reduction coefficients (as rb_3 will be cancelled). rc_1 = 100%, rc_2 = 26% and rc_3 = 0%. See Section 1.1.1 for the details.

[36] Current legislation of the pension system takes into consideration all career years but not those before year 1986.

In the projection horizon the average pension benefit (*pen_v*) for a given generation *g* and sex *s* is calculated on the basis of the pension spending (*pen_e*) and the number of pensions (*pen*). The average pension in respective year of projection is a weighted average of average pension from the previous period and the newly granted pension benefits

$$pen\_v_t^{g,s} = \frac{pen\_e_t^{g,s}}{pen_t^{g,s}} = \frac{\left(pen_t^{g,s} - npen_t^{g,s}\right)}{pen_t^{g,s}} \cdot pen\_v_{t-1}^{g,s} \cdot \left(1 + index_t\right) + \frac{npen_t^{g,s}}{pen_t^{g,s}} \cdot npen\_v_t^{g,s}. \tag{4.23}$$

Replacement rate of each pension type is simply share of average pension benefit of paid out pension (*pen_v*), resp. newly granted pension (*npen_v*), over average gross wage at retirement (*aw_ret*)

$$pen\_rr_t^{g,s} = \frac{pen\_v_t^{g,s}}{aw\_ret_t}, \qquad npen\_rr_t^{g,s} = \frac{npen\_v_t^{g,s}}{aw\_ret_t}. \tag{4.24}$$

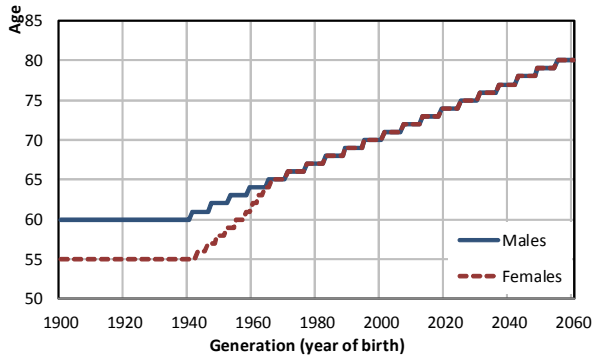
4.6 Additional features of the model

Statutory retirement age increase

The model must take into consideration the continuous increase in retirement age. According to the legislation, statutory age changes for each generation by several months (details in Annex C). However, the model works with yearly data, therefore the evolution of statutory age is not so smooth. This causes somewhat erratic development in case of data for new pensions.

There are still differences in retirement age not only in case of sexes, but for women the number of children raised matters too. For the modelling purposes we work with an average woman that has 2 children.

Figure 4.2: Evolution of statutory retirement age in the model



A Methodological annex

Methodological annex summarizes required explanations of some pension projection features. To some extent, these issues are also included in several parts throughout the document, where the respective clarifications are needed.

Economy-wide average wage at retirement

In order to estimate the relationship between economy wide average wage and average wage at retirement, we used the data of the Czech Statistical Office on wage distribution. We examined data for past fourteen years, which show that wage profile across the ages from 15 to 65+ shows relatively high inertia. This enables us to assume constant wage profile in the future. We assume the shift in the age specific wage profile from 2013 onwards with respect to postponement of retirement age and thus constant relationships to average wage. This means that the average gross wage at retirement grows exactly in the same pace as the average wage given by the AWG assumptions and is approximately by 7.7% higher than economy wide average wage.

Table A.1: Economy wide average wage at retirement evolution (in thousands euro)

	2013	2020	2030	2040	2050	2060
Economy-wide average wage	11,5	13,7	20,2	29,3	42,5	60,7
Economy-wide average wage at retirement	12,3	14,8	21,7	31,6	45,7	65,3

Pensions vs. pensioners

The model primarily works with the number of pensions, not with the number of pensioners. The number of pensioners is somewhat lower than the number of pensions since some pensioners may be entitled to receive more (two) types of pension benefits. According to the Czech pension legislation recipients of disability or old-age pensions may under given conditions receive widow's/widower's pension at the same time. Thus, the number of pensioners can be obtained by subtracting the number of widow's/widower's pensions in concurrence with other pensions from the total number of pensions. The ratio between pensioners and pensions is rather stable over time amounting to 80% – 84%.

Pension taxation

Pension benefits are not taxed in absolute majority of cases. This is due to relatively high threshold up to which income of pensioners is tax exempt. Only pensioner's income exceeding 36times minimum wage[37] is subject to 15% Personal Income Tax. Currently only a negligible number of pensioners (not even 1% of them) pays taxes. Moreover, such negligible personal income tax revenue is a source of the state budget and not of the social security system itself. For these reasons tax calculations are not part of projection exercise.

Disability pension

Disabled people of any type could occur only in ages under 65 or statutory retirement age if higher. At 65 or statutory retirement, they are automatically transferred to old-age pensions.

There has not been any reform since last projections. However, recently we have had more data and thus we can better assess the impact of the reform effective from 2010. Three years ago, when the three-tier disability system replaced the two-tier one, we had to work with one year observations only. Now we can use data for past four years, which definitely allows for more accurate calculation of disability probabilities.

In our system with continuous increase of retirement age, disability rates play role, mainly in pre-retirement ages. We observe the increased disability shares in case of ages that are continuously becoming ineligible for old-age or even early retirement pension. Table A.2 shows evolution of disability rates for crucial age cohorts over time. While for younger people (below age of 55) disability rates are stable, older cohorts witness their increase, which is solely due to retirement age postponement. Graphical illustrations of disability profiles development can be found in Annex D. However, although disability profiles increase with deferred retirement, they do not fully offset missing retirement, while also participation rates are very low in these ages.[38]

[37] Minimum gross wage is set from 1st August 2013 to be 102,000 CZK per year (approx. 3,926 EUR).

[38] For detailed discussion of the problem please see Annex B.

Table A.2: Disability rates by age groups
(in %)

	2013	2020	2030	2040	2050	2060
Age group -54	3,3	3,4	3,6	3,4	3,3	3,5
Age group 55-59	16,3	13,7	13,1	13,2	13,7	13,8
Age group 60-64	11,1	10,5	9,2	12,2	14,9	17,2
Age group 65-69	0,1	0,0	0,0	1,4	4,8	8,1
Age group 70-74	0,0	0,0	0,0	0,0	0,0	0,0
Age group 75+	0,0	0,0	0,0	0,0	0,0	0,0

Survivor pensions

The way of calculation of survivors' pensions is in detail introduced at the end of Section 4.5.1. Equation 4.11 and 4.15 give intuition, that the development of both widows'/widowers' and orphans' pensions is affected solely by population projection (and mortality rates). It is confirmed by illustrative graphs Figure D.18 and Figure D.19, where numbers of pensions are more or less stable over projection horizon. The same applies to expenditure too as replacement rates are constant over time. See Figure D.25 and Figure D.26.

Non-earnings related minimum pension

Desired minimum amount of any pension is ensured by the flat rate component (which is the same for everyone) and the minimum earnings related component for each pension type. Another instrument that also prevents people from the poverty is the institute of the subsistence level.[39] Both these instruments are set by the government and are revaluated on irregular basis. There is not any special minimum pension scheme besides this one inbuilt in all pension types. For details of pension calculations see system description in Section 1.1.1.

Contributions

Public pension contributions are paid by working population from their wages that develop in line with GDP over the horizon. We assume constant contribution rate, which equals to 28% as stipulated by law. Contribution burden is shared between employee (6.5%) and employer (21.5%). This results in the constant share of contributions on GDP in all projection years.

Comparison with previous projection round

Table A.3 shows detailed comparison of this projection exercise with the previous one. Firs two parts of the Table illustrates the importance of individual effect in driving of pension expenditures. Numbers are calculated as percentage changes over certain projection periods. It is clear that the highest contribution to expenditure growth has dependency ratio effect, which is a result of population ageing and longevity. However, there are also factors that limit the dynamic of expenditure pressures. It is mainly the continuous postponement of retirement age, which is behind the decrease of coverage ratio effect. Consequently, induced higher number of workforce improve situation on the labour market and better employment ratio effect helps the pension system.

Third part of Table A.3 indicates changes between the two projection exercises. Overall public pension expenditure dynamics is lower by almost 22p.p.[40] The biggest part is caused by better population outlook with more favourable dependency ratio effect. Worse coverage ratio effect is not a result of any policy measure but rather a consequence of higher additional coverage of inactive people in this exercise. This effect is also behind lower benefit ratio, where more people are assumed to accept early retirement pension with lower pension benefit.[41]

[39] A person whose income is lower than the subsistence level has a claim for social support benefits.

[40] Note that the two projections differ in terms of starting point. While the base year of 2012 Ageing report was in 2010, recent exercise uses the last observed data from 2013.

[41] For details of additional coverage, please see Annex B.

Table A.3: Detailed comparison of 2012 and the new public pension projection

(A) Ageing Report 2015	2013 - 2020	2020 - 2030	2030 - 2040	2040 - 2050	2050 - 2060	2013 - 2060
Public pensions to GDP	0,3	-0,6	0,1	7,3	1,3	8,3
Dependency ratio effect	24,7	13,1	14,4	18,6	5,0	75,9
Coverage ratio effect	-18,0	-6,9	-8,1	-7,9	-2,5	-43,3
Benefit ratio effect	0,1	-5,7	-4,1	1,4	0,6	-7,8
Employment ratio effect	-4,0	-0,5	-1,3	-3,9	-1,8	-11,5
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,1
Residual	-2,5	-0,7	-0,9	-1,0	-0,1	-5,2
(B) Ageing Report 2012	**2010 - 2020**	**2020 - 2030**	**2030 - 2040**	**2040 - 2050**	**2050 - 2060**	**2010 - 2060**
Public pensions to GDP	-4,8	2,7	8,4	14,9	8,8	30,0
Dependency ratio effect	35,0	13,1	16,5	25,0	11,9	101,5
Coverage ratio effect	-24,4	-6,5	-7,9	-8,4	-3,7	-50,9
Benefit ratio effect	-6,1	-3,1	2,0	3,4	1,5	-2,3
Employment ratio effect	-3,4	0,2	0,6	-2,6	-1,1	-6,4
Labour intensity effect	0,0	0,0	0,0	0,1	0,0	0,1
Residual	-5,9	-1,0	-2,8	-2,5	0,1	-12,1
(A - B) Difference: Ageing Report 2015 - Ageing Report 2012	**base year - 2020**	**2020 - 2030**	**2030 - 2040**	**2040 - 2050**	**2050 - 2060**	**base year - 2060**
Public pensions to GDP	5,1	-3,3	-8,3	-7,6	-7,5	-21,7
Dependency ratio effect	-10,3	0,1	-2,1	-6,4	-6,9	-25,6
Coverage ratio effect	6,4	-0,4	-0,2	0,6	1,2	7,6
Benefit ratio effect	6,2	-2,6	-6,1	-2,0	-1,0	-5,5
Employment ratio effect	-0,6	-0,7	-1,9	-1,3	-0,7	-5,1
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,0
Residual	3,3	0,4	2,0	1,5	-0,2	6,9

Alternative pension spending decomposition

Table A.4 and Table A.5 are equivalent to Table 3.4 and Table 3.5 that are calculated by dividing into sub-interval so to have smaller residual effect (interaction effect). On the other hand, such reduction of the residual is not applied in Table 3.4 and Table 3.5.

Table A.4: Factors behind the change in public pension expenditures between 2013 and 2060 – pensions
(alternative decomposition, in percentage points of GDP)

	2013 - 2020	2020 - 2030	2030 - 2040	2040 - 2050	2050 - 2060	2013 - 2060
Public pensions to GDP	0,0	-0,1	0,0	0,7	0,1	0,8
Dependency ratio effect	2,5	1,6	2,0	3,0	0,9	10,0
Coverage ratio effect	-1,6	-0,5	-0,6	-0,5	-0,1	-3,4
Coverage ratio old-age	-0,8	-0,2	-0,4	-0,2	-0,1	-1,7
Coverage ratio early-age	-1,8	-2,0	-0,4	-0,1	-0,2	-4,4
Cohort effect	-2,0	0,5	-1,1	-1,8	-0,3	-4,7
Benefit ratio effect	0,0	-0,5	-0,4	0,1	0,0	-0,7
Labour Market/Labour intensity effect	-0,4	0,0	-0,1	-0,3	-0,1	-1,0
Employment ratio effect	-0,3	0,0	0,1	-0,3	-0,1	-0,6
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,0
Career shift effect	-0,1	0,0	-0,2	-0,1	0,0	-0,4
Residual	-0,4	-0,6	-1,0	-1,6	-0,5	-4,0

Table A.5: Factors behind the change in public pension expenditures between 2013 and 2060 – pensioners
(alternative decomposition, in percentage points of GDP)

	2013 - 2020	2020 - 2030	2030 - 2040	2040 - 2050	2050 - 2060	2013 - 2060
Public pensions to GDP	0,0	-0,1	0,0	0,7	0,1	0,8
Dependency ratio effect	2,5	1,6	2,0	3,0	0,9	10,0
Coverage ratio effect	-1,6	-0,5	-0,5	-0,5	-0,2	-3,2
Coverage ratio old-age	-0,6	0,0	-0,3	-0,1	-0,1	-1,0
Coverage ratio early-age	-1,7	-1,9	-0,4	-0,1	-0,2	-4,2
Cohort effect	-2,0	0,5	-1,1	-1,8	-0,3	-4,7
Benefit ratio effect	-0,1	-0,6	-0,4	0,0	0,1	-1,0
Labour Market/Labour intensity effect	-0,4	0,0	-0,1	-0,3	-0,1	-1,0
Employment ratio effect	-0,3	0,0	0,1	-0,3	-0,1	-0,6
Labour intensity effect	0,0	0,0	0,0	0,0	0,0	0,0
Career shift effect	-0,1	0,0	-0,2	-0,1	0,0	-0,4
Residual	-0,4	-0,5	-0,9	-1,5	-0,5	-4,0

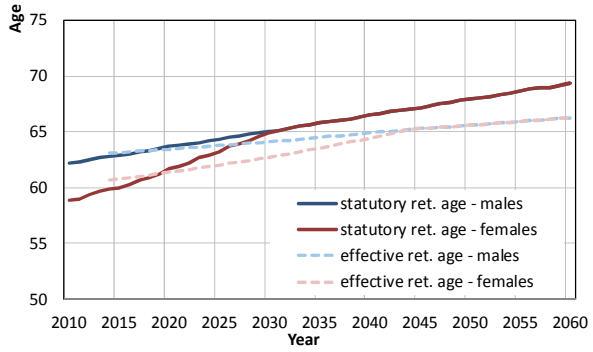
B Annex: Coverage rate adjustments

This annex aims at shedding some light on differences between the Cohort Simulation Model (CSM) and the national pension model that have impact on pension projection exercise. Naturally, there are and will be reasonable differences between the two models by definition. Therefore it requires more explanation, how the pension model has been adjusted, mainly on the share of pensioners over inactive people, as illustrated in Table 3.8 and Table 3.10.

Statutory retirement age vs. effective retirement age

What causes the problem with coverage rate decline is difference between the statutory retirement age and effective retirement age assumed by CSM. The Czech Republic has legislated continuous increase in statutory retirement age as shown in the following Figures. This is directly set in the law and it is not a subject to any possible future approval of the Government and/or Parliament. Although the retirement age is assigned to each generation (according year of birth), with a simple calculation, it can be assigned to calendar years as depicted by solid lines for men and women. This retirement age postponement is crucial for the pension model, which shifts the profiles of pensions according to that, as shown in Equation 4.5.

Figure B.1: Statutory retirement age vs. effective retirement age in CSM assumptions



On the other hand, macroeconomic assumptions work with effective retirement. It is assumed that with increasing retirement age there will be a weaker link between the two ages, i.e. the higher the retirement age the more people will tend to leave labour market earlier.[42] The share of inactive people over population increases in the years where people are not allowed to retire anymore as participation rates themselves are set insufficient to cover for this effect.

Pension model adjustments

Pension model, as was introduced in Section 4.5.1 respects current legislation and shifts profiles with respect to statutory retirement, which is the only relevant age for e.g. old-age pension entitlements. On the other hand, there is an automatic adjustment from the disability pensions' scheme. As visible in quoted Figures, share of disabled people in population increases with age. This increase and shifts of profile stem from past observed data.

However, the pension model incorporates additional adjustments in order to consider commonly agreed assumption to the highest possible extent. But at the same time it is important to stick to the assumption of no-policy change projections. With this regard, the only solution seems to assume that people will much more opt for early retirement as the pension age increases. Therefore the model takes the initial result of projection of numbers of pensions and calculates numbers of uncovered inactive people. It further analyses, whether a person could possibly be entitled for early retirement pension. If yes, such a person is additionally assigned early retirement pension. In this respect we assume that this additional demand for early retirement increases with the proximity of statutory age. The problem is, that old age pensions are, in case of some ages and cohorts, unable to cover additional inactive people, as they are not allowed even for early retirement.

In addition to that we expect that in line with this rationale more people will tend to withdraw their capital savings from 3rd pillar and opt for pre-retirement scheme.[43]

There are not additional adjustments made in other types of pensions, e.g. in disabilities. Last observed data and the reform effective since 2010 show strong effect of tightening eligibility conditions in order limit possible leaking from

[42] Although recent data shows that it has not been the case as effective retirement age develops with statutory retirement age. This is mainly due very strict and painful penalizations for early retirement. However, it seems reasonable to assume that this link will be weakened to some extent.

[43] For details about pre-retirement scheme see Section 1.1.3.

labour market. To use disability pensions for increasing coverage would require quite substantial jumps in disability profiles. This would violate the rule of no policy change.

Effects of additional coverage on pension results

Beside the improvement in ratio of pensioners over inactive people, model adjustments have other impacts on results. Early retirement pensions that are somewhat increased, means lower benefits for these pensioners. As illustrated in Table 1.2, certain reductions apply amounting to more than quarter of an earnings-related pension benefit in case of earliest possible retirement. The adjustment assumption of higher demand for early retirement as pension age approaches seems reasonable, because not many people would accept dramatic penalizations imposed when retiring at the earliest possible age.

If we assume that all inactive people would accept early retirement it would result in unprecedentedly low replacement rates. And consequently in decrease of total pension expenditure over time;[44] well below the current share on GDP at the end of projection horizon. Such projections would definitely not be reliable.

[44] People would be assigned benefit earlier but on much lower permanent level. Total outlays for such pensioner would be in sum lower than when assigned regular pension benefit later. This would drag the total pension expenditure down.

C Annex: Retirement age

Table C.1: Retirement age by the year of birth
(y = year, m = month)

Generation	Men	Women and number of raised children				
		0	1	2	3 and 4	5+
1936	60y2m	57y	56y	55y	54y	53y
1937	60y4m	57y	56y	55y	54y	53y
1938	60y6m	57y	56y	55y	54y	53y
1939	60y8m	57y4m	56y	55y	54y	53y
1940	60y10m	57y8m	56y4m	55y	54y	53y
1941	61y	58y	56y8m	55y4m	54y	53y
1942	61y2m	58y4m	57y	55y8m	54y4m	53y
1943	61y4m	58y8m	57y4m	56y	54y8m	53y4m
1944	61y6m	59y	57y8m	56y4m	55y	53y8m
1945	61y8m	59y4m	58y	56y8m	55y4m	54y
1946	61y10m	59y8m	58y4m	57y	55y8m	54y4m
1947	62y	60y	58y8m	57y4m	56y	54y8m
1948	62y2m	60y4m	59y	57y8m	56y4m	55y
1949	62y4m	60y8m	59y4m	58y	56y8m	55y4m
1950	62y6m	61y	59y8m	58y4m	57y	55y8m
1951	62y8m	61y4m	60y	58y8m	57y4m	56y
1952	62y10m	61y8m	60y4m	59y	57y8m	56y4m
1953	63y	62y	60y8m	59y4m	58y	56y8m
1954	63y2m	62y4m	61y	59y8m	58y4m	57y
1955	63y4m	62y8m	61y4m	60y	58y8m	57y4m
1956	63y6m	63y2m	61y8m	60y4m	59y	57y8m
1957	63y8m	63y8m	62y2m	60y8m	59y4m	58y
1958	63y10m	63y10m	62y8m	61y2m	59y8m	58y4m
1959	64y	64y	63y2m	61y8m	60y2m	58y8m
1960	64y2m	64y2m	63y8m	62y2m	60y8m	59y2m
1961	64y4m	64y4m	64y2m	62y8m	61y2m	59y8m
1962	64y6m	64y6m	64y6m	63y2m	61y8m	60y2m
1963	64y8m	64y8m	64y8m	63y8m	62y2m	60y8m
1964	64y10m	64y10m	64y10m	64y2m	62y8m	61y2m
1965	65y	65y	65y	64y8m	63y2m	61y8m
1966	65y2m	65y2m	65y2m	65y2m	63y8m	62y2m
1967	65y4m	65y4m	65y4m	65y4m	64y2m	62y8m
1968	65y6m	65y6m	65y6m	65y6m	64y8m	63y2m
1969	65y8m	65y8m	65y8m	65y8m	65y2m	63y8m
1970	65y10m	65y10m	65y10m	65y10m	65y8m	64y2m
1971	66y	66y	66y	66y	66y	64y8m
1972	66y2m	66y2m	66y2m	66y2m	66y2m	65y2m
1973	66y4m	66y4m	66y4m	66y4m	66y4m	65y8m
1974	66y6m	66y6m	66y6m	66y6m	66y6m	66y2m
1975	66y8m	66y8m	66y8m	66y8m	66y8m	66y8m
1976	66y10m	66y10m	66y10m	66y10m	66y10m	66y10m
1977	67y	67y	67y	67y	67y	67y

Each younger generation will have statutory retirement age higher by 2 additional months comparing the precedent generation. I. e. generation born in 1978 will retire at age 67y2m, 1979 at age 67y4m and so on.

D Annex: Detailed results

This annex brings overview of more detailed results for illustration so a reader can better orientate what is behind results.

Cross sectional profiles – age specific shares

The following figures show cross sectional profiles in specific years that reflect the calendar year, in which the statutory retirement age increases by one additional year. It is apparent that the process takes longer for women despite the faster speed (rise by 2 months a year for men compared to 4 months for women) until they reaches the retirement age of men. It is a result of the much higher increase in statutory age for women.

Figure D.1: Old-age pensions – males

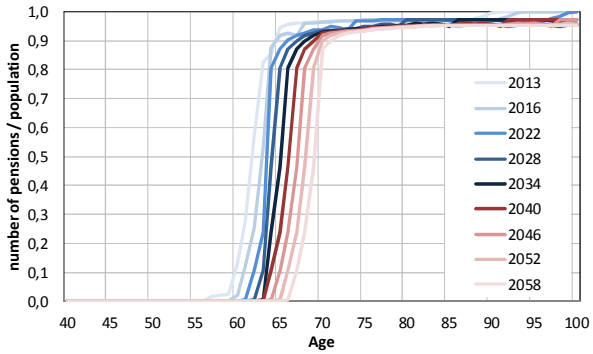


Figure D.2: Old-age pensions – females

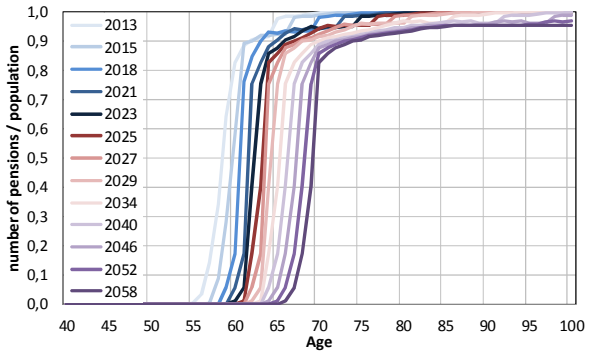


Figure D.3: 3rd degree disability pensions - males

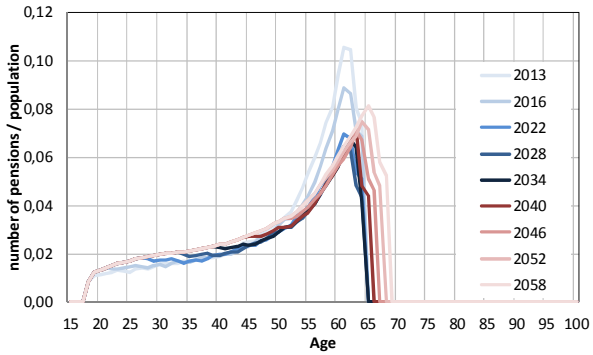


Figure D.4: 3rd degree disability pensions - females

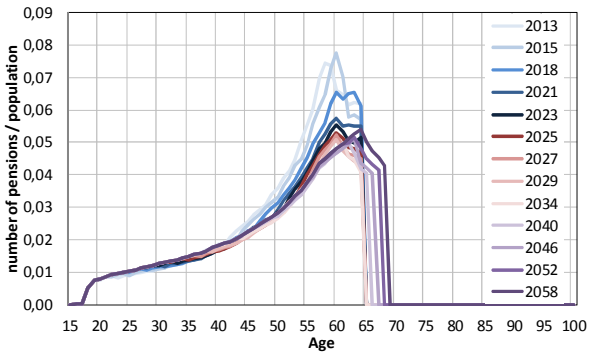


Figure D.5: 2nd degree disability pensions – males

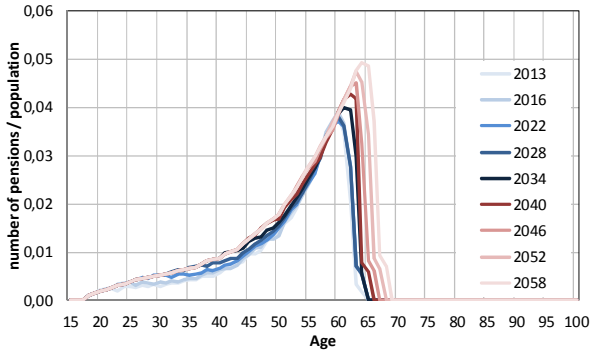


Figure D.6: 2nd degree disability pensions – females

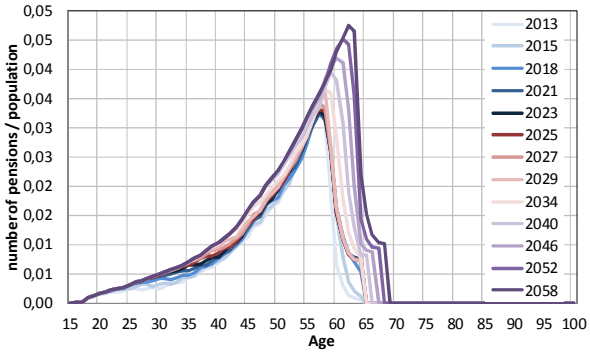


Figure D.7: 1st degree disability pensions – males

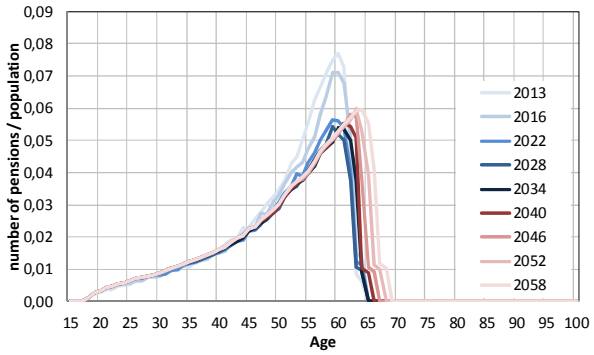
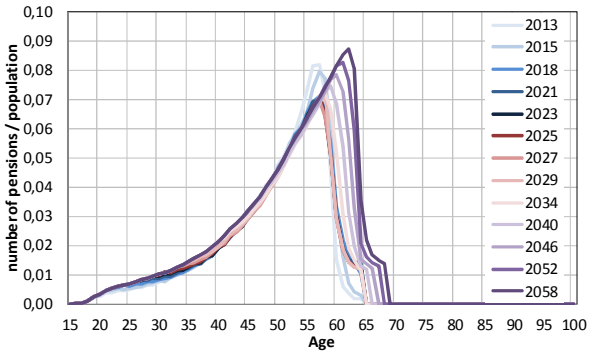


Figure D.8: 1st degree disability pensions – females



Note that minor changes in the peak of profiles for disability pensions for years at the beginning of projections are caused by generational effect of the 2010 reform. However, important feature of profiles – an increase of disability shares for pre-retirement ages – are clearly visible for projection years as retirement age increases.

Figure D.9: Widower's pensions - males

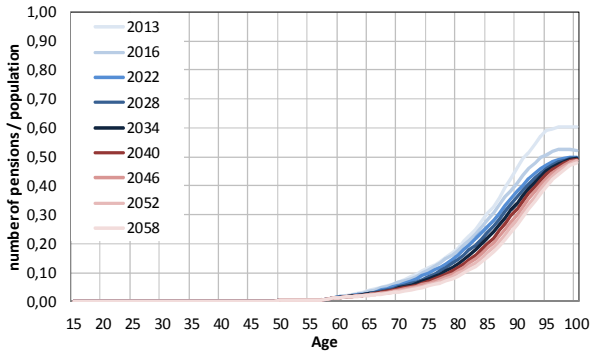


Figure D.10: Widows' pensions - females

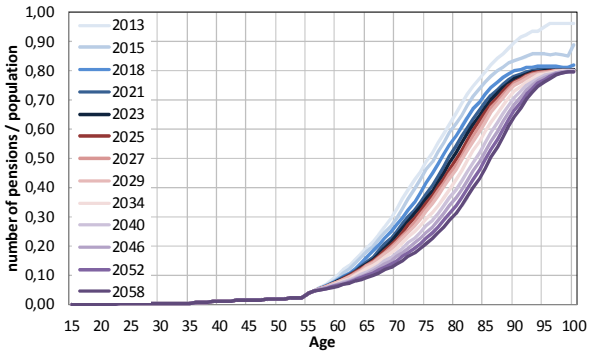


Figure D.11: Orphan's pensions – males

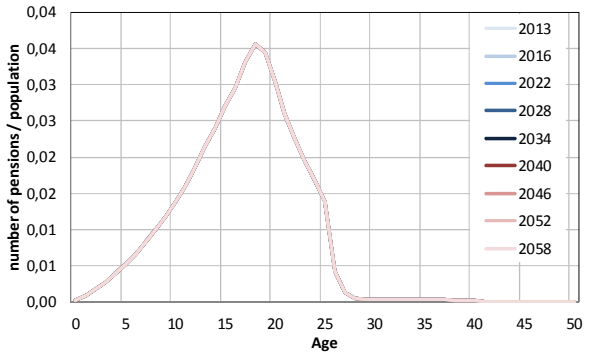
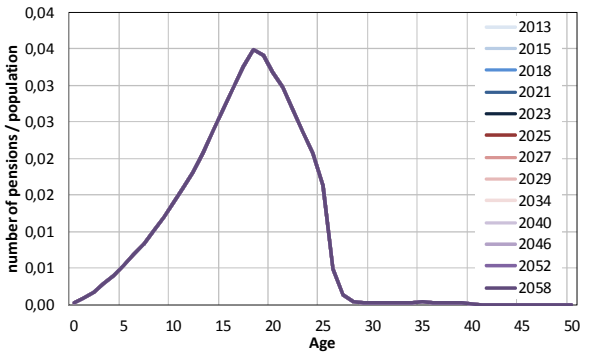


Figure D.12: Orphan's pensions - females



Profiles of orphans' pensions do not change with retirement age and are held constant for all years of projection.

Numbers of pensions

Figure D.13: Number of pensions - all pensions

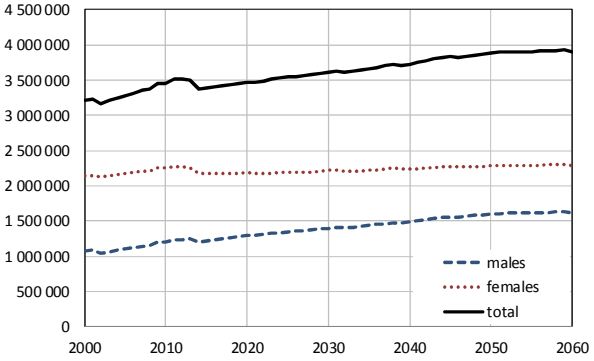


Figure D.14: Number of pensions - old-age pensions

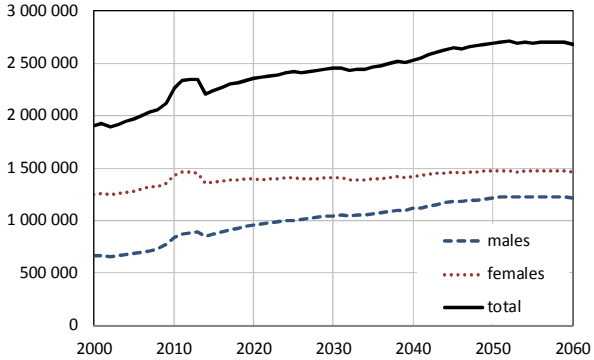


Figure D.15: Number of pensions - 3rd degree disability pensions

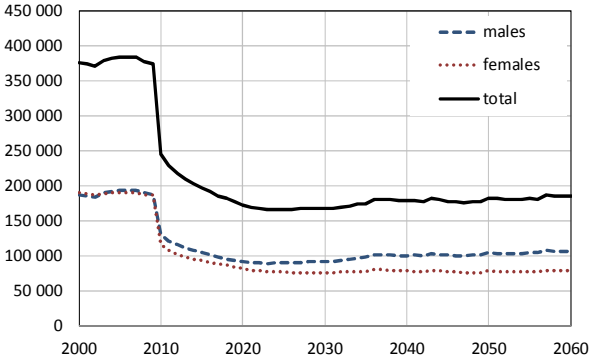


Figure D.16: Number of pensions - 2nd degree disability pensions

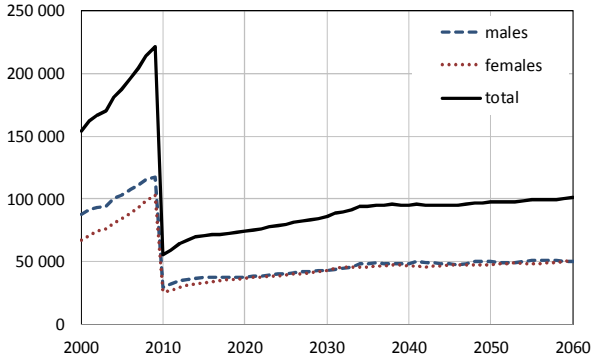


Figure D.17: Number of pensions - 1st degree disability pensions

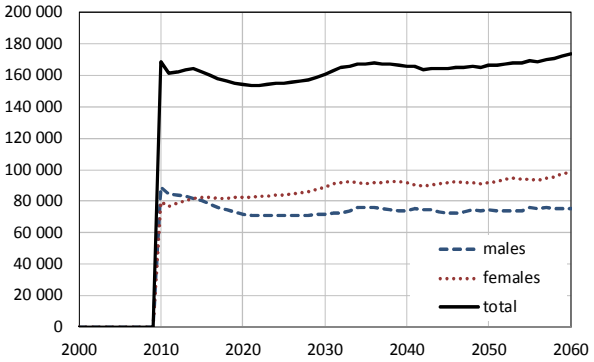


Figure D.18: Number of pensions - widows'/widowers' pensions

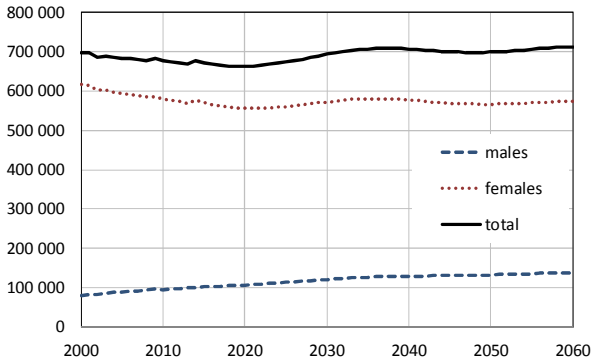
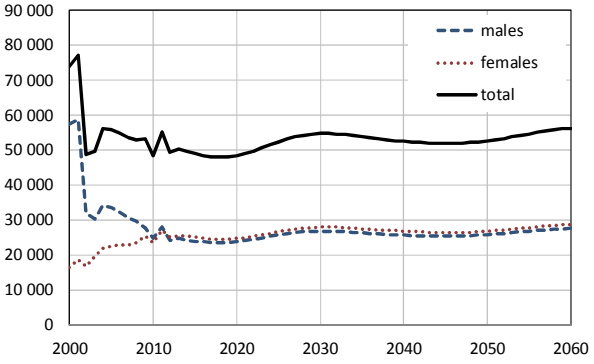


Figure D.19: Number of pensions - orphans' pensions



Replacement rates

Figure D.20: Replacement rates - all pensions

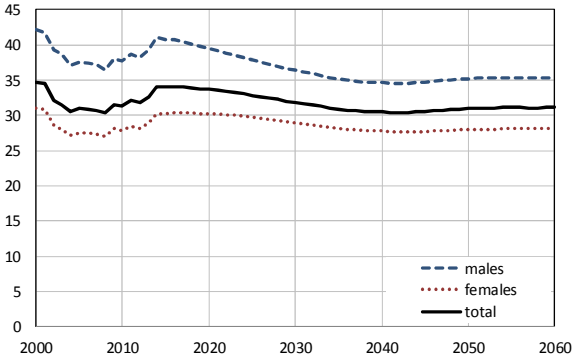


Figure D.21: Replacement rates - old-age pensions

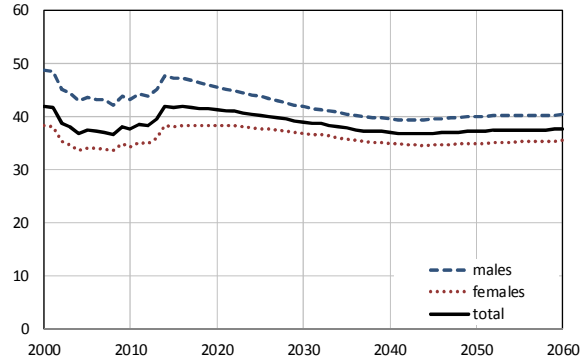


Figure D.22: Replacement rates - 3rd degree disability pensions

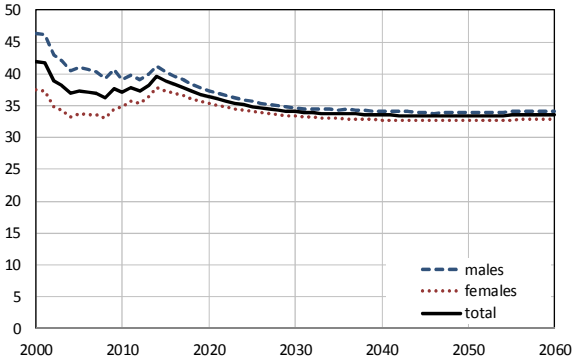


Figure D.23: Replacement rates - 2nd degree disability pensions

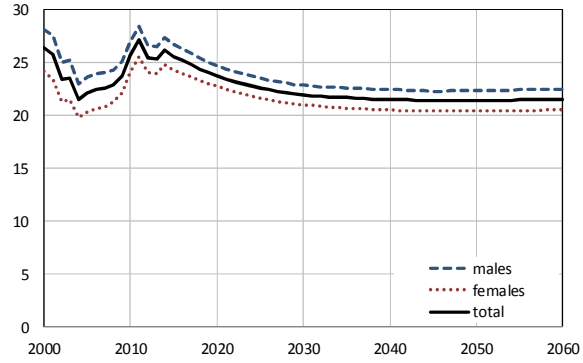


Figure D.24: Replacement rates - 1st degree disability pensions

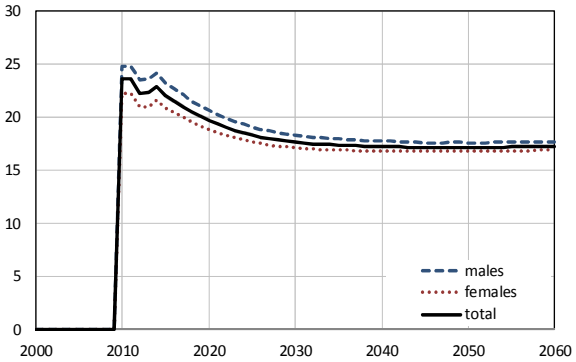


Figure D.25: Replacement rates - widows'/widowers' pensions

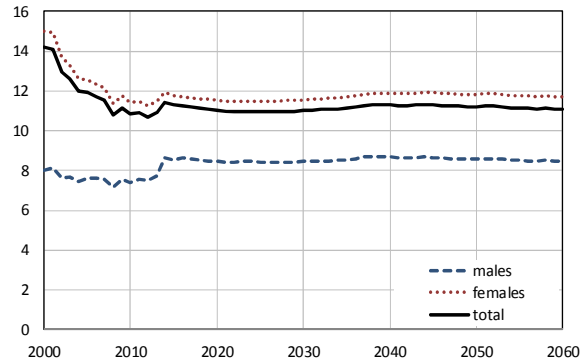
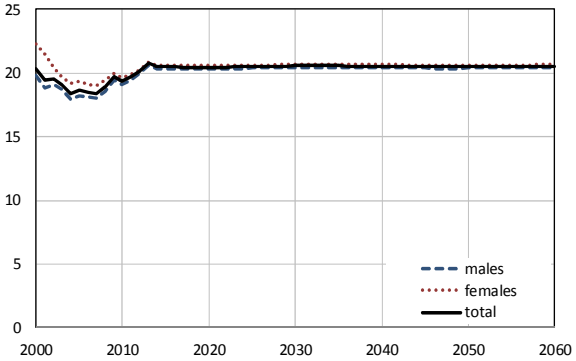


Figure D.26: Replacement rates - orphans' pensions



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