Peer reviews on pension projections

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1   OVERVIEW OF THE PENSION SYSTEM

Various instruments have been created in Luxembourg to ensure that elder people continue to receive an income. They may be categorized as follows:

- The general pension scheme for the private sector
- Special pension schemes for the public sector
- Supplementary pension schemes for the private sector
- Private pension plans
- Social assistance

Apart from civil servants and other employees of the government, local authorities, public institutions and the Luxembourg national railways, which have their own statutory schemes (the special pension schemes for the public sector), all those who are covered by pension insurance in Luxembourg belong to the general pension scheme. People belonging to a pension scheme by virtue of working for an international body are not subject to a national scheme.

In addition, every company is free to establish one or more supplementary pension schemes for all or certain categories of its employees. A private pension plan consists of a contract between an insurer and an individual, which can be established under specific conditions.

Individuals with insufficient financial resources benefit from the respective social assistance measures provided by public authorities.

1.1   DESCRIPTION

1.1.1   The general pension scheme

The general pension scheme for the private sector in Luxembourg is based on a system of compulsory insurance. It comprises disability, early old age, old age, and survivor pensions.

Qualifying conditions

Three criteria define the conditions that a scheme member must fulfil in order to qualify for an old age or early old age pension. In order to be eligible for an old age pension *OA65*, an insured person needs to be at least 65 years old and have accumulated a total of 10 years of contributory periods *CY*. An insured person that is at least 60 years old and has accumulated a combined total of 40 years of contributory periods *CY* and credited non-contributory periods *NY* (e.g. years of study or years taken off to bring up children) qualifies for an early old age pension *EOA60*, provided that contributions have been paid for at least 10 years. Individuals that are at least 57 years old gain access to early old age benefits *EOA57* if they accumulated a total of 40 years of contributory periods *CY*.

Table 1 – Qualifying conditions for retiring (identical for men and women)

	Minimum conditions	*2016*	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
OA65	Contributory period *CY*	10	10	10	10	10	10	10
	Statutory retirement age	65	65	65	65	65	65	65
EOA60	Combined periods *CY+NY* (of which *CY*)	40 (10)	40 (10)	40 (10)	40 (10)	40 (10)	40 (10)	40 (10)
	Retirement age	60	60	60	60	60	60	60
EOA57	Contributory period *CY*	40	40	40	40	40	40	40
	Retirement age	57	57	57	57	57	57	57

The entitlement to a disability pension requires at least one year of contributions paid during the three years preceding the disability as well as an age younger than 65. Similarly, the entitlement to a survivor pension in the case of a deceased active person requires a minimum one year of contribution in the three years preceding his or her death. Clearly, these conditions do not hold for deceased pensioners.

A minimum personal pension is guaranteed for members that have belonged to the scheme for at least 20 years. In the case of a full 40-year-career, the minimum pension amounts to about 90% of the social minimum income. For each missing year, this quantity is reduced by one fortieth, down to the eligibility threshold of 20 years.

The pension formula

Under the current legislation, the pension formula $P = P1 + P2 + P3 + P4$ is determined as a sum of four components and depends on a total of four annual pension formula parameters $p1, p2\_1, p2\_2, p3$. Its main elements are defined as:

- The pro-rata enhancement $P1$. It is calculated as a given percentage $p1$ of the total contributory income TCI.

- The incremental enhancement $P2$. For each full year that the sum of the individual's age AGE plus the total of contributory years CY exceeds the given annual parameter $p2\_1$, the pro-rata enhancement is increased by a fixed percentage $p2\_2$, up to a ceiling of 2.05%.

- The flat rate $P3$. This corresponds to a given percentage $p3$ of the social minimum income SMI, which is calculated based on the number of qualifying years QY. The latter number includes both contributory years CY as well as credited non-contributory years NY, and it is capped at 40.

- The end-of-year allowance bonus $P4$. This represents roughly 2.5% of the social minimum income SMI. It is due as long as the global contribution rate has not to be increased. The periods taken into account are the same as for the flat rate component.

Complementing the above information, Table 2 describes the evolution of the annual pension formula parameters $p1$, $p2\_1$, $p2\_2$, and $p3$.

Table 2 - Evolution of the annual pension formula parameters

Year	p1 (%)	p2_1	p2_2 (%)	p3 (%)	Year	p1 (%)	p2_1	p2_2 (%)	p3 (%)
before 2013	1.850	93	0.010	23.500	2033	1.719	96	0.018	25.863
2013	1.844	93	0.011	23.613	2034	1.713	96	0.019	25.975
2014	1.838	93	0.011	23.725	2035	1.707	97	0.019	26.088
2015	1.832	93	0.012	23.838	2036	1.700	97	0.019	26.200
2016	1.825	93	0.012	23.950	2037	1.694	97	0.020	26.313
2017	1.819	93	0.012	24.063	2038	1.688	97	0.020	26.425
2018	1.813	94	0.013	24.175	2039	1.682	97	0.021	26.538
2019	1.807	94	0.013	24.288	2040	1.675	97	0.021	26.650
2020	1.800	94	0.013	24.400	2041	1.669	98	0.021	26.763
2021	1.794	94	0.014	24.513	2042	1.663	98	0.022	26.875
2022	1.788	94	0.014	24.625	2043	1.657	98	0.022	26.988
2023	1.782	94	0.015	24.738	2044	1.650	98	0.022	27.100
2024	1.775	95	0.015	24.850	2045	1.644	98	0.023	27.213
2025	1.769	95	0.015	24.963	2046	1.638	98	0.023	27.325
2026	1.763	95	0.016	25.075	2047	1.632	99	0.024	27.438
2027	1.757	95	0.016	25.188	2048	1.625	99	0.024	27.550
2028	1.750	95	0.016	25.300	2049	1.619	99	0.024	27.663
2029	1.744	95	0.017	25.413	2050	1.613	99	0.025	27.775
2030	1.738	96	0.017	25.525	2051	1.607	99	0.025	27.888
2031	1.732	96	0.018	25.638	2052	1.600	100	0.025	28.000
2032	1.725	96	0.018	25.750	after 2052	1.600	100	0.025	28.000

Formally, the composition of the pension formula can be summarized as given in the following box.

The Pension Formula

$P = P1 + P2 + P3 + P4,$ where $P1 = p1 * TCI$

$P2 = (AGE + CY - p2\_1) * p2\_2 * TCI,$ if $AGE + CY > p2\_1$

$P3 = min(40, QY) / 40 * p3 * SMI$

$P4 = min(40, QY) / 40 * 0.025 * SMI$

Disability pensions are calculated in the same way as old age pensions. Yet, in order to ensure that recipients of disability pensions receive an adequate income, the period taken into account for the pro rata and flat rate enhancements are extended to the age of 55 and 65, respectively (special pro rata and flat rate enhancements). The amount of the pro rata enhancement is derived from a notional salary corresponding to the average of the monthly salaries on which actual contributions have been paid.

The surviving spouse's pension comprises three quarters of the pro rata enhancement, including any incremental or special enhancement, as well as the entire flat rate and end-of-year allowance of the pension that the deceased person has been or would have been entitled to. Abatement provisions apply if the surviving spouse's total income exceeds a fixed ceiling. The surviving child's pension comprises one quarter of the pro rata enhancement, again including any incremental or special enhancement, one third of the flat rate component and one third of the end-of-year allowance.

Indexation of pensions

Two kinds of indexation are applied. While the revaluation mechanism concerns new pensions, the price indexation and readjustment mechanisms relate to pensions in payment.

For the initial calculation, new pensions are revaluated with respect to price evolution (full revaluation) and real wage evolution (revaluation up to the fourth year preceding entitlement). Pensions in payment are indexed to price evolution in a non-periodic way each time prices increase by more than 2.5%, with reference to the price level at the time of the previous application. Moreover, as long as revenue from contributions exceeds the system's expenditure, pensions in payment are fully readjusted to real wage evolution (with respect to the second year preceding the evaluation date) at an annual pace. As soon as the above condition is not satisfied, the readjustment mechanism is to be reduced by at least 50% if not cancelled.

Financing of the general pension scheme

The funding of the general pension scheme is based on a system of division into ten-year coverage periods with mandatory formation of a reserve fund exceeding one and a half times the total amount of annual pension expenditure. The contribution rate is set at the beginning of each ten-year period at a level that shall guarantee the funding of the scheme throughout the period. After 5 years however, the system's financial situation is verified, and the global rate may be increased for a new period of 10 years if necessary.

The contribution rate, half of which is payable by the employer and half by the employee, amounts to 16% of the gross contributory income. The central government contributes as well, amounting to a further 8% of the gross contributory income. Income from contributions is currently running ahead of expenditure on benefits, and the level of contribution-based income, amounting to 24% of the contributions base, is around 2% in excess of what would be required by a straightforward burden-sharing system. The resulting surplus is assigned to the pension fund reserve.

The key task of the reserve fund is to optimize the way in which the scheme's reserve is managed and to achieve investment security while minimizing the risk inherent in the financial markets.

1.1.2 Special pension schemes

The public sector includes the civil service, Luxembourg national railways, local authorities as well as public institutions whose staff is subject to a special pension scheme differing from the general scheme. Since the public pension system has been reformed in 1999, there exist two distinct pension schemes for the public sector.

On one hand, the original scheme, now known as the transitional special pension scheme, concerns civil servants and persons treated as such who were in post on 31 December 1998 or had been appointed by that date. Here, pension benefits are calculated based on the final salary earned by the civil servant at a reference replacement rate of 83.33%. For years of service after 1 January 1999, the latter is lowered in stages from 83.33% to 72%. Pensions awarded prior to the entry into force of the new law were not affected by the 1999 reform.

On the other hand, the new special pension scheme essentially corresponds to the general pension scheme, diverging only in a few selected procedural and funding arrangements. It applies to civil servants who entered the public service after 31 December 1998. The new special pension scheme retains the status of a special scheme, but it is based on the same principles as the general scheme for the private sector with the exception of the absence of an income ceiling for the assessment of contributions.

Pensions awarded under the transitional and new special schemes are paid by the central government. Members of both schemes contribute at the rate of 8% of the gross contributory income.

1.1.3 Supplementary pension schemes

The law provides for a statutory framework designed to protect the rights of employees and to put the various supplementary pension schemes on the same fiscal footing. These schemes are either internally funded by companies through provisions in the balance sheet or externally funded in the form of a pension fund or group policy.

The legislative act in question applies to all supplementary pension schemes established or giving rise to payouts of capital sums or annuities after its entry into force. It concerns supplementary schemes established by a company for all of its employees or for certain categories of its employees. However, promises made to individual members of staff are not covered.

Each company is free to establish one or more supplementary pension schemes and to determine their organizational structure, the conditions of membership, the funding arrangements, the level of benefits, the ways in which benefits are assigned, and the rules governing the amendment and termination of the scheme.

1.1.4 Individual pension plans

A pension plan is a contract between an insurer and an individual. From a fiscal point of view, the cost of premiums paid into a pension plan is tax-deductible under the heading of special expenses.

As for membership, the scheme is accessible to all taxpayers residing in Luxembourg as well as to non-residents who opt to be treated in the same way as residents for tax purposes, on condition that at least 90% of their total earned income from domestic and foreign sources is taxable in Luxembourg.

1.1.5 Social assistance

Unlike the general pension scheme, which is an instrument of social security based on solidarity between people in different income brackets and between generations, the minimum guaranteed income is defined as a measure of social assistance provided by the public authorities to individuals with insufficient financial resources. It is a universal and subjective right and it is non-discretionary. Contrary to other countries, there is no distinction made between working age adults and retired adults in Luxembourg.

Currently, the minimum guaranteed income amounts to about 72% of the social minimum income, and in general, it is indexed to price evolution in the same way as pensions. Social assistance benefits are at the charge of central government.

1.2 RECENT REFORMS INCLUDED IN THE PROJECTION

No reforms have been enacted since the last projection exercise.

1.3 "CONSTANT POLICY" ASSUMPTIONS USED IN THE PROJECTION

No particular constant policy assumptions have been implemented.

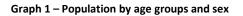# 2 OVERVIEW OF THE DEMOGRAPHIC AND LABOUR FORCE PROJECTIONS

2.1 DEMOGRAPHIC DEVELOPMENT

The new population projections provided by EUROSTAT expect the resident population of Luxembourg to almost double throughout the projection period, amounting to just above 1 million in 2070. As can be seen in Table 3, the expected population growth rate is the highest in the beginning of the projection, which means that the resulting employment growth rates will also assume their maxima during the first projected years.

Table 3 - Main demographic variables evolution

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Population (thousand)	583	635	760	865	941	995	1 037	2070
Population growth rate	2.3	2.1	1.6	1.1	0.7	0.5	0.4	2016
Old-age dep. ratio (pop65/pop15-64)	20.6	21.7	26.9	32.9	38.5	44.6	48.9	2070
Ageing of the aged (pop80+/pop65+)	28.0	27.8	26.0	29.0	34.7	36.3	39.9	2070
Men - Life expectancy at birth	79.2	80.0	81.5	82.8	84.1	85.3	86.4	2070
Men - Life expectancy at 65	18.5	19.0	20.0	20.9	21.8	22.7	23.5	2070
Women - Life expectancy at birth	84.6	85.3	86.6	87.8	88.9	89.9	90.9	2070
Women - Life expectancy at 65	22.4	22.9	23.8	24.7	25.6	26.4	27.1	2069
Men - Survivor rate at 65+	87.3	88.3	89.9	91.3	92.5	93.6	94.5	2070
Men - Survivor rate at 80+	59.3	61.8	66.4	70.6	74.3	77.6	80.5	2070
Women - Survivor rate at 65+	93.1	93.6	94.5	95.3	96.0	96.5	97.0	2070
Women - Survivor rate at 80+	75.2	77.0	80.2	83.0	85.5	87.6	89.3	2070
Net migration	10.8	10.2	8.7	7.0	5.0	4.5	4.0	2016
Net migration over population change	0.8	0.8	0.7	0.8	0.8	0.9	1.1	2070

In comparison with the two previous projection exercises, it is noted that, due to a downward revision of the assumption on net migration with respect to the previous round, the population develops in a more conservative way than in the 2015 projection, while still exceeding the growth behaviour reported in 2012.

Graph 1 – Population by age groups and sex

It is clear that the above figures already set the tone in view of the outcome of the pension expenditure projections that is to be expected. Indeed, since more and more pensioners will have to be supported by the active population, Luxembourg's pension schemes will be subject to an increasing amount of pressure under the no-policy-change assumption.

2.2 LABOUR FORCE

Since the 2012 reform did not affect legislated retirement ages and no explicit linkage with evolution of life expectancy is implemented, they remain constant throughout the projection period. Thus, no major variations in participation and employment rates for older workers are reported.

Table 4 – Participation rate, employment rate and share of workers for the age groups 55-64 and 65-74

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Labour force participation rate 55-64	42.4	44.2	42.4	42.9	43.0	42.1	42.5	2019
Employment rate for workers aged 55-64	40.7	42.7	41.2	41.6	41.8	40.9	41.3	2019
Share of workers aged 55-64 on the labour force 55-64	95.9	96.5	97.0	97.1	97.1	97.2	97.2	2060
Labour force participation rate 65-74	2.2	3.0	4.4	4.1	4.1	4.0	3.9	2029
Employment rate for workers aged 65-74	2.2	3.0	4.4	4.1	4.1	4.0	3.9	2029
Share of workers aged 65-74 on the labour force 65-74	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2032
Median age of the labour force	39.0	39.0	39.0	40.0	40.0	39.0	39.0	2034

For both men and women, the average effective exit age behaves in line with what could be expected from the above explanations (Table 5 and Table 6). However, the average length of the contributory period is expected to increase considerably for both sexes. As will be explained in more detail in Section 3.3, this is related with incomplete careers in Luxembourg of migrant and cross-border workers, which will become more and more complete as new entrants to the labour force will remain in Luxembourg's labour market for their entire career. Although the last reform introduced an annual decrease of the accrual rates in order to reduce pension expenditure, it is expected that the longer contribution periods will counterbalance this effect.

Table 5 – Labour market effective exit age and expected duration of life spent at retirement - MEN

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Average effective exit age (CSM) (II)	60.4	60.4	60.4	60.4	60.4	60.4	60.4	2054
Contributory period	30.6	30.3	31.5	34.6	36.3	37.2	37.1	2062
Duration of retirement	22.8	23.1	24.2	25.2	26.2	27.1	28.0	2070
Duration of retirement/contributory period	0.7	0.8	0.8	0.7	0.7	0.7	0.8	:
Percentage of adult life spent at retirement	35.0	35.2	36.3	37.3	38.2	39.0	39.8	2070
Early/late exit	7.5	6.2	4.1	4.0	4.1	3.6	4.3	2018

Table 6 – Labour market effective exit age and expected duration of life spent at retirement - WOMEN

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Average effective exit age (CSM) (II)	60.0	60.1	60.1	60.1	60.1	60.1	60.1	2045
Contributory period	32.2	31.0	32.6	35.1	36.6	37.3	37.1	2061
Duration of retirement	27.0	27.3	28.4	29.3	30.2	31.1	31.9	2070
Duration of retirement/contributory period	0.8	0.9	0.9	0.8	0.8	0.8	0.9	:
Percentage of adult life spent at retirement	39.1	39.4	40.3	41.0	41.8	42.5	43.1	2070
Early/late exit	8.1	8.0	4.8	4.6	4.5	4.0	4.8	2019

The reported increases in life expectancy together with the constant retirement ages yield an increase in the expected duration of retirement. Thus, pensions will have to be paid for a longer period, which will have a negative impact on the finances of the pension system.

3 PENSION PROJECTION RESULTS

3.1 EXTENT OF THE COVERAGE OF THE PENSION SCHEMES

The coverage of the pension projection model is close to 100%. The model includes public pension expenditure from the general pension scheme of the private sector (ESSPROS scheme 3) and the special pension schemes of the public sector (ESSPROS schemes 17, 18 and 20). However, all special public schemes are merged into a unique scheme. Expenditure items include early old age, old age, disability, and survivor pension benefits. In addition, projections do include a minimum pension provision guaranteed in the context of the pension schemes.

Table 7 - Eurostat (ESSPROS) vs. Ageing Working Group definition of pension expenditure (in % of GDP)

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
1 Eurostat total pension expenditure	8.3	8.6	9.6	9.2	9.2	9.6	9.6	9.3
2 Eurostat public pension expenditure	8.3	8.6	9.6	9.2	9.2	9.6	9.6	9.3
3 Public pension expenditure (AWG)	8.4	8.5	9.5	9.2	9.2	9.5	9.3	9.0
4 Difference (2) - (3)	-0.1	0.1	0.1	0.0	0.0	0.1	0.3	0.3

The high level of pension provision from public pensions leaves only a limited need for supplementary schemes. Occupational pension schemes are voluntary for employees and have developed mainly in foreign or very large industrial and commercial companies, as well as in the banking sector. In addition, until now, no detailed information is available neither on occupational pension schemes nor on individual private pensions. For both reasons, supplementary pension expenditures are excluded from the projections.

Apart from minimum pension provision, social assistance expenditure to people in the retirement age amounts to less than 0.1% of GDP and is not included in the projections.

3.2 OVERVIEW OF PROJECTION RESULTS

The expected development of public pension expenditure shows a steady increase between 2016 and 2070. Starting at roughly 9.0% of GDP, it will reach about 17.9% of GDP at the end of the projection horizon (Table 8).

Table 8 - Projected gross and net pension spending and contributions (in % of GDP)

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Gross public pension expenditure	9.0	9.0	10.2	11.5	13.0	16.0	17.9	2070
Net public pension expenditure	7.7	7.6	8.6	9.8	11.0	13.6	15.2	2070
Public pension contributions	9.5	9.2	9.2	9.3	9.4	9.3	9.3	2016

The essential driving force for expenditure comes from old age and early pensions (Table 9). Indeed, because of the formidable economic growth of the country over the last 30 years, the private sector showed a huge increase of scheme members from 1980 onwards. These former active contributors get pension beneficiaries once they become eligible for retirement by 2020. In contrast to the previous projection exercise, the resulting considerable increase in public expenditure is less counterbalanced by the assumed population growth, which, being favorable to employment growth, impacts the GDP growth.

Table 9 - Projected gross public pension spending by scheme (in % of GDP)

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*	*Peak year*
Total public pensions	9.0	9.0	10.2	11.5	13.0	16.0	17.9	2070
Of which								
*Old age and early pensions**	6.7	6.7	7.7	8.9	10.1	12.9	14.9	2070
Disability pensions	0.7	0.8	0.9	0.9	1.1	1.2	1.1	2058
Survivor pensions	1.6	1.6	1.6	1.7	1.8	1.9	1.9	2070

* Old age and early pensions are entirely earnings-related

3.3 DESCRIPTION OF THE MAIN DRIVING FORCES BEHIND THE PROJECTION RESULTS AND THEIR IMPLICATIONS FOR MAIN ITEMS FROM THE PENSION QUESTIONNAIRE

In Luxembourg, the pressure on public pension spending comes from changes in the dependency ratio of the pension system. Over the projection period, the support ratio (Table 12), i.e. the number of contributors per pensioner, is decreasing so that less and less contributors have to support more and more pensioners.

The standard decomposition of the ratio of public pension expenditure to GDP into the dependency, coverage, benefit ratio, employment rate and labour intensity is not significant in the case of Luxembourg public pension projections. As the share of cross-border workers in employment is supposed to stay above 40% over the whole projection period, pure demographic components as well as labour force considerations, essentially focused on resident population, do only partially capture the expected impacts. In order to make this kind of analysis meaningful for Luxembourg, the decomposition is therefore limited to two components, namely the dependency ratio and the benefit ratio.

Table 10 - Factors behind the change in public pension expenditures between 2016 and 2070 (in % of GDP)

	2016-20	2020-30	2030-40	2040-50	2050-60	2060-70	2016-70
Public pension expenditure	-0.1	1.2	1.4	1.4	3.0	2.0	8.9
Dependency ratio*	0.0	1.3	1.4	1.5	2.9	2.0	9.2
Benefit ratio**	0.0	-0.1	-0.1	0.0	0.1	0.0	-0.1
Residual	0.0	0.0	0.0	0.0	0.0	0.0	-0.1

* ratio between pensioners and contributors
** ratio between pension expenditure divided by pensioners and GDP divided by contributors

The reduced decomposition above clearly shows that the pressure on the pension scheme almost exclusively results from the increasing number of pensioners in comparison to the number of contributors (Table 10). On the financial side, as will be seen next, opposing trends are cancelling each other out.

For a better understanding of the reported progress of the benefit ratio and the replacement rate (Table 11), it is convenient to disaggregate residents and non-residents.

Table 11 - Replacement rate with respect to the average economic wage (RR), benefit ratio (BR) and coverage (in %)

	2017	2020	2030	2040	2050	2060	2070
Public scheme old-age earnings related (BR)	58%	60%	58%	56%	56%	56%	55%
Public scheme old-age earnings related (RR)	73%	66%	61%	64%	62%	64%	63%
Coverage	100%	100%	100%	100%	100%	100%	100%

Considering resident workers (Graph 2, left part), it is noted that both indicators decrease until the early 2050s and remain roughly constant thereafter. Mainly, this is a direct consequence of the annual decreases in the accrual rate introduced by the 2012 reform. In the beginning of the projection period, this effect is even more pronounced since the average working career in Luxembourg of new pensioners declines, which is a corollary of the growing proportion of migrants in the resident workforce. Careers become longer from the late 2020s onwards as migrants entering the national labour market at a young age stay there until retirement, whence the reform effect is slightly counterbalanced during these years.

Graph 2 – Evolution of benefit ratio and replacement rate – Resident workers (left) and non-resident workers (right)

In contrast, the benefit ratio and the replacement rate increase for non-resident workers (Graph 2, right part). Here, pensioners present on average a low career length in Luxembourg in the beginning of the projection period since they spent a significant part of their working career abroad. In the long run, it is assumed that cross border workers, who enter the labour market at young ages, will stay in the national labour market until retirement. Hence, the resulting strong increase in the average contributory period is the main driver behind the behaviour of both indicators, thus surpassing the attenuating effect of the reform.

The dynamics of the projection are such that the number of pensioners will increase pronouncedly in the 2020s and early 2030s. This mainly due to fact that present migrant and cross-border workers get eligible to pension entitlements over this period (Table 12). The support ratio evolution from 2040 onwards is linked to ageing phenomena.

Table 12 - Number of pensioners and contributors in the public pension scheme (in 1000) and related support ratio (in %)

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Number of pensioners	191.1	213.6	288.1	355.6	418.6	518.4	592.6
Number of contributors	435.5	488.0	575.6	623.7	650.1	659.0	669.5
Support ratio	2.3	2.3	2.0	1.8	1.6	1.3	1.1

The proportion of pensioners by age class does not change significantly over the projection period, which is consistent with the constant participation rate profile over the projection period (Table 13, Table 14). Over the period 1980-1995 the average entry age to the pension scheme increased substantially from around 17 to 21. Thus it has to be expected that in the long run less people are eligible for early age retirement at age 57 (40 contributory years, see Section 1.1.1). Current new retirees, due the fact that they present over 40 contributory years since they started their professional career on average at age 17, are eligible for early retirement at age 57. Future retirees will on average only present 37 contributory years at that age so that they are not eligible for early retirement at age 57. Hence the relative amount of pensioners aged 55-59 is reported to decrease.

Table 13 - Ratio of pensioners (all schemes) to the sum of pensioners and contributors by age group

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
0-54	3%	3%	3%	4%	4%	3%	3%
55-59	28%	22%	24%	23%	21%	21%	21%
60-64	79%	80%	80%	82%	85%	89%	88%
65+	100%	100%	100%	100%	100%	100%	100%

Table 14 - Ratio of female pensioners (all schemes) to the sum of pensioners and contributors by age group

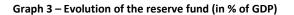|	*2016*	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
0-54	4%	4%	5%	5%	6%	5%	4%
55-59	31%	26%	27%	24%	22%	24%	22%
60-64	78%	83%	83%	85%	89%	92%	91%
65+	100%	100%	100%	100%	100%	100%	100%

As explained above, the mixed impact of the increased contributory periods of resident female and cross-border contributors on the total contributory period yields an increase from on average 30 years presently to about 37 years in 2070). This and the amplified number of new pension beneficiaries are the main driving forces of new public pension expenditure over the projection period (Table 15).
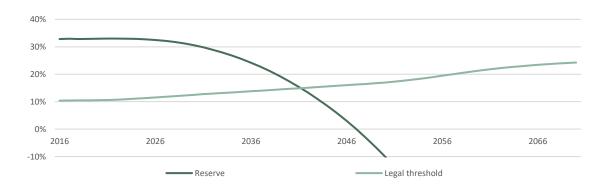
Table 15 - Projected and disaggregated new public pension expenditure (old-age and early earnings-related pensions)

	2017	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
I Projected new pension expenditure (millions EUR)	262.5	235.6	471.8	682.2	1204.9	2361.9	2794.5
II. Average contributory period	31.2	30.5	31.9	34.9	36.4	37.3	37.1
III. Monthly average pensionable earnings	5426.0	5436.4	6962.2	9939.6	13498.4	19169.0	27204.7
IV. Average accrual rates (%)	1.8	1.8	1.7	1.7	1.6	1.6	1.6
V. Sustainability/Adjustment factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VI. Number of new pensions ('000)	7.1	6.6	10.2	9.8	12.7	17.2	14.4
VII Average number of months paid the first year	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Monthly average pensionable earnings / Monthly economy-wide average wage	1.3	1.2	1.1	1.1	1.1	1.1	1.1

3.4   FINANCING OF THE PENSION SYSTEM

As explained in Section 1.1.1, the general pension scheme is primarily financed through contributions and supplementary revenue generated by the reserve fund. The assets of the scheme currently amount to about 33% of GDP. They are projected to increase until the early 2030s and decline afterwards. As percentage of GDP however, the peak is attained in the early 2020s. After 2040, assets are expected to fall below the legal threshold of 1.5 times the annual pension expenditure, and around 2050, they will be exhausted.

Graph 3 – Evolution of the reserve fund (in % of GDP)

3.5   SENSITIVITY ANALYSIS

Table 16 provides an overview of the impact of the different alternative scenarios.

The higher life expectancy scenario increases expenditure pressure on the pension schemes as no demographic calibration mechanism is included in the pension formula.

In the higher and lower TFP scenarios, the deviation from the baseline scenario only becomes visible in the medium term. Indeed, a resulting change in the productivity assumption has an impact on pensions in payment by means of the readjustment mechanism (indexation to real wage growth, see Section 1.1.1) and on GDP. Now, the readjustment mechanism is to be reduced by 50% from the mid-2020s onwards. This yields that pensions and the GDP do not grow at similar rates anymore afterwards, and the deviation from the baseline scenario becomes more and more visible.

The higher and lower employment rate scenarios have an immediate impact since they mainly act on the denominator and an increased/decreased level of GDP leading to a lower/higher ratio of pension expenditure to GDP. In fact, as labour input increases, whereas pension expenditure roughly remains unchanged, the ratio of expenditures to GDP decreases slightly in the medium term. It is only towards the end of the projection period where employees affected by the assumed alteration of the employment rates retire and hence cause the numerator to deviate from the baseline as well, which leads to a cancellation of the above denominator effect.

A higher employment rate of older workers leads to a constant decrease of the expenditure to GDP ratio in the medium term due to a constant increase of retirement age and a continuous increase of employment over the same period.

The higher and lower migration scenarios are similar to the respective employment scenarios, although considerably more pronounced. Indeed, migration directly affects the population that the employment assumptions are deduced from.

Table 16 - Public pension expenditure under different scenarios (p.p. deviation from the baseline)

	2016	*2020*	*2030*	*2040*	*2050*	*2060*	*2070*
Public Pension Expenditure							
Baseline	**9.0**	**9.0**	**10.2**	**11.5**	**13.0**	**16.0**	**17.9**
Higher life expectancy (2 extra years)	0.0	0.0	0.1	0.1	0.2	0.3	0.5
Higher TFP (+0.25 pp.)	0.0	0.0	0.0	-0.2	-0.6	-0.9	-1.2
Lower TFP (-0.25 pp.)	0.0	0.0	0.0	0.2	0.6	1.0	1.3
Higher employment rate (+2 pp.)	0.0	0.0	-0.2	-0.3	-0.3	-0.2	-0.1
Lower employment rate (-2 pp.)	0.0	0.0	0.3	0.4	0.4	0.3	0.1
Higher emp. of older workers (+10 pp.)	0.0	-0.1	-0.5	-0.6	-0.7	-0.6	-0.2
Higher migration (+20%)	0.0	-0.3	-0.8	-1.3	-1.7	-1.6	-1.4
Lower migration (-20%)	0.0	0.3	1.0	1.8	2.4	2.4	2.0
Lower fertility	0.0	0.0	0.0	0.1	0.6	1.4	2.4
Risk scenario	0.0	0.0	0.2	0.4	0.5	0.6	0.6
Policy scenario: linking retirement age to increases in life expectancy	0.0	-0.2	-0.4	-0.8	-1.2	-2.0	-1.8

In turn, the lower fertility scenario can be considered as a shifted lower employment scenario. Changes in the fertility assumption affect employment in the medium term, when former new-borns start to work. This leads to a phasing in of the denominator effect explained above because, clearly, pension expenditure is barely affected at that point.

The risk scenario behaves just like the lower TFP scenario with a slightly earlier impact, caused by an earlier assumed deviation from baseline TFP.

Finally, a significant downward deviation from the baseline is observed in the policy scenario. Here, the linking of the retirement age to increases in life expectancy induces a considerable reduction of pension expenditure. In addition, a slightly more pronounced growth of GDP, resulting from assumed increases in employment growth, induces a supplementary minor denominator effect.

3.6 DESCRIPTION OF THE CHANGES IN COMPARISON WITH THE 2006, 2009, 2012 AND 2015 PROJECTIONS

Comparing previous and current projection exercises, the decomposition of the increase of public pension expenditure as share of GDP over the respective projection period into the dependency and benefit ratio effects (Table 17) clearly shows that, in each projection exercise, the main driving force behind the reported expenditure increases is the change in the dependency ratio.
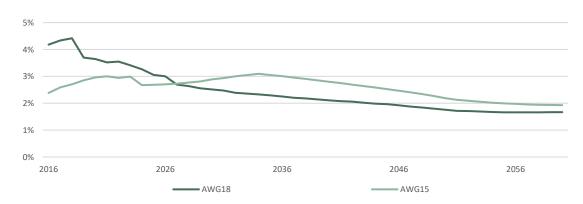
Table 17 – Average annual change in public pension expenditure to GDP during the projection period under the 2006, 2009, 2012 and 2015 projection exercises

	pp. change*	dependency ratio	benefit ratio	residual
2006	7.7	5.6	1.8	0.2
2009	13.5	11.1	1.9	0.5
2012	8.8	9.7	-0.8	-0.1
2015	4.0	3.6	0.3	0.1
2018	8.9	9.2	-0.1	-0.1

* Between 2010 and 2050 for the 2006, 2009 and 2012 projections, between 2013 and 2060 for the 2015 projections, between 2016 and 2070 for the 2018 projections.

A closer look at the changes in the dependency ratio between the different exercises reveals that they are the outcome of varying economic growth rate assumptions over the respective projection periods. For example, average economic growth rates evolved from 2.0% in the 2012 exercise up to 2.6% in 2015 and back down to about 2.3% in the current projections. At comparable productivity assumptions, these changes are induced by corresponding revisions of the assumed employment growth rates, which, in turn, are directly affected by population growth.

In the 2006 and 2009 projection exercises, a portion of the increase in public pension expenditure comes from an increasing benefit ratio, because contributory careers of people eligible for pension benefits become more and more complete throughout the respective projection. As can be seen in Table 15, this phenomenon is also reported in the current projection exercise. However, in the current projection as well as in those from 2012 and 2015, this effect is counterbalanced by the partial readjustment of pensions to real wage evolution and the annually decreasing accrual rate introduced in the 2012 pension reform.

Towards a more detailed analysis of the differences in pension expenditure as a share of GDP between the last and current projection exercises, it is customary to have a closer look at the projected GDP growth rates. Indeed, Graph 4 reveals that they have been revised significantly in the sense that they are assumed to surpass the growth rates of the 2015 exercise during the first 15 projection years, while evolving underneath the previous rates afterwards.

Graph 4 – Evolution of GDP growth between 2016 and 2060 – Current and previous projections

The decomposition of the difference in pension expenditure as a share of GDP between the last and current projection exercises (Table 18) reveals that the change in the macroeconomic assumptions discussed above has a major impact on the development of the figures.

Table 18 – Decomposition of the difference between 2015 and the new public pension projection (in % of GDP)

	2016	2020	2030	2040	2050	2060
Ageing report 2015	9.9	10.5	11.9	12.6	12.4	13.4
Improvement in the coverage or in the modelling	*0.1*	*-0.2*	*0.0*	*-0.3*	*0.0*	*0.1*
Change in assumptions	*-1.0*	*-1.4*	*-1.7*	*-0.8*	*0.5*	*2.5*
New projection	9.0	9.0	10.2	11.5	13.0	16.0

Indeed, in absolute terms, pension expenditure is expected to remain rather stable when compared with the 2015 figures, in particular during the first half of the projection period. In turn, the denominator effect resulting from the upward revision of GDP growth can be easily deduced from the third line in the above table. Indeed, pension expenditure as a share of GDP shows a positive growth right from the start in the last exercise but remains almost constant in the beginning of the current projections. Later, when the 2015 growth rates catch up and even exceed the new ones, the reported expenditure figures behave in line. The relative growth is even more pronounced from 2050 onwards when the stronger economic growth from the first years starts to manifest itself on the pension side.

4   DESCRIPTION OF THE PENSION PROJECTION MODEL AND ITS BASE DATA

4.1   INSTITUTIONAL CONTEXT

The General Inspectorate of Social Security (Inspection générale de la sécurité sociale – IGSS) uses a customized version of the International Labour Organization (ILO) generic pension modelling tool to perform the financial projections of the pension schemes. In order to take account of the particularities of the labour market in Luxembourg in terms of a high proportion of cross-border workers, the ILO modelling tool has been adapted to include dimensions such as residency status and employment status (beyond the general breakdown by age, sex and benefit type). The model thus makes a difference between total labour force and 'national' labour force.

As explained in Section 1.1.1, the funding of the general pension scheme is based on a system of division into ten-year coverage periods. Article 238 of the Code of Social Security states that "the global contribution rate is to be fixed for each coverage period based on a technical report and accompanying actuarial forecasts established by the IGSS". Furthermore, "in the middle of each coverage period, the IGSS provides an actualization of the report and the forecasts". In this context, the tool is used by the IGSS to provide for a regular evaluation of the financial situation of the general pension scheme.

4.2   ASSUMPTIONS AND METHODOLOGIES APPLIED

The modified ILO pension model includes two components. A demographic component projects the number of contributors and pensioners, and a financial component evaluates income and expenditure of the pension systems. All model components are calibrated in order to comply with AWG assumptions.

Fertility rate, life expectancy, and migration are in line with the population projections provided by EUROSTAT. In turn, AWG employment growth assumptions are used for the projections based on national account labour series.

The total number of civil servants is supposed to increase in line with general employment. Since civil servants schemes apply the same pension formula as the general pension scheme from 1999 onwards, the relative share of civil servants within the employed does not have a major impact on pension expenditure in the medium and long run.

Age and career length specific earning profiles are used to compute total economic wage levels. Earning profiles are kept constant over the projection period. AWG labour productivity assumptions are applied to model real wage growth.

4.3   DATA USED TO RUN THE MODEL

Projections are based on individual register data available in the data warehouse at the IGSS. Based on the compulsory membership of people to the national social protection system, individual administrative data is available in common operational files of the Social security institutions in Luxembourg.

Main administrative data relates to protected people monthly income declarations, which are at the basis of the computation of the contributions. Other important administrative data is related to monthly benefits paid out by the institutions. Both sources are essential to gather information on disposable income of protected people.

4.4   REFORMS INCORPORATED IN THE MODEL

The 2012 pension reform has been fully incorporated in the model.

4.5   GENERAL DESCRIPTION OF THE MODEL

The national pension model used for providing actuarial estimates of future expenditure and contributions base of the general and special pension schemes in Luxemburg in line with the economic and demographic framework used in the AWG projections exercise is a standard deterministic cohort-based pension projection model. It is a fully customized version of the ILO generic pension modelling tool and it closely complies with local social insurance legislation in Luxembourg and captures national pension peculiarities.

It is based on macro simulation techniques, whence the projections rely on grouped data. Under the model, each status of an insured person (active person, inactive person, and pensioner) is explicitly modelled, distinguishing new persons from initial stock, and associated values (average salary, average pension, etc.) are projected year by year.

The national pension model satisfies the following key methodological features:

- The model is based on standard actuarial mathematics for social security schemes and on actuarially assumed transition probabilities (mortality rates, disability rates, retirement rates, etc.) which are used to map the transition of an insured person (active person, inactive person and pensioner) from a given year onto the next year's status.

- The development of the active insured population is linked to the evolution of total employed population and earnings assumptions, which, in turn, are explicitly linked to the assumptions on macroeconomic growth and the wage share of GDP.

- The active insured population as well as all pensioners are disaggregated into different population groupings, depending on gender (males/females), employment category (public/private), and residency (residents/non-residents).

The model is written in the LIAM2 microsimulation developing environment. As a declarative programming tool, LIAM2 offers a clean and simple structure that allows developers to construct complex yet readable models.

In terms of structure, the model is organized as follows:

- The input files regroup all exogenous data that is needed to run the model. Common demographic and macro-economic assumptions are stored by projection year. For each population grouping, separate input files contain the initial population data for the base year as well as distributions of, e.g., average insurable salaries, past contributory income, or entry rates into disability.

- After an initialization step, where input files are read and all base year tables are being established, the model proceeds with a year-by-year projection of the relevant demographic and financial variables.

- In the end of every projection step, the main results are written to specific output tables. At an aggregate level, the total number of contributors and the respective amount of contributions are provided as well as the total number of pensioners and the corresponding amount of pension benefit expenditure. Additional result files provide a disaggregation of the above output results at a detailed level by population grouping, (sex and residency status) age, and categories of pension benefits.

5   APPENDIX: COMMON AGREED REPORTING TABLES

TABLE1		Qualifying condition for retiring	2016	2020	2030	2040	2050	2060	2070
Qualifying condition for retiring with a full pension	Minimum requirements	Contributory period - men	:	:	:	:	:	:	:
		Retirement age - men	:	:	:	:	:	:	:
		Contributory period - w omen	:	:	:	:	:	:	:
		Retirement age - w omen	:	:	:	:	:	:	:
	Statutory retirement age - men		:	:	:	:	:	:	:
	Statutory retirement age - w omen		:	:	:	:	:	:	:
Qualifying condition for retirement WITHOUT a full pension	Early retirement age - men		:	:	:	:	:	:	:
	Early retirement age - w omen		:	:	:	:	:	:	:
	Penalty in case of earliest retirement age		:	:	:	:	:	:	:
	Bonus in case of late retirement		:	:	:	:	:	:	:
	Minimum contributory period - men		:	:	:	:	:	:	:
	Minimum contributory period - w omen		:	:	:	:	:	:	:
	Minimum residence period - men		:	:	:	:	:	:	:
	Minimum residence period - w omen		:	:	:	:	:	:	:

TABLE 2a	Number of new pensioners by age group - administrative data (MEN)				
Age group	All	Old age	Disability	Survivor	Other (including minimum)
15 - 49	236	0	174	62	0
50 - 54	214	0	203	11	0
55 - 59	1 412	1 116	285	11	0
60 - 64	1 732	1 591	126	15	0
65 - 69	827	804	0	23	0
70 - 74	23	0	0	23	0

TABLE 2b	Number of new pensioners by age group - administrative data (WOMEN)				
Age group	All	Old age	Disability	Survivor	Other (including minimum)
15 - 49	320	0	146	174	0
50 - 54	201	0	148	53	0
55 - 59	725	405	194	126	0
60 - 64	1 066	821	102	143	0
65 - 69	970	775	0	195	0
70 - 74	173	0	0	173	0

TABLE 2c	Number of new pensioners by age group - administrative data (TOTAL)				
Age group	All	Old age	Disability	Survivor	Other (including minimum)
15 - 49	320	0	320	236	0
50 - 54	351	0	351	64	0
55 - 59	2 000	1 521	479	137	0
60 - 64	2 640	2 412	228	158	0
65 - 69	1 579	1 579	0	218	0
70 - 74	0	0	0	196	0

Table 3	Main demographic variables evolution							
	2016	2020	2030	2040	2050	2060	2070	Peak year*
Population (thousand)	583	635	760	865	941	995	1 037	2070
Population grow th rate	2.3	2.1	1.6	1.1	0.7	0.5	0.4	2016
Old-age dependency ratio (pop65/pop15-64)	20.6	21.7	26.9	32.9	38.5	44.6	48.9	2070
Ageing of the aged (pop80+/pop65+)	28.0	27.8	26.0	29.0	34.7	36.3	39.9	2070
Men - Life expectancy at birth	79.2	80.0	81.5	82.8	84.1	85.3	86.4	2070
Men - Life expectancy at 65	18.5	19.0	20.0	20.9	21.8	22.7	23.5	2070
Women - Life expectancy at birth	84.6	85.3	86.6	87.8	88.9	89.9	90.9	2070
Women - Life expectancy at 65	22.4	22.9	23.8	24.7	25.6	26.4	27.1	2069
Men - Survivor rate at 65+	87.3	88.3	89.9	91.3	92.5	93.6	94.5	2070
Men - Survivor rate at 80+	59.3	61.8	66.4	70.6	74.3	77.6	80.5	2070
Women - Survivor rate at 65+	93.1	93.6	94.5	95.3	96.0	96.5	97.0	2070
Women - Survivor rate at 80+	75.2	77.0	80.2	83.0	85.5	87.6	89.3	2070
Net migration	10.8	10.2	8.7	7.0	5.0	4.5	4.0	2016
Net migration over population change	0.8	0.8	0.7	0.8	0.8	0.9	1.1	2070

Table4 4	Participation rate, employment rate and share of workers for the age groups 55-64 and 65-74							
	2016	2020	2030	2040	2050	2060	2070	Peak year*
Labour force participation rate 55-64	42.4	44.2	42.4	42.9	43.0	42.1	42.5	2019
Employment rate for workers aged 55-64	40.7	42.7	41.2	41.6	41.8	40.9	41.3	2019
Share of workers aged 55-64 on the labour force 55-64	95.9	96.5	97.0	97.1	97.1	97.2	97.2	2060
Labour force participation rate 65-74	2.2	3.0	4.4	4.1	4.1	4.0	3.9	2029
Employment rate for workers aged 65-74	2.2	3.0	4.4	4.1	4.1	4.0	3.9	2029
Share of workers aged 65-74 on the labour force 65-74	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2032
Median age of the labour force	39.0	39.0	39.0	40.0	40.0	39.0	39.0	2034

TABLE 5a	Labour market effective exit age and expected duration of life spent at retirement - MEN							
	2017	2020	2030	2040	2050	2060	2070	Peak year
Average effective exit age (CSM) (II)	60.4	60.4	60.4	60.4	60.4	60.4	60.4	2054
Contributory period	30.6	30.3	31.5	34.6	36.3	37.2	37.1	2062
Duration of retirement	22.8	23.1	24.2	25.2	26.2	27.1	28.0	2070
Duration of retirement/contributory period	0.7	0.8	0.8	0.7	0.7	0.7	0.8	:
Percentage of adult life spent at retirement	35.0	35.2	36.3	37.3	38.2	39.0	39.8	2070
Early/late exit	7.5	6.2	4.1	4.0	4.1	3.6	4.3	2018

TABLE 5b	Labour market effective exit age and expected duration of life spent at retirement - WOMEN							
	2017	2020	2030	2040	2050	2060	2070	Peak year
Average effective exit age (CSM) (II)	60.0	60.1	60.1	60.1	60.1	60.1	60.1	2045
Contributory period	32.2	31.0	32.6	35.1	36.6	37.3	37.1	2061
Duration of retirement	27.0	27.3	28.4	29.3	30.2	31.1	31.9	2070
Duration of retirement/contributory period	0.8	0.9	0.9	0.8	0.8	0.8	0.9	:
Percentage of adult life spent at retirement	39.1	39.4	40.3	41.0	41.8	42.5	43.1	2070
Early/late exit	8.1	8.0	4.8	4.6	4.5	4.0	4.8	2019

TABLE 6	Eurostat (ESSPROS) vs. Ageing Working Group definition of pension expenditure (% GDP)							
	2007	2008	2009	2010	2011	2012	2013	2014
1 Eurostat total pension expenditure	8.3	8.6	9.6	9.2	9.2	9.6	9.6	9.3
2 Eurostat public pension expenditure	8.3	8.6	9.6	9.2	9.2	9.6	9.6	9.3
3 Public pension expenditure (AWG)	8.4	8.5	9.5	9.2	9.2	9.5	9.3	9.0
4 Difference (2) - (3)	-0.1	0.1	0.1	0.0	0.0	0.1	0.3	0.3
5 Expenditure categories not considered in the AWG definition, please specify:	:	:	:	:	:	:	:	:
5.1 …	:	:	:	:	:	:	:	:
5.2 …	:	:	:	:	:	:	:	:
5.3 …	:	:	:	:	:	:	:	:

TABLE 7	Projected gross and net pension spending and contributions (% of GDP)							
Expenditure	2016	2020	2030	2040	2050	2060	2070	Peak year*
Gross public pension expenditure	9.0	9.0	10.2	11.5	13.0	16.0	17.9	2070
Private occupational pensions	:	:	:	:	:	:	:	:
Private individual pensions	:	:	:	:	:	:	:	:
Mandatory private	:	:	:	:	:	:	:	:
Non-mandatory private	:	:	:	:	:	:	:	:
Gross total pension expenditure	9.0	9.0	10.2	11.5	13.0	16.0	17.9	2070
Net public pension expenditure	7.7	7.6	8.6	9.8	11.0	13.6	15.2	2070
Net total pension expenditure	7.7	7.6	8.6	9.8	11.0	13.6	15.2	2070
Contributions	2016	2020	2030	2040	2050	2060	2070	Peak year*
Public pension contributions	9.5	9.2	9.2	9.3	9.4	9.3	9.3	2016
Total pension contributions	9.5	9.2	9.2	9.3	9.4	9.3	9.3	2016

TABLE 8	Projected gross public pension spending by scheme (% of GDP)							
Pension scheme	2016	2020	2030	2040	2050	2060	2070	Peak year *
Total public pensions	9.0	9.0	10.2	11.5	13.0	16.0	17.9	2070
of which								
Old age and early pensions:	6.7	6.7	7.7	8.9	10.1	12.9	14.9	2070
Flat component	:	:	:	:	:	:	:	:
Earnings related	6.7	6.7	7.7	8.9	10.1	12.9	14.9	2070
Minimum pensions (non-contributory) i.e. minimum income guarantee for people above 65	:	:	:	:	:	:	:	:
Disability pensions	0.74	0.76	0.86	0.89	1.07	1.22	1.07	2058
Survivor pensions	1.63	1.56	1.59	1.70	1.81	1.89	1.95	2070
Other pensions	:	:	:	:	:	:	:	:
of which								
country-specific scheme 1	:	:	:	:	:	:	:	:
country-specific scheme 2	:	:	:	:	:	:	:	:
country-specific scheme 3	:	:	:	:	:	:	:	:

Note: The standard decomposition of the ratio of public pension expenditure to GDP into the dependency, coverage, benefit ratio, employment rate and labour intensity is not significant in the case of Luxembourg public pension projections. As the share of cross-border workers in employment is supposed to stay above 40% over the whole projection period, pure demographic components as well as labour force considerations, essentially focused on resident population, do only partially capture the expected impacts. In order to make this kind of analysis meaningful for Luxembourg, the decomposition is therefore limited to two components, namely the dependency ratio and the benefit ratio (see Table 10 in Section 3.3).

TABLE 9a	Factors behind the change in public pension expenditures between 2016 and 2070 using pension data (in percentage points of GDP) - pe							
	2016-20	2020-30	2030-40	2040-50	2050-60	2060-70	2016-70	Average annual change
Public pensions to GDP	-0.1	1.2	1.4	1.4	3.0	2.0	8.9	0.165
Dependency ratio effect	0.4	2.1	2.3	1.9	2.1	1.6	10.4	19.2%
Coverage ratio effect	-0.2	-0.5	-0.8	-0.5	0.7	0.5	-0.8	-1.5%
Coverage ratio old-age*	0.0	-0.4	-0.2	-0.6	0.4	2.0	1.2	2.2%
Coverage ratio early-age*	-0.5	1.2	-1.1	1.2	4.4	-2.3	2.9	4.8%
Cohort effect*	-0.1	-1.7	-1.6	-1.3	-2.3	-1.9	-8.9	-17.5%
Benefit ratio effect	-0.2	-0.3	-0.1	-0.1	0.1	0.0	-0.6	-1.0%
Labour Market/Labour intensity effect	-0.1	-0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1%
Employment ratio effect	-0.1	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1%
Labour intensity effect	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1%
Career shift effect	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1%
Residual	0.0	-0.1	-0.1	0.0	0.1	0.0	-0.2	-0.1%

* Sub components of the coverage ratio effect do not add up necessarily.

TABLE 9b	Factors behind the change in public pension expenditures between 2016 and 2070 using pensioners data (in percentage points of GDP) -							
	2016-20	2020-30	2030-40	2040-50	2050-60	2060-70	2016-70	Average annual change
Public pensions to GDP	-0.1	1.2	1.4	1.4	3.0	2.0	8.9	0.165
Dependency ratio effect	0.4	2.1	2.3	1.9	2.1	1.6	10.4	19.2%
Coverage ratio effect	-0.2	-0.5	-0.8	-0.5	0.7	0.5	-0.8	-1.5%
Coverage ratio old-age*	0.0	-0.4	-0.2	-0.6	0.4	2.0	1.2	2.2%
Coverage ratio early-age*	-0.5	1.2	-1.1	1.2	4.4	-2.3	2.9	4.8%
Cohort effect*	-0.1	-1.7	-1.6	-1.3	-2.3	-1.9	-8.9	-17.5%
Benefit ratio effect	-0.2	-0.3	-0.1	-0.1	0.1	0.0	-0.6	-1.0%
Labour Market/Labour intensity effect	-0.1	-0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1%
Employment ratio effect	-0.1	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1%
Labour intensity effect	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1%
Career shift effect	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1%
Residual	0.0	-0.1	-0.1	0.0	0.1	0.0	-0.2	-0.1%

* Sub components of the coverage ratio effect do not add up necessarily.

TABLE 10	Replacement rate at retirement (RR), benefit ratio (BR) and coverage by pension scheme (in %)						
	2016	2020	2030	2040	2050	2060	2070
Public scheme (BR)	52%	54%	53%	52%	52%	53%	52%
Public scheme (RR)	:	57%	55%	56%	55%	58%	56%
Coverage	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Public scheme old-age earnings related	58%	60%	58%	56%	56%	56%	55%
Public scheme old-age earnings related	:	66%	61%	64%	62%	64%	63%
Coverage	65.9	66.4	69.4	71.4	71.9	75.3	78.6
Private occupational scheme (BR)	:	:	:	:	:	:	:
Private occupational scheme (RR)	:	:	:	:	:	:	:
Coverage	:	:	:	:	:	:	:
Private individual scheme (BR)	:	:	:	:	:	:	:
Private individual scheme (RR)	:	:	:	:	:	:	:
Coverage	:	:	:	:	:	:	:
Total (BR)	52%	54%	53%	52%	52%	53%	52%
Total (RR)	:	66%	61%	64%	62%	64%	63%

Note: As the share of cross-border workers in employment is supposed to stay above 40% over the whole projection period, pure demographic components as well as labour force considerations, essentially focused on resident population, do only partially capture the expected impacts. In order to make this kind of analysis meaningful for Luxembourg, the decomposition is therefore limited to three components: the numbers of pensioners and contributors and the support ratio as shown in Table 12 of the country fiche.

TABLE 11	System dependency ratio and old-age dependency ratio						
	2016	2020	2030	2040	2050	2060	2070
Number of pensioners (thousand) (I)	191.1	213.6	288.1	355.6	418.6	518.4	592.6
Employment (thousand) (II)	266.4	294.0	339.8	368.2	383.8	389.0	395.2
Pension System Dependency Ratio (SDR) (I)/(II)	71.7	72.6	84.8	96.6	109.1	133.3	149.9
Number of people aged 65+ (thousand) (III)	83.3	94.8	134.9	180.5	222.3	261.3	289.7
Working age population 15 - 64 (thousand) (IV)	403.9	437.6	500.9	548.0	577.7	585.6	593.0
Old-age Dependency Ratio (ODR) (III)/(IV)	20.6	21.7	26.9	32.9	38.5	44.6	48.9
System efficiency (SDR/ODR)	3.5	3.4	3.1	2.9	2.8	3.0	3.1

Note: The ratios presented in Tables 12a, 12b, 13a, and 13b are not meaningful since the numerator includes resident and cross-border beneficiaries whereas the denominator only includes resident population.

TABLE 12a	Pensioners (public scheme) to inactive population ratio by age group (%)						
	2016	2020	2030	2040	2050	2060	2070
Age group -54	7.4	7.8	8.0	8.9	9.7	8.0	7.4
Age group 55-59	85.0	72.0	77.3	62.0	77.8	87.7	75.7
Age group 60-64	128.6	126.4	135.9	122.3	127.0	194.4	169.8
Age group 65-69	165.1	148.8	139.9	141.4	121.8	164.3	180.9
Age group 70-74	159.4	169.7	134.5	145.6	129.3	128.8	188.3
Age group 75+	162.2	169.4	180.3	164.2	162.5	152.0	156.7

TABLE 12b	Pensioners (public schemes) to total population ratio by age group (%)						
	2016	2020	2030	2040	2050	2060	2070
Age group -54	3.1	3.2	3.3	3.7	4.1	3.4	3.1
Age group 55-59	33.4	28.4	30.7	24.7	30.3	34.5	29.7
Age group 60-64	103.0	95.8	103.4	93.1	96.5	147.8	129.1
Age group 65-69	160.2	142.4	131.5	133.2	114.8	154.8	170.5
Age group 70-74	157.7	167.5	131.4	142.4	126.5	126.0	184.2
Age group 75+	162.2	169.4	180.3	164.2	162.5	152.0	156.7

TABLE 13a	Female pensioners (public scheme) to inactive population ratio by age group (%)						
	2016	2020	2030	2040	2050	2060	2070
Age group -54	7.9	8.6	9.4	10.4	11.1	9.1	8.3
Age group 55-59	61.6	60.1	69.1	55.9	68.9	77.3	66.2
Age group 60-64	94.9	101.1	119.9	110.4	115.7	163.3	143.1
Age group 65-69	132.8	119.9	122.7	127.6	110.9	141.0	153.0
Age group 70-74	129.9	143.9	120.3	136.5	121.6	119.6	163.1
Age group 75+	149.5	160.1	179.4	170.9	171.8	163.4	161.7

TABLE 13b	Female pensioners (public scheme) to total population ratio by age group (%)						
	2016	2020	2030	2040	2050	2060	2070
Age group -54	3.5	3.7	4.0	4.5	4.8	4.0	3.7
Age group 55-59	30.0	28.6	29.9	23.6	28.2	31.9	27.3
Age group 60-64	80.9	82.9	96.4	87.9	91.6	129.3	113.3
Age group 65-69	131.5	117.1	118.5	122.8	106.7	135.5	147.1
Age group 70-74	129.9	143.7	119.3	135.3	120.4	118.5	161.5
Age group 75+	149.5	160.1	179.4	170.9	171.8	163.4	161.7

TABLE 14a	Projected and disaggregated new public pension expenditure (old-age and early earnings-related pensions)						
New pension	2016	2020	2030	2040	2050	2060	2070
I Projected new pension expenditure (millions EUR)	0.0	235.6	471.8	682.2	1204.9	2361.9	2794.5
II. Average contributory period	0.0	30.5	31.9	34.9	36.4	37.3	37.1
III. Monthly average pensionable earnings	0.0	5436.4	6962.2	9939.6	13498.4	19169.0	27204.7
IV. Average accrual rates (%)	1.8	1.8	1.7	1.7	1.6	1.6	1.6
V. Sustainability/Adjustment factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VI. Number of new pensions ('000)	0.0	6.6	10.2	9.8	12.7	17.2	14.4
VII Average number of months paid the first year	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Monthly average pensionable earnings / Monthly economy-wide average wage	0.0	1.2	1.1	1.1	1.1	1.1	1.1

TABLE 14b	Disaggregated new public pension expenditure (old-age and early earnings-related pensions) - MEN						
New pension	2016	2020	2030	2040	2050	2060	2070
I Projected new pension expenditure (millions EUR)	0.0	159.2	298.8	405.5	758.9	1561.3	1831.4
II. Average contributory period	0.0	30.3	31.5	34.6	36.3	37.2	37.1
III. Monthly average pensionable earnings	0.0	5972.2	7400.6	10569.7	14812.8	21047.0	29880.5
IV. Average accrual rates (%)	1.8	1.8	1.7	1.7	1.6	1.6	1.6
V. Sustainability/Adjustment factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VI. Number of new pensions ('000)	0.0	4.1	6.2	5.5	7.3	10.4	8.6
VII Average number of months paid the first year	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Monthly average pensionable earnings / Monthly economy-wide average wage	0.0	1323.4	1175.4	1171.7	1154.1	1170.6	1165.7

TABLE 14c	Disaggregated new public pension expenditure (old-age and early earnings-related pensions) - WOMEN						
New pension	2016	2020	2030	2040	2050	2060	2070
I Projected new pension expenditure (millions EUR)	0.0	76.4	173.0	276.8	446.0	800.6	963.0
II. Average contributory period	0.0	31.0	32.6	35.1	36.6	37.3	37.1
III. Monthly average pensionable earnings	0.0	4580.1	6315.9	9141.2	11727.8	16327.6	23245.8
IV. Average accrual rates (%)	1.8	1.8	1.7	1.7	1.6	1.6	1.6
V. Sustainability/Adjustment factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0
VI. Number of new pensions ('000)	0.0	2.5	4.0	4.3	5.4	6.8	5.8
VII Average number of months paid the first year	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Monthly average pensionable earnings / Monthly economy-wide average wage	0.0	1.0	1.0	1.0	0.9	0.9	0.9

TABLE 15	Revenue from contribution (Millions), number of con		
	Public employees	Private employees	Self-employed
Contribution base	0	0	0
Contribution rate/contribution			
Employer	8%	8%	16%
Employee	8%	8%	
State	8%	8%	8%
Other revenues	Buffer fund of at	Buffer fund of at	Buffer fund of at
Maximum contribution	0	0	0
Minimum contribution	0	0	0

Note: The ratio (I)/(II) presented in Table 16 is not meaningful since the numerator includes resident and cross-border beneficiaries whereas the denominator only includes resident population.

TABLE 16	Revenue from contribution (Millions), number of contributors in the public scheme (in 1000), total employment (in 1000) an						
	2016	2020	2030	2040	2050	2060	2070
Public contribution	5172.4	6342.6	10437.3	16203.6	24029.8	34125.1	49421.6
Employer contribution	1724.1	2114.2	3479.1	5401.2	8009.9	11375.0	16473.9
Employee contribution	1724.1	2114.2	3479.1	5401.2	8009.9	11375.0	16473.9
State contribution	1724.1	2114.2	3479.1	5401.2	8009.9	11375.0	16473.9
Other revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of contributors (I)	435.5	488.0	575.6	623.7	650.1	659.0	669.5
Employment (II)	266.4	294.0	339.8	368.2	383.8	389.0	395.2
Ratio of (I)/(II)	1.6	1.7	1.7	1.7	1.7	1.7	1.7

TABLE17	Public and total pension expenditure under different scenarios (p.p. deviation from the baseline)						
	2016	2020	2030	2040	2050	2060	2070
Public Pension Expenditure							
Baseline	9.0	9.0	10.2	11.5	13.0	16.0	17.9
Higher life expectancy (2 extra years)	0.0	0.0	0.1	0.1	0.2	0.3	0.5
Higher lab. productivity (+0.25 pp.)	0.0	0.0	0.0	-0.2	-0.6	-0.9	-1.2
Lower lab. productivity (-0.25 pp.)	0.0	0.0	0.0	0.2	0.6	1.0	1.3
Higher emp. rate (+2 pp.)	0.0	0.0	-0.2	-0.3	-0.3	-0.2	-0.1
Lower emp. rate (-2 pp.)	0.0	0.0	0.3	0.4	0.4	0.3	0.1
Higher emp. of older workers (+10 pp.)	0.0	-0.1	-0.5	-0.6	-0.7	-0.6	-0.2
Higher migration (+20%)	0.0	-0.3	-0.8	-1.3	-1.7	-1.6	-1.4
Lower migration (-20%)	0.0	0.3	1.0	1.8	2.4	2.4	2.0
Lower fertility	0.0	0.0	0.0	0.1	0.6	1.4	2.4
Risk scenario	0.0	0.0	0.2	0.4	0.5	0.6	0.6
Policy scenario: linking retirement age to increases in life expectancy	0.0	-0.2	-0.4	-0.8	-1.2	-2.0	-1.8
Total Pension Expenditure							
Baseline	9.0	9.0	10.2	11.5	13.0	16.0	17.9
Higher life expectancy (2 extra years)	0.0	0.0	0.1	0.1	0.2	0.3	0.5
Higher lab. productivity (+0.25 pp.)	0.0	0.0	0.0	-0.2	-0.6	-0.9	-1.2
Lower lab. productivity (-0.25 pp.)	0.0	0.0	0.0	0.2	0.6	1.0	1.3
Higher emp. rate (+2 pp.)	0.0	0.0	-0.2	-0.3	-0.3	-0.2	-0.1
Lower emp. rate (-2 pp.)	0.0	0.0	0.3	0.4	0.4	0.3	0.1
Higher emp. of older workers (+10 pp.)	0.0	-0.1	-0.5	-0.6	-0.7	-0.6	-0.2
Higher migration (+20%)	0.0	-0.3	-0.8	-1.3	-1.7	-1.6	-1.4
Lower migration (-20%)	0.0	0.3	1.0	1.8	2.4	2.4	2.0
Lower fertility	0.0	0.0	0.0	0.1	0.6	1.4	2.4
Risk scenario	0.0	0.0	0.2	0.4	0.5	0.6	0.6
Policy scenario: linking retirement age to increases in life expectancy	0.0	-0.2	-0.4	-0.8	-1.2	-2.0	-1.8

Note: The standard decomposition of the ratio of public pension expenditure to GDP into the dependency, coverage, benefit ratio, employment rate and labour intensity is not significant in the case of Luxembourg public pension projections. As the share of cross-border workers in employment is supposed to stay above 40% over the whole projection period, pure demographic components as well as labour force considerations, essentially focused on resident population, do only partially capture the expected impacts. In order to make this kind of analysis meaningful for Luxembourg, the decomposition is therefore limited to two components, namely the dependency ratio and the benefit ratio (see Table 17 in Section 3.6).

TABLE 18	Overall change in public pension expenditure to GDP under the 2006, 2009, 2012 and 2015 projection exercises						
	Public pensions to GDP	Dependency ratio	Coverage ratio	Employment effect	Benefit ratio	Labour intensity	Residual (incl. Interaction effect)
2006 *	7.38	7.18	2.48	-4.38	2.10	:	0.00
2009 **	15.24	8.39	5.23	0.04	1.25	:	0.32
2012 ***	9.44	11.25	0.28	0.06	-2.07	0.06	-0.13
2015****	4.06	6.79	-2.41	-0.28	0.10	0.06	-0.20
2018*****	8.90	10.43	-0.76	-0.06	-0.55	0.06	-0.23

* 2004-2050; ** 2007-2060; *** 2010-2060; **** 2013-2060; *****2016-2070

TABLE 19	Decomposition of the difference between 2015 and the new public pension projection (% of GDP)						
	2016	2020	2030	2040	2050	2060	2070
Ageing report 2015	9.9%	10.5%	11.9%	12.6%	12.4%	13.4%	:
Change in assumptions	-1.0%	-1.4%	-1.7%	-0.8%	0.5%	2.5%	:
Improvement in the coverage or in the modelling	0.1%	-0.2%	0.0%	-0.3%	0.0%	0.1%	:
New projection	9.0%	9.0%	10.2%	11.5%	13.0%	16.0%	: