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What are the consequences of the AWG 2018 projections and hypotheses on pension adequacy?

Simulations for three EU member states

June 2018

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Abstract - In preparation of the 2018 Pension Adequacy Report (PAR), the Social Protection Committee working group on Ageing Issues (SPC WG-AGE) invited member states to use their dynamic microsimulation models to describe the consequences of the Ageing Working Group (AWG) hypotheses and assumptions underlying the 2018 Ageing Report (AR) on pension adequacy using commonly-agreed indicators. This request received a favourable reception from Belgium, Sweden, and Italy.

The next section of this paper describes microsimulation and the models used in this project. Next the AWG scenarios are being presented briefly, after which a selection of the simulation results are presented and discussed.

This report underlies the section 5.1.2. of the 2018 Pension Adequacy Report.

Jel Classification - C1, C5, J11, I32, H55
Keywords - AWG, pension sustainability, pension adequacy, microsimulation

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Executive summary

Pension cost takes up a large part of public expenditures in the EU member states (European Commission, 2015b, Graph 3, page 5), so pensions and pension reforms are a point of focus of the Ageing Working Group (AWG). The Ageing Report wants to map the prospective development of public (pension) expenditures under an "unchanged policy scenario" and identify the main drivers of these expenditures, including demography, labour market developments, and (the reform of) eligibility conditions and benefit formulas in public pensions and other age-related social security systems.

However, the current and prospective adequacy of social security benefits including pensions is also a dimension of social protection that requires and gets attention on the EU level. The Social Protection Committee (SPC) monitors social conditions in the EU. The SPC mandates the SPC Working Group on Ageing Issues (SPC WG-AGE) to prepare a "2018 Pension Adequacy Report" to examine current and projected pension adequacy trends.

Besides using AWG projections on the benefit ratios and extensive analysis of Theoretical Replacement Rates (TRR), the SPC WG-AGE already in its 2012 PAR recognised it could not assess the "extent to which pension systems in Member States will contribute to the goal of reducing the number of people exposed to poverty or social exclusion" (EC, 2012, 137), to add that "if all Member States were able to apply dynamic micro-simulation models to this task, likely scenarios which could offer guidance to policy makers could be constructed." (*op. cit.*, 138). In preparation of the 2018 PAR, microsimulation teams from Belgium, Sweden and Italy use their dynamic microsimulation models to simulate the possible developments of pension adequacy while taking into account the set of economic and demographic projections developed by the AWG, as well as the joint assumption of unchanged policy besides already legislated pension reform. As such, the results of this exercise allow to complement the AWG simulations of pension expenditures in a context of demographic ageing by projections on pension adequacy. The results described in detail in this report were summarised in the section 5.1.2. of the 2018 Pension Adequacy Report

Contrary to the other countries, the cost of pensions shows a continuous increase in Belgium. This is because demographic ageing is stronger than the cost-reducing effects of, among other things, the increasing employment rate and the increase of the average exit age. The latter developments however result in a higher pension benefit after retirement, thus bringing down the poverty risk among pensioners.

In Italy and relative to GDP, pension spending would remain stable at first, then increase until about 2040, after which a strong decrease would set in again. The increase before 2040 would be the result of low productivity growth and the transition of large cohorts into retirement. The subsequent decrease, however, would be the result of the gradual replacement of the stock of pensioners that had earned a benefit under the old Defined Benefit regime by those that have a benefit under the Notionally Defined Contribution regime (NDC) that was implemented in the 1995 and 2011 reforms. The less generous (particularly to intermittent careers) NDC regime would drive the benefit ratio down and may push the poverty risk up.

Gross pension expenditure in Sweden is expected to remain roughly constant relative to GDP, among other things driven by comparably high net immigration. However, the actuarial correction for longevity produced by the adoption of the NDC system in 1996 would drive the benefit ratio down. This decrease would be reinforced by the AWG assumption of a constant labour market exit age and would result in a considerable increase of the poverty risk among the elderly. While Italy has also adopted an NDC scheme, the contemporary implementation of an automatic adjustment of retirement ages to increases in life expectancy is set to counterbalance most of the effect of the actuarial correction. In any event, the performance of the labour market will be crucial in assuring longer, stable careers to older workers, essential to adequate levels of pension in an NDC scheme.

Although the three models used in this project differ in scope and size and have not been developed with a focus on international comparison, this project demonstrates how dynamic microsimulation can be used to bridge the gap between the assessment of pension sustainability and adequacy in comparative perspective. As such, it shows the potential of these simulation techniques in Europe.

Synthèse

Les dépenses de pension représentent une partie importante des dépenses publiques dans les États membres de l'UE (Commission européenne, 2015b, Graphique 3, page 5). C'est pourquoi l'Ageing Working Group (AWG) porte une grande attention aux pensions et aux réformes des pensions. L'Ageing Report décrit l'évolution future des dépenses publiques (de pension) à politique inchangée et en identifie les principales causes sous-jacentes, notamment la démographie, l'évolution du marché du travail, (la réforme des) les conditions d'éligibilité et le calcul des allocations de pension et d'autres systèmes de sécurité sociale liés à l'âge.

Toutefois, l'adéquation actuelle et future des prestations de sécurité sociale, et notamment des pensions, est également un aspect de la protection sociale qui réclame et retient une grande attention à l'échelle de l'UE. Le Comité de la protection sociale (CPS) suit la situation sociale et l'évolution des politiques de protection sociale au sein de l'UE. Il charge le SPC Working Group on Ageing Issues (SPC WG-AGE) d'élaborer un « 2018 Pension Adequacy Report » (2018 PAR) décrivant les tendances actuelles et attendues en matière d'adéquation des pensions.

Le SPC WG-AGE utilise les projections de l'AWG sur les benefit ratios et analyse les taux théoriques de remplacement de manière approfondie. Il avait déjà reconnu dans le 2012 PAR qu'il ne pouvait évaluer la mesure dans laquelle les régimes de pension des États membres contribueront à atteindre l'objectif consistant à réduire le nombre de personnes âgées exposées à un risque accru de pauvreté et d'exclusion sociale (CE, 2012, 137). Il avait ajouté dans le même rapport que « si tous les États membres étaient en mesure d'appliquer des modèles de microsimulation dynamique à cette tâche, il serait possible de construire des scénarios susceptibles d'aider les décideurs politiques (*op. cit.*, 138). Afin de préparer le 2018 PAR, des équipes de la Belgique, de la Suède et de l'Italie ont collaboré pour simuler l'évolution possible de l'adéquation des pensions à l'aide de leurs modèles de microsimulation respectifs en tenant compte des scénarios et projections élaborés par l'AWG ainsi que de la réglementation existante en matière de pensions. En tant que tels, les résultats de cet exercice complètent les simulations de l'AWG concernant l'impact budgétaire du vieillissement par des projections sur l'adéquation des pensions. Les résultats de ce rapport sont décrits à la section 5.1.2 du « 2018 Pension Adequacy Report ».

Contrairement aux autres pays, la Belgique connaît une augmentation continue du coût des pensions, parce que l'impact du vieillissement de la population sur le coût des pensions est plus important que les effets de réduction des coûts, comme l'accroissement du taux d'emploi et l'augmentation de l'âge effectif de la retraite. Toutefois, ces deux facteurs entraînent une pension moyenne plus élevée après la mise à la retraite, réduisant ainsi le risque de pauvreté en Belgique. En Italie, les dépenses de pension par rapport au PIB resteraient stables dans un premier temps, puis augmenteraient jusqu'en 2040 environ avant de reculer sensiblement par la suite. L'augmentation avant 2040 résulterait d'une faible croissance de la productivité et de l'accès de cohortes importantes à la retraite. La baisse ultérieure s'expliquerait par le remplacement progressif des pensionnés ayant reçu une allocation dans l'ancien régime Defined Benefit par des pensionnés recevant une allocation moins élevée dans le régime NDC mis en œuvre par les réformes de 1995 et 2011. Le régime Notionally Defined Contribution (NDC) moins généreux (surtout pour les personnes présentant des carrières interrompues) entraînerait une baisse du benefit ratio et une hausse du risque de pauvreté des pensionnés. En Suède, les dépenses brutes de pension par rapport au PIB devraient rester relativement stables, notamment en raison de l'immigration nette comparativement élevée. En 1996, la Suède a introduit un régime de pension NDC. Les pensions ont été adaptées à la baisse pour tenir compte de l'accroissement de l'espérance de vie, ce qui ferait baisser le benefit ratio dans les projections. Cette baisse serait encore renforcée par l'hypothèse, retenue par l'AWG, d'un âge effectif de la retraite constant. De ce fait, le risque de pauvreté des pensionnés s'accroîtrait sensiblement en Suède. L'Italie a également adopté un régime NDC, mais l'introduction récente d'un ajustement automatique de l'âge de la retraite à l'accroissement de l'espérance de vie devrait compenser la majeure partie de l'effet de la correction actuarielle. Dans les deux cas, on peut conclure que la mesure dans laquelle le marché du travail est en mesure d'offrir des carrières plus longues et stables aux travailleurs âgés sera cruciale pour maintenir les pensions à un niveau suffisant.

Même si les trois modèles utilisés dans le cadre de ce projet diffèrent par leur portée et leur taille et n'ont pas été élaborés à des fins de comparaison internationale, ce projet montre comment la microsimulation dynamique peut être utilisée pour rapprocher l'étude de la soutenabilité budgétaire des pensions et l'évaluation de l'adéquation de ces dernières. En tant que tel, il montre tout le potentiel de ces techniques de simulation en Europe.

Synthese

De uitgaven voor pensioenen vertegenwoordigen een omvangrijkdeel van de publieke uitgaven in de Europese Lidstaten (Europese Commissie, 2015b, figuur 3, bladzijde 5). Pensioenen en (de hervorming van) pensioenstelsels vormen dan ook een belangrijk aandachtspunt van de Ageing Working Group (AWG). Het "Ageing Report" beschrijft de ontwikkeling van publieke (pensioen)uitgaven bij een scenario van onveranderd beleid, en wijst op de belangrijkste onderliggende oorzaken hiervan. Deze omvatten onder meer demografie, ontwikkelingen op de arbeidsmarkt, en (de hervorming van) de voorwaarden voor uittreding en de berekening van de uitkering bij pensioenen en andere leeftijdsgebonden sociale-zekerheidsuitkeringen.

Maar ook de actuele en toekomstige toereikendheid van de sociale zekerheidsuitkeringen, waaronder pensioenen, krijgt de nodige aandacht op het Europese niveau. Het Social Protection Committee (SPC) volgt de sociale bescherming binnen de EU op. Zij gaf een mandaat aan de SPC Working Group on Ageing Issues (SPC WG-AGE) om een "2018 Pension Adequacy Report" (2018 PAR) op te stellen, waarin huidige en verwachte ontwikkelingen in de toereikendheid van pensioenen worden beschreven.

De SPC WG-AGE gebruikt hiervoor de AWG projecties, meer in het bijzonder de benefit ratios, en maakteen diepgaande analyse van "theoretical replacement rates", maar erkende reeds in de 2012 PAR dat ze op basis hiervan niet in staat is na te gaan in welke mate de pensioenstelsels van de lidstaten in projectie zullen bijdragen aan het bereiken van de doelstelling van het terugdringen van het aantal ouderen met een verhoogd risico op armoede en sociale uitsluiting (EC, 2012, 137). Zij voegt er in hetzelfde rapport aan toe dat "mogelijke scenario's voor beleidsondersteuning zouden kunnen worden ontwikkeld indien alle lidstaten hiertoe dynamische microsimulatiemodellen zouden gebruiken" (*op. cit.*, 138). In de voorbereiding van de 2018 PAR hebben teams uit België, Zweden en Italië samengewerkt om met behulp van hun respectievelijke microsimulatiemodellen de mogelijke ontwikkelingen in de toereikendheid van pensioenen te simuleren, uitgaande van de scenario's en projecties zoals deze door de AWG werden ontwikkeld. Hierbij wordt eveneens rekening gehouden met de reeds besliste hervormingen inzake pensioenen. Op deze manier kan dit rapport door haar simulaties van de toereikendheid van de pensioenuitkeringen complementair zijn aan de simulaties van de AWG betreffende de budgettaire impact van de vergrijzing. De resultaten uit dit rapport worden samengevat in paragraaf 5.1.2 van het 2018 PAR.

In tegenstelling tot de andere landen in deze studie zouden de kosten van de vergrijzing in België een ononderbroken stijging vertonen. De impact van de demografische vergrijzing op de kost van de pensioenen is immers sterker dan de kosten-reducerende ontwikkelingen, zoals onder meer de stijgende tewerkstellingsgraad en de stijging van de effectieve pensioenleeftijd. Deze laatste ontwikkelingen leiden echter eveneens tot een hogere gemiddelde uitkering na pensionering, waardoor het armoederisico voor gepensioneerden in België zou afnemen.

In Italië zouden de pensioenuitgaven ten opzichte van het bbp eerst redelijk stabiel blijven. Tussen 2020 en 2040 zouden ze toenemen, om daarna weer sterk te dalen. De stijging zou worden veroorzaakt door een lage productiviteitsgroei en de overgang van verhoudingsgewijs omvangrijke bevolkingscohorten naar pensionering. De daaropvolgende daling zou veroorzaakt worden door een graduele vervanging van gepensioneerden met een uitkering uit het oude Defined Benefit-systeem door gepensioneerden die een lagere uitkering uit het in de hervormingen van 1995 en 2011 ingestelde Notionally Defined Contribution-stelsel (NDC) zouden krijgen. Deze lagere uitkeringen, vooral voor personen met onderbroken loopbanen, zou leiden tot een daling van de benefit ratio en een stijging van het armoederisico onder gepensioneerden.

In Zweden zouden de pensioenuitgaven als fractie van het bbp naar verwachting redelijk gelijk blijven, onder meer omwille van de sterke netto-immigratie. In 1996 heeft Zweden een NDC-pensioensysteem ingevoerd. Hierbij worden de uitkeringen naar beneden bijgesteld als gevolg van de toenemende levensverwachting, hetgeen de benefit ratio in de projecties zou doen dalen. Deze afname wordt nog versterkt door de veronderstelling van de AWG van gelijkblijvende effectieve pensioenleeftijd. Hierdoor zou het armoederisico onder gepensioneerden in Zweden gevoelig toenemen.

Zowel Zweden als Italië hebben een NDC-pensioensysteem ingevoerd, maar in Italië worden de negatieve consequenties van de stijgende levensverwachting op de uitkeringen deels tenietgedaan door de stijging van de wettelijke pensioenleeftijd, die eveneens aan de levensverwachting gekoppeld is. Hoe dan ook kan worden geconcludeerd dat de mate waarin de arbeidsmarkt in staat is om langere, stabiele loopbanen te bieden aan oudere werknemers, cruciaal zal zijn om de uitkeringen toereikend te houden.

De drie dynamische microsimulatie modellen die in deze studie zijn gebruikt, verschillen op een aantal punten van elkaar. Ook zijn ze uiteindelijk niet ontwikkeld voor een internationale vergelijking. Desalniettemin demonstreert dit project de meerwaarde van deze modellen in het overbruggen van de kloof tussen de analyse van de budgettaire impact van de vergrijzing en de toereikendheid van de pensioenen in vergelijkend perspectief. Het laat dus zien welke potentie deze modellen kunnen hebben in een Europese beleidscontext.

1. Introduction

1.1. Description of the project

The ECOFIN council of the European union mandated the Economic Policy Committee (EPC) to produce a set of consistent long term budgetary projections of age-related expenditures (pensions, health care, long-term care, education and – for completeness' sake – unemployment) for the 28 European member states (EC, 2017c, 1).

The starting point of this process are the Eurostat population projections. Next, the EPC Ageing Working Group (AWG) develops agreed-upon assumptions and methodologies to project a series of macroeconomic variables, including labour force participation, employment and unemployment rates. In the third step, the commission and the member states produce budgetary projections to the AWG on the basis of the information provided by the Commission. These projections are then published in the EPC/AWG "2018 Ageing Report" (2018 AR), and used in the European Semester to identify policy challenges, set the medium-term policy objectives and assess the sustainability of public finances in the context of the Stability and Growth Pact (*op. cit.*, 1).

Pension cost takes up a large part of public expenditures in the EU member states (European Commission, 2015b, Graph 3, page 5), so pensions and pension reforms are a point of focus of this exercise. The Ageing Report thus wants to map the prospective development of public (pension) expenditures under an "unchanged policy scenario" and identify the main drivers of these expenditures, including demography, labour market developments, and (the reform of) eligibility conditions and benefit formulas in public pensions and other age-related social security systems.

However, the current and prospective adequacy of social security benefits including pensions is also a dimension of social protection that requires and gets attention on the EU level. The Social Protection Committee (SPC) is an advisory committee for the Employment and Social Affairs Ministers in the Employment and Social Affairs Council (EPSCO). It monitors social conditions in the EU and prepares Council discussions on social protection and country-specific recommendations on these matters in the context of the European Semester (EC, 2017). The SPC mandates the Indicators Subgroup (ISG) to develop EU social indicators and carry out analytical work, and the SPC Working Group on Ageing Issues (SPC WG-AGE) to prepare a "2018 Pension Adequacy Report" (2018 PAR[1]) to examine current and projected pension adequacy trends using the ISG indicators.

Besides using AWG projections on the benefit ratios and extensive analysis of Theoretical Replacement Rates (TRR), the SPC WG-AGE already in its 2012 PAR recognised it could not assess the "extent to which pension systems in Member States will contribute to the goal of reducing the number of people exposed to poverty or social exclusion" (EC, 2012, 137), to add that "if all Member States were able to apply dynamic micro-simulation models to this task, likely scenarios which could offer guidance to policy makers could be constructed." (*op. cit.,* 138). Thus, in the context of the 2015 PAR, the SPC WG-AGE decided that Belgium, Hungary and Sweden would use their dynamic microsimulation models to complement the TRR's by simulating possible developments of pension adequacy, while

1 The previous versions are the 2012 PAR (EC, 2012) and 2015 PAR (EC, 2015).

taking into account the projections and hypotheses of the AWG[2]. In preparation of the 2018 PAR, the SPC WG-AGE again invited member states to use their dynamic microsimulation models to describe the consequences of the AWG hypotheses and assumptions underlying the 2018 AR on pension adequacy using commonly-agreed indicators. This request received a favourable reception from Belgium, Sweden, and Italy.

The next section of this preparatory paper describes microsimulation and the models used in this project. Next the AWG scenarios are being presented briefly, after which a selection of the simulation results are presented and discussed.

1.2. Pension adequacy and its indicators

As said in the previous section, the goal of this project is to use dynamic microsimulation models to describe the consequences of the AWG hypotheses and assumptions underlying the 2018 AR on pension adequacy using commonly-agreed indicators. The combination with the budgetary costs of ageing described for the countries under scrutiny in the Country Reports should ideally allow to paint the picture on the full impact of pensions and pension reform in ageing European societies. As such, this joint assessment on sustainability and adequacy of pensions can be seen as a step towards the goal of improving "the long-term sustainability of pension systems, without jeopardizing the main function of pensions which is to allow people to maintain, to a reasonable degree, their standard of living after retirement and to prevent the risk of poverty among the elderly" (EC, 2017b, 29).

After discussion between the countries participating in this project, consulting with DG EMPL and using the experience gained in the previous project, we agreed on the following indicators to describe pension adequacy.

- The at-risk-of-poverty-rate (AROP). Here an individual is defined as having an increased risk of poverty when she lives in a household where the equivalent income (that is, the households' income corrected for the size and composition of the household through the modified OECD equivalence scale) is lower than 60 percent of the median equivalent income. Note that this is a relative indicator in that the average income of the poor may differ between countries.
- The Gini coefficient is a measure of statistical dispersion very commonly used to represent inequality of equivalent income. It is based on the comparison of cumulative proportions of the population against cumulative proportions of income they receive. It ranges between zero (a perfect relation between cumulative proportion and cumulative income, i.e. all have the same average income) and 1 (one person receives total income and all others have nothing). This scale uniformity allows for a straightforward comparison.
- The income quintile share ratio (S80/S20; a special case of the Decile Dispersion Ratio) is calculated as the ratio of total income received by the 20% richest (S80 or the top quintile) to that received by

[2] See Dekkers *et al.*, 2015, and reported in Box 5.1. (page 227) of the 2015 PAR. Note that this 2015-project was itself based on experience gathered through an earlier academic project where dynamic microsimulation was used to assess the consequences of the AWG hypotheses and projections for Belgium, Italy and German. See Dekkers *et al.* (2010) for a detailed discussion.

the 20% poorest (S20 or the bottom quintile). It is readily interpretable but ignores information on incomes in the middle of the distribution, as well as within decile income distribution.

– The average duration in retirement, measured in years at death (and the ratio of average duration in retirement and average career, again measured in years at death).

These indicators are presented for the population as a whole, for the working, for pensioners and for those aged the Standard Retirement Age (SRA) or older – usually referred to as 'the elderly'. Furthermore, the results are presented for those living in households where the head is married, a single male or a single female.

Note that we in this project do not report replacement rates. They can be produced by a dynamic microsimulation model also, but we choose to exclude them in order to prevent overlap – and confusion – with the aggregate-level indicators with the same name that are being reported in the AWG Country Reports.

Furthermore, the indicators used in this report are selected to be complementary to the TRRs that are being used in the 2018 PAR. This has been extensively discussed in the previous project report (Dekkers *et. al.*, 2015, section 1.3, 3), so this discussion will only be summarised here. Holzmann and Hinz (2005, 6) define a pension system to be adequate if it provides benefits sufficient to prevent old-age poverty, in addition to provide means to smooth lifetime consumption for most of the population. Where the TRRs cover the "consumption smoothing dimension" of pension adequacy in the above definition, the various indicators on poverty and income inequality among the elderly clearly fall under the "income security dimension" of adequacy. The two groups of indicators therefore are complements and together provide a full and prospective assessment of pension adequacy.

1.3. Dynamic Microsimulation models

Microsimulation models differ from other models in 1) that modelling is done at the level of the micro-unit, in our case individuals and their household, 2) that the starting point of the simulations is a survey or administrative dataset representing actual individuals at a certain point in time (Dekkers *et al.*, 2010; 2015). Thus, microsimulation models are designed for the simulation of the impact of exogenous societal economic or policy changes on the income distribution, including poverty risks, inequality and on non-linear types of models such as progressive tax systems. Furthermore, and again contrary to semi-aggregate models, the dimensions by which simulation results can be presented are a priori undefined and limited only by the scope of the model (Dekkers *et al.*, 2015, 2). A semi-aggregate model that discerns age and gender as modelling categories, cannot present results for, say, single mothers only. For a microsimulation model, this is not a problem since its output is essentially a micro-level dataset and the user has the choice which of the dimensions to maintain in the presentation of this output.

To date, the most well-known applications of microsimulation in research and policy assessment, certainly on the European level, are through the model EUROMOD. This is a static model which takes individual characteristics and behaviours as exogenous, and that is commonly used to evaluate the immediate distributional impact upon individuals of possible policy changes (Li *et al.*, 2014; Sutherland, 2014). EUROMOD is now a key tool in scientific research and policy assessment within countries, and about the reference tool for multi-country microsimulation.

However, in order to assess the consequences of social, economic developments, or to model policy systems with an inherent dynamic component, static models do not suffice. This includes the simulation of social security systems in a context of demographic ageing. In that case, we require models that include a notion of time. The three models used in this exercise are all of the "full dynamic type", which means allowing individuals and households progress over time (Li *et al.*, 2014, 306). Depending on the information on transitions or risks available, a dynamic model builds up synthetic life histories for each individual in the dataset, providing a panel dataset as output. Individuals are born, go to school, marry or cohabit, enter the labour market, become unemployed or not, retire and, finally, die. The occurrence of all these events in the lifetime of an individual in the model together make up a life and career, and are simulated using exogenous probabilities or reduced-form behavioural equations, often of the logit or probit-type.

Dynamic models traditionally have been used to simulate pensions and pension reform (Li *et al.*, 2014, table 10.1, page 307) and the simulation of the redistributive or budgetary impacts of pensions is still the main reason why many member states invest in these models. Nevertheless, with some notable exceptions (such as Dekkers *et al.*, 2010; see Sutherland, 2014, 79; followed by Dekkers *et al.*, 2015) cross-country comparative analysis based on dynamic microsimulation is still rare. At least for the EU, reasons for this might include that 1) many dynamic models are being developed by public or semi-public research institutions whose focus –for good reasons- is national rather than international, and 2) although being grouped under "dynamic microsimulation models", they often are technically so diverse that comparison of their output is highly problematic[3]. However, and even though differences remain, the three models used in this project are essentially of the same fundamental type.

Note, finally, that the simulation results used in this project may vary in scope and coverage. For example, the simulation results of the Italian model T-DYMM present equivalent gross income rather than net income. The Belgian model MIDAS and the Swedish model SESIM do simulate net income. On the other hand, only the Swedish model SESIM simulates emigration and immigration and financial wealth, income from capital and real wealth in its simulation of net equivalent household income. These, and other differences between the various models will be discussed in more detail when the various models are presented.

Still, although the various models have been developed with an obvious national focus and even though some key differences in model scope and coverage still exist, their results allow for a cross-national comparison. Furthermore, through a number of alignment-techniques, dynamic microsimulation models are able to calibrate their output to conform to external macro-data (Scott, 2001, in Li and O'Donoghue, 2014, 217). Like the previous exercises (2010, 2015), we make use of this feature to align these models to the common AWG hypotheses and projections that underlie the budgetary costs of ageing. In Italy and Belgium, a semi-aggregate model is being used to simulate the budgetary cost of ageing, whereas the dynamic microsimulation model simulates the consequence in terms of pension adequacy. In Sweden, by contrast, the dynamic microsimulation model provides both the sustainability and

[3] See Dekkers and Van Den Bosch (2016), for a first discussion on dynamic microsimulation models used by the EU member states for policy analysis.

adequacy results. Either way, the output of the microsimulation models allows to put the focus on the adequacy of pensions, thereby being complementary to the AWG budgetary projections. The combination of dynamic microsimulation with semi-aggregate modelling makes a "tale of many models" (Dekkers *et al.*, 2015b, 135) that attempts to paint the full picture on the impact of pensions and pension reform in ageing European societies.

Finally, before turning to the budgetary and adequacy simulation results, one classic caveat must be mentioned. The results described in this report are not to be interpreted as predictions of the future, but rather as projections under assumptions of a policy scenario – most often the assumption of unchanged policy – and base scenarios or variants on key developments. As such, the results do not describe what the future will be, but rather how these scenarios might impact the adequacy of pensions.

1.4. AWG Base scenario and variants

1.4.1. Base scenario

The AWG baseline scenario illustrates a possible development of budgetary costs of ageing given a set of demographic and economic developments for the EU member states, while assuming unchanged policy besides already legislated pension reform. Furthermore, these projections are based on common assumptions and methodologies for all member states. So for example, demographic projections in the base scenario are provided by Eurostat and assume a partial convergence approach (EC, 2017c, 12) in that the key determinants are assumed to converge over the very long-term. The total population projections that result from these assumptions on fertility, mortality, and net migration, are shown in Table 1.

Table 1 Total population projections (2016-2070); annual average - millions

								Old-age dependency ratio (65+/15-64; %)		
	2016	2030	2040	2050	2060	2070	% change	2016	2070	p.p.-change
BE	11.3	12.3	12.9	13.3	13.6	13.9	22.8	28.4	45.2	16.7
IT	60.8	60.3	60	58.9	56.8	54.9	-9.7	34.5	60.3	25.8
SE	9.9	11.3	12	12.7	13.3	13.9	39.9	31.6	43.2	11.6
EU27	445.3	452.4	453.3	450.8	445	439.2	-1.4	29.9	52.2	22.4

Source: EC, 2017c, table I.1.7, 21, and Table I.1.9, page 23. EU27 includes all EU Member States except the UK (op. cit., footnote 1, page 3).

The Table 1 shows that population in the EU27[4] as a whole would increase from 445 million in 2016 to 453 million in its peak year 2040, after which it would decrease to 439 million in 2070. All in all, the EU27-population would decrease by just 1.4% between 2016 and 2070. However, under this relative stability lie very different patterns on the level of the various member states. Decrease of the population are foreseen in half of the member states, including Italy. On the other hand, population growth is quite strong in Sweden and moderate in Belgium. The drivers behind these trends are a combination of large 'babyboom cohorts' and further gains in life expectancy, and low fertility rates combined with shrinking cohorts of women in childbearing ages (*op. cit.*, 22). In Belgium and Sweden, net migration inflow remains strong enough to counter these developments, which explains the increase of the total population (FPB, 2017, 8; Ministry of Finance of Sweden, 2017, 10). Although net migration is equally strong in Italy

[4] EU27 includes all EU Member States except the UK (EC, 2017c, footnote 1, page 3).

as in Sweden (EC, 2017c, Table I.1.6, 18), the aforementioned demographic effects are so strong in Italy that migration alone cannot reverse the decrease in population. As a result, the old-age dependency ratio would show a strong increase in Italy, while it would be more moderate in Belgium and especially Sweden[5].

On the basis of these demographic projections, the Commission uses a Cohort Simulation Model (CSM; see EC, 2017c, box I.2.1, page 33 and further) to create consistent labour force projections for the various member states, while capturing the country-specific situation. The fundamental trends that underlie these projections include 1) the reversal of the declining participation rates among men aged between 55 and 65, 2) the steady increase of female participation rates, 3) the decline of activity rates of younger cohorts, which result from higher educational attainment levels (*op. cit.*, 29). Furthermore, many member states have implemented pension reform, often restricting early retirement and increasing the statutory retirement age (SRA). Thus, total participation rates change as a result of these age-gender specific developments, in combination with demographic changes which cause the size of the various age-gender groups to change relative to each other.

The below Table 2 separates the change of the participation rate into various sub-effects.

Table 2 Contributions to the Changes of the participation rate

	Participation rate in 2070	% change	contribution of group specific rates	Demographic effect	Change in unemployment rate (p.p.)	Change in employment rate (p.p.)
BE	77.3	3.9	4.1	-0.3	0	3.6
IT	72.9	3.2	3.7	-1.2	-4	5.7
SE	86.5	-0.1	0.1	-0.2	-1.4	1
EU27	80	3	3.5	-0.6	-2.7	4.9

Source: EC, 2017c, Tables I.2.9, 57; unnumbered table, 60; table I.2.10, 61. The first three columns are % changes, and the last two are percentage points.

Next, in order to get from activity rates to employment, assumptions on the development of unemployment are needed. A positive growth of the activity rate translates into higher unemployment and/or higher employment. The unemployment rates are assumed to converge to NAWRU rates, corresponding to the closure of the output gap over a course of 5 years. These NAWRU rates have been developed by the Output Gap Working Group of the Economic Policy Committee (EC, 2017c, box I.2.3, 59), and are in turn assumed to converge to country-specific anchors, resulting from econometric work carried out by DG ECFIN. The unemployment rate in Belgium would, after a peak value in the late 2020s fall back to its initial value. This means that the increase of the activity rate would more or less translate into an increase of the employment rate. This zero-growth rate between 2016 and 2070 in Belgium stands in contrast to the EU27 as a whole and the other countries under scrutiny, where the decrease of the unemployment rate ranges between 4 and 0.2 percentage points. Especially in Italy, the country in this report that faces the strongest impact of demographic ageing and that has suffered the most from the previous economic crisis, would the decrease of unemployment be strong. Thus, the increases of the activity rate, by itself smaller than in Belgium, would result in higher employment growth rates. The most remarkable thing to say about Sweden is that the changes are comparably small. A small negative

[5] The update of the AWG demographic scenario in 2017 has harshly worsened long-term budgetary projections for Italy. For a better understanding of the drivers of the changes occurred, see European Commission (2017c), pp. 25-28 and MEF (2017), pp. 54-58.

change of the activity rate, combined with a decrease of unemployment, results in a small positive growth rate of employment between 2016 and 2070.

The next step is to go from employment projections to GDP projections. This is denominator of the cost of ageing. For this, given employment developments and hours worked per person, long-term productivity projections are required. The contribution of labour input on GDP would be positive up to 2020. After that, even with increasing employment rates, the decline in the share of the working-age population would result in a lower (Belgium and Sweden) and often negative (Italy, and EU27 as a whole) contribution of labour to GDP growth. Thus, productivity will be the main driver for GDP growth in the long run. Furthermore, a scenario for productivity is also needed to set the growth rate of earnings. Projections of labour productivity per hour are determined for around two-thirds by total factor productivity and one-third by the capital stock per worker, and the central assumption used by the AWG is that the national rates converge at the end of the projection horizon across all member states (EC, 2017c, 72).

These projections are then transferred to the various member states, who then use their national models to simulate the cost of pensions. The other the age-related budgetary items are calculated by the commission based on the commonly agreed assumptions and methods. The next section describes the projected sustainability of the pension systems in the three countries under scrutiny and identifies the main trends. This discussion will be based on the various Country reports (FPB, 2017; Ministry of Finance of Sweden, 2017; MEF, 2017).

1.4.2. Results

This section summarises the results from the various Country Reports in Belgium, Italy and Sweden on the budgetary cost of ageing, and combines them with the simulation results on the adequacy of pensions that are produced in this project. The latter results are described in detail in the next chapters of this report. Unless explicitly stated otherwise, the sustainability of pensions, i.e. discussion of the AWG simulation results are based on gross public pension expenditures (including disability and survivor's pensions; minimum pensions and guaranteed minimum benefits), as a percentage of GDP. By contrast, pension adequacy results are based on net equivalent income, unless stated otherwise.

Table 3 shows the gross public pension expenditures as a fraction of GDP in Belgium, Italy and Sweden.

Table 3 Gross public pension expenditures as a fraction of GDP

	2016	2020	2030	2040	2050	2060	2070	peak
Belgium	12.1	12.6	13.8	14.5	14.7	14.9	15	2096
Italy	15.6	15.6	17.2	18.7	17.3	15.1	13.9	2040
Sweden	8.2	7.6	7.2	6.8	6.6	7.0	7.0	2016

Source: FPB, 2017; Table 9, 16; Ministry of Finance of Sweden, 2017; MEF, 2017, Table 8, 38).
Note: The Swedish figures do not include the premium pension, occupational pensions or private pensions.

Belgium

Contrary to the other countries, the cost of pensions shows a continuous increase in Belgium. The main driver behind this development is demographic ageing. The dependency ratio increases by 2.9 p.p. over the whole period, and especially during the 2020s. The other developments, mostly the restriction of access to early retirement and the increase of the SRA, and –to a lesser extent- the increase of employment, are not strong enough to counter this development. The conditions to enter early retirement are tightened, and the average exit age increases by 2.5 years over the whole simulation period. This especially causes the early-age coverage ratio to decrease in the 2020s and 2030s. However, also due to the increased activity rate of women, the proportion of pensioners over 65+ (the old-age coverage ratio) increases, so that the decrease of the overall coverage rate is small. The employment rate among the population 20-64 increases, especially in the first half of the simulation period, but the reducing impact of this on the cost of ageing is countered by the benefit ratio, which increases during the first half of the simulation period, and decreases only from 2040 on. The increasing employment rate, the higher average exit age and especially the increasing activity rate of women, all translate into a higher pension benefit after retirement, and we will show later that the poverty risk of pensioners therefore decreases. Furthermore, especially until the mid-2030s, the growth rate of the minimum provisions exceeds that of earnings. This has no budgetary impact (because the amounts are small in terms of GDP and because GDP increases faster than productivity, again especially up to 2030, due to the increase of labour input[6]) but further reduces the poverty risk as well as inequality in that period.

Italy

Pension spending in Italy would remain stable at 15.6 percent GDP up to about 2020. This stability would mainly be the result of the tightening of the eligibility requirements for old-age and early pensions, linking them to life-expectancy from 2013 on. From about 2020 and up to 2040, the increase in pension spending would set in, mainly driven by low productivity growth projections, combined with the transition of large baby boom cohorts into old-age. However, the 1995 and the 2011 pension law, respectively, adopted and strengthened an NDC system. As time goes by, new pensioners that have a benefit computed under the new regime would gradually replace the stock of pensioners that have a benefit computed under the old Defined Benefit regime.

This ‘gradual introduction’ of the NDC would cause the benefit ratio to decrease. The new NDC scheme is overall less generous, especially towards short and exponential careers, which enjoyed higher internal rates of return on contributions accrued under the old DB scheme, while NDC rules apply the same IRR to all pensioners. Between 2020 and 2040, this effect would not be strong enough to counter the aforementioned demographic and productivity developments that cause the budgetary cost of ageing to increase, but after 2040 pension spending would fall back again to 13.9 percent in 2070, thanks to the compensating effects brought about by the substantial pension reforms adopted in the past, in particular: i) the introduction of the NDC scheme and the indexation of pensions to price inflation; ii) the increase in the eligibility requirements and their automatic linkage to changes in life expectancy which will reduce the coverage ratio and iii) higher employment rates for the elderly, mainly boosted by the postponement of the retirement age.

Sweden

In Sweden, the gross total pension expenditure is expected to remain almost the same. The total gross expenditure will start off at 10.7% of GDP in 2016, and remain around this level until 2070 when it will

[6] To see this, compare tables I.3.1 to I.3.3., page 72 and 73 of EC (2017c).

reach 10.2% of GDP. The development of public pension expenditures is expected to decrease starting off at 8.2 percent, it decreases by 1.4 pp, reaching a minimum of 6.6 percent in 2050 and resulting in 7.0% in 2070. Thus, public pension expenditures as a percentage of GDP will decrease by 1.2 pp over the whole simulation period. Besides strong population growth, driven by high fertility, longevity and net immigration, a key element in is that Sweden implemented a two-layer pension system, of which the first layer the income pension is a NDC system and the second, the premium pension is a DC system. The DC system is statistically classified as private pension although publicly administered. Both schemes are therefore based on individual accounts that reflect lifetime earnings. As said, a key element in explaining the reduction in public pension expenditures is the continuing population growth which causes the increase of the dependency ratio to be smaller in Sweden than in the other EU countries. So even though the dependency ratio would cause pension expenditures to increase, this effect is comparably weak and easily countered by a strong decrease of the benefit ratio. The key reason for the benefit ratio to decrease is related to the AWG assumptions about a constant labour market exit age. Since the individuals' pension benefit, at retirement, is derived by dividing the account value by a number reflecting unisex life expectancy at the age of retirement. Thus, increased longevity in combination with an assumed unchanged effective retirement age would cause this actuarial correction factor to increase, which *cet. par.* would result in a lower pension benefit.

Finally, the private pension system would mature gradually, which means that the private part in pension expenditure would increase, partially replacing the public part shown in the above table.

As said, the average pension benefit would decrease as a result of increased longevity in combination with an assumed unchanged effective retirement age, which under the rules of the NDC would cause this actuarial correction factor to increase. This would also result in a considerable increase by more than 5%-points of the poverty risk among the elderly population. This increase can be interpreted as showing the consequences of the AWG's assumption on the unchanged retirement age.

2. Country results for Belgium

2.1. MIDAS: the dynamic microsimulation model for Belgium

MIDAS (Microsimulation for the Development of Adequacy and Sustainability) is a dynamic microsimulation model that simulates individuals and households between 2011 and 2070. The version of MIDAS used in the previous project was based on a 2001 sample of 300 000 individuals. The current version is based on a compound administrative dataset of 553 722 individuals in 249 121 households, which is expanded to 2 780 148 individuals in 1 239 681 households. Furthermore, the model has undergone many improvements. One major improvement is that the projections of cohabiting individuals has now been aligned to the official household projections by the FPB. The general structure of the model has however remained unchanged[7].

MIDAS consists of various modules that can be grouped in five blocks: demographics, labour market, social security and pensions, taxation and output. These blocks contain the following processes (among other things):

– Demographic block: mortality, fertility, partner selection, marriage or cohabitation, separation or divorce, educational attainment level, being in education.

– Labour market block: continuing or starting to work, hours of work, earnings per hour, ceasing to work, unemployment, disability, unemployment with company allowance, and retirement.

– Social security and pensions block: this block simulates the social security benefits depending on the state that the individual occupies: unemployment benefit, unemployment benefit with company allowance, disability benefit and retirement benefit. Other benefits simulated are independent on the state of the individual: means-tested minimum guaranteed income, means-tested Guaranteed Income for the Elderly and children-benefits.

– Fiscal block: gross-net trajectory, depending on the income source(s).

– Output: all kinds of tables, calculation of equivalent gross and net household income, poverty risks, Gini, Income quintile share ratio, etc.

MIDAS does not include private savings or pensions from the second or third pension pillars, wealth and housing. Immigration and emigration are not included either but are currently under development. These caveats should be considered when considering the results.

As explained in section 1.3., alignment techniques are being used extensively to replicate exogenous (semi-)aggregate data. In the Belgian case, this feature is used to incorporate and replicate macro-economic and socio-demographic results of the Belgian MALTESE system of models that has been used to produce AWG projections for Belgium. Its purpose is to make the simulations pertaining to adequacy are as consistent as possible with the budgetary results

So, for MIDAS_BE and also for the other models, there exist three 'channels of consistency' (Dekkers *et al.*, 2012). The first is the most important and allows to use alignment techniques to replicate socio-

[7] The following discussion is largely based on Dekkers *et al.* (2015, section 2.1)

demographic projections of the MALTESE system of models. The second channel of consistency involves proportionally adjusting the micro-level earnings each period, so that the growth rate of the average earnings of the micro-level is equal to the growth rate of earnings from the semi-aggregated cohort simulation model. An important feature of any microsimulation model is that it is possible to include all kind of social and fiscal parameters in the model. MIDAS therefore reflects the same actual or decided policy changes as MALTESE does. This is the third channel of consistency.

2.2. An overview of the Belgian pension system

This section contains a brief overview of the Belgian first-pillar pension system. It is mainly based on the country fiche developed for the AWG.

Amounting to about 12.1% of GDP in 2016, the first pillar is the principal part of the Belgian pension system. It is a statutory public pension scheme with defined benefits (DB) for 99% of the expenses, i.e., except for the assistance scheme, which is means-tested. The first pillar is based on the pay-as-you-go financing (PAYG) principle.

In the wage earners' scheme, the maximum career is 45 years. The normal accrual rate equals 1.33% (60%/45), and is applied to wages earned during the career and adjusted only to current prices. For those beneficiaries that are head of a household with a dependent spouse, the accrual rate is 1.67% (75%/45). However, the accrual rate is lower for those employees with earnings higher than a cap, called the wage ceiling. Beneficiaries can receive a minimum pension (which is higher than the assistance scheme) if they have a career of at least two-thirds of the maximum career. Finally, pensions are automatically adjusted to price index and partially adjusted to living standards.

For the self-employed, the accrual rates are comparable to those of the wage earners' scheme. The reference income of the self-employed takes into account the much lower contribution rate. As a result, 60% of the beneficiaries are entitled to a minimum pension (not the assistance scheme) of the same amount as in the wage earners' scheme. For civil servants, the normal nominal accrual rate of 1.67% (1/60), but it is applied not to the average wage of the whole career, but of the last 10 years of work only (and 5 years for people born before 1962). Furthermore, the average pension is automatically adjusted to increases in the average nominal wage of working civil servants.

The minimum early retirement age and the minimum number of career years required for eligibility were respectively 62 and 40 years in 2016. After a short transition period, the minimum early retirement age is going to be 63 years as of 2018 and the minimum number of career years 42 years as of 2019. Nevertheless, exceptions would still be possible for those with long careers. The statutory retirement age in the old-age public pension schemes was 65 for both men and women in 2016 and is going to raise to 66 in 2025 and to 67 in 2030. Although the qualifying conditions for old-age and early retirement are the same in the three schemes (wage earners, self-employed and civil servants), these three schemes have specific characteristics. Finally, the minimum age for beneficiaries of a survivor pension is increasing from 45 years today to 55 years in 2030.

Finally, the minimum age to benefit from the means-tested guaranteed income for elderly people is the same as the statutory retirement age.

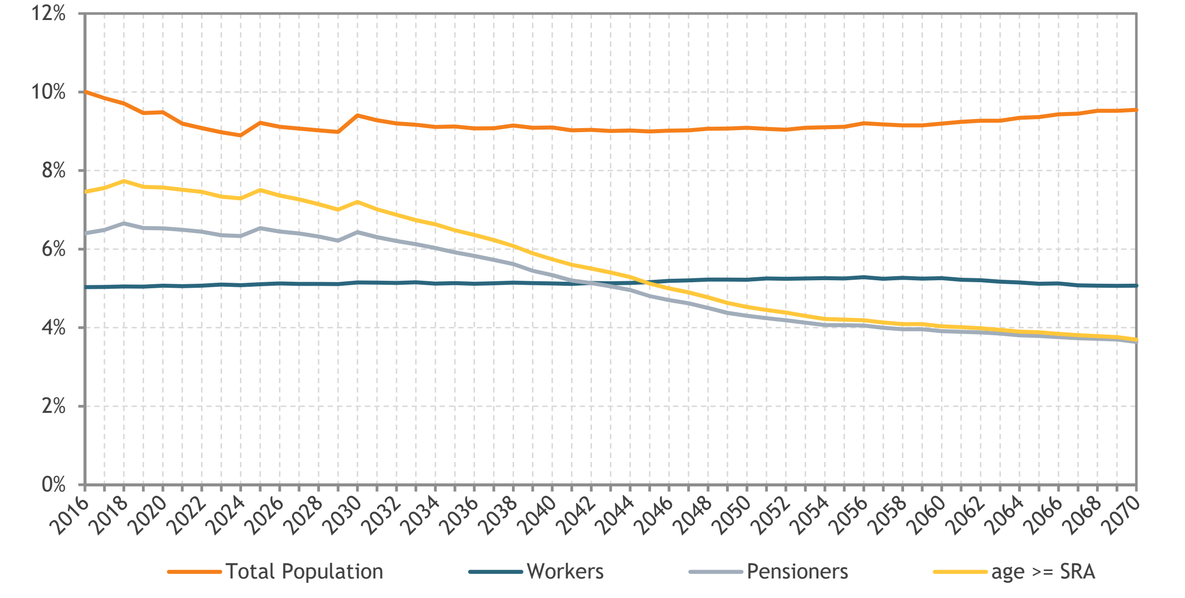
2.3. Results for Belgium in the base variant

In this section, a selection of indicators will be presented and discussed. This includes the at-risk-of-poverty (AROP) rates, the Gini and the income quintile share ratio (S80/S20), and an indicator of the length of retirement at death. Note that all indicators of poverty and inequality are based on equivalent after-tax income, i.e. total disposable household income corrected for the size and composition of the household through the modified OECD scale.

Next and contrary to the previous report (Dekkers *et al.*, 2015), we now also present the average length of retirement at death and the ratio of the average length of retirement at death over the average length of career at retirement. This is the only indicator that has an apparent aggregate-level counterpart provided in the Country Fiche (See FPB, 2017, Table 6, page 10). In these reports, the average length of retirement is calculated by the Commission as the difference between "life expectancy at average effective exit age and the average effective exit age itself" (*op. cit.*, 10), and where the latter comes from the Commission's Cohort Simulation Model. Next, for any simulation year *x*, the Commission takes the ratio of the average length of retirement *of those dying in x* and the average length career *of those reaching retirement* in that year. Obviously, these are not the same people. In contrast, the effective retirement ages in MIDAS are observed for pensioners in the starting year 2011 and simulated by MIDAS on the level of the individual using the AWG projections by MALTESE as a starting point for the alignment. The same goes for the length of the career, which is also observed and/or simulated on the level of the individual. Also, and contrary to the aggregate-level results of the Commission, the average length of retirement and average length of career that constitute the numerator and denominator of the ratio pertain to the same individuals, namely *those that die in the simulation year x*. All these differences make it very hard to make a meaningful comparison between the Commission's results and ours. The latter should therefore be seen as complementary to the former.

The below Graph 1 presents the poverty risks for the population as a whole and three subgroups: workers, pensioners and those aged the statutory retirement age (SRA) or older. It reflects the proportion of the relevant group who live in households where the equivalent income is below a poverty threshold value, which itself equals 60 percent of the median equivalent income. However, since several incomes are not simulated in MIDAS, the median income, and thus the poverty line, are lower than observed in the SILC. Furthermore, this simulated threshold is below most of the minimum benefits for the elderly. Consequently, the starting value of the AROP for the elderly (i.e. the value in 2016) is below the official value, and the key message in below simulation results should be their evolution over time and their level relative to other groups.

Graph 1 Poverty risks (net equivalent income) to state



The results in Graph 1 show that the poverty risk of the elderly and the pensioners starts off higher than that of the working population, but decreases over time and ends up lower from the mid-2040s onward. This decrease of the poverty risk is due to several factors.

First of all, the growth rate of the minimum provisions exceeds that of earnings until the mid-2030s. This is the result of previous increases of the minimum provisions and the assumed indexation parameters, in combination with the low growth rate of earnings in the short- and middle-long run, following the AWG simulations. The AWG budgetary projections take into account all measures decided by the government up to September 2017. From 2019 onwards, all social allowances are adjusted according to the parameters used for computing the budget that is devoted to adjusting the living standards of these budgets (FPB, 2017, page 6). These are real annual growth rates that range between 0.5 and 1.25 percent, and that are independent of the growth rate of wages. Only the civil servants' pension benefit follows the real growth rate of wages minus 0.4 percent. Thus, the indexation of most benefits, including first-pillar pensions, are independent of the development of wages. Next, Graph 2 (FPB, 2017, page 28) of the Belgian Country Report shows that the growth rate of earnings is well below the one percent up to 2030. This implies that benefits increase in real terms in the first half of the simulation period, which causes the AROP of the pensioners and elderly to decrease.

In the long run, a second effect kicks in, and that is the increasing labour market participation of women. Compared to their mothers, current active generations of women more often work, and the proportion of short careers among woman decreases over time. This over time results in higher pension benefits for women, and as a result the AROP of women and their male partners decreases. This is reinforced by the increase of the effective exit age by 2.5 years between 2017 and 2070 (FPB, 2017, Table 7, page 11). This results in a higher pension after retirement, and therefore lowers the AROP of pensioners and elderly.

Third, as explained in the AWG Country Fiche (FPB, 2017, 6), the 2015 pension reform among other things raises the statutory retirement age (SRA) from 65 to 66 years in 2025 and to 67 years in 2030. Furthermore, it increases the minimum retirement age as well as the minimum career length for early retirement (EC, 2017c, Box I.2.2, 38). Over time, this results in new cohorts of pensioners having longer careers and therefore slightly higher pension benefits, which will add to lowering the AROP of pensioners and elderly.

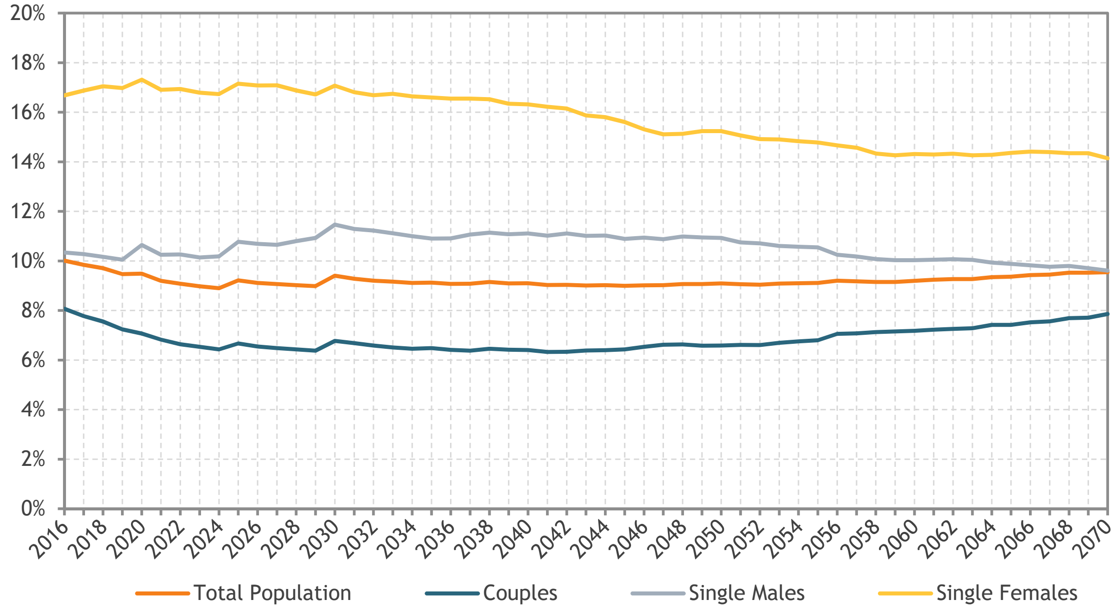
Next, we turn the discussion to the other groups. The level of the AROP of the working population is lower than that of the population as a whole, which is simply because earnings on average exceed pensions or other social security benefits.

Graph 1 also shows that the AROP of those older than the SRA (henceforth denoted as the elderly) exceeds that of the pensioners, but the two curves converge over time. Note that the elderly without a retirement benefit are not considered pensioners, even if they are older than the SRA. So they are not included in the AROP of the pensioners, while they are included in the AROP of the elderly. Thus the latter increases relative to the former. Furthermore, those that retire before the SRA must fulfil conditions pertaining to the length of the career. Hence at any age, they tend to have a longer career than those that can only retire at the SRA, which further explains the lower AROP of pensioners compared to elderly. Finally, and again due to those retiring before the SRA, the average age of pensioners is lower than that of the elderly. This cet. par. implies that pensioners on average retired less years ago than the elderly. Assuming a constant indexation regime, this implies that the pension benefit is higher when one entered into retirement less years ago, which further explains why the AROP of the pensioners is lower than that of the elderly.

Over time, the AROP of pensioners and elderly will converge for various reasons. First of all, and especially as a result of the increasing labour market participation of women, the number of elderly without any pension benefit is expected to decrease. Thus, the effect that causes the difference in AROP between the two groups will become smaller over time. Furthermore, the various pension reforms restrict access to early retirement benefit, while the life expectancy of elderly continues to increase (EC, 2017c, Table I.1.4). The proportion of elderly among the pensioners therefore increases considerably between 2017 and 2040.

Graph 2 shows the poverty risk to the cohabiting status of the head of the household, and this for the population as a whole. The groups here are those living in a household where the head is part of a (married or cohabiting) couple, and those living in a household where the head is a single man or woman. First, those that live in a household where the head is part of a couple have the lowest AROP. This is mainly because partners obviously have the possibility to pool incomes and because the equivalence scale of a partner is half of that of a head of the household. Thus, the income gained by a person cet. par. has more impact if the person is a partner than if she is a head.

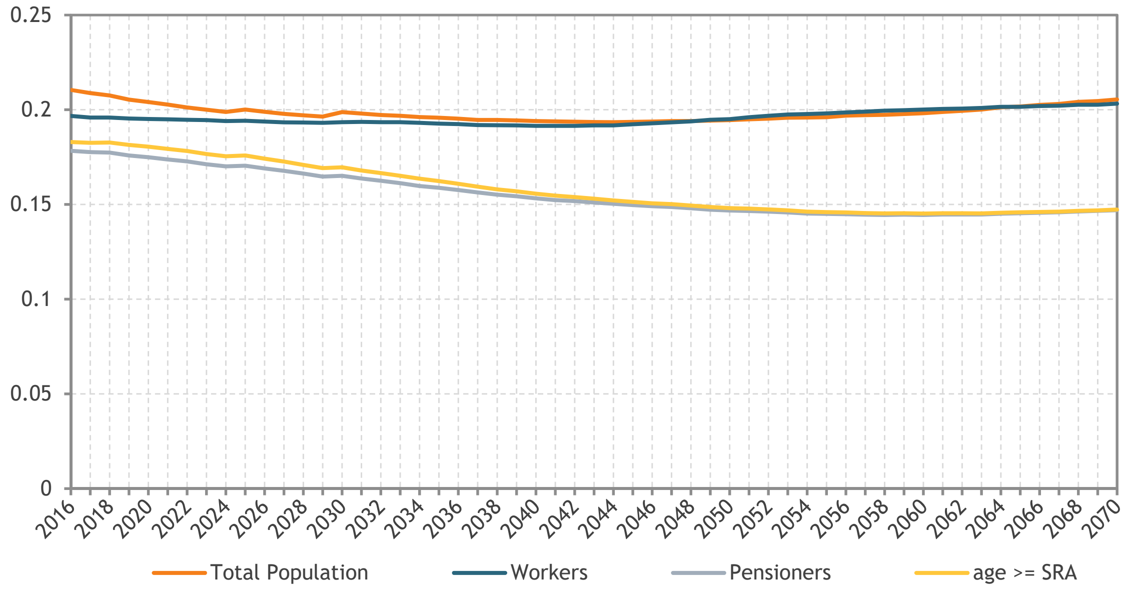
Graph 2 Poverty risks (net equivalent income) to cohabiting status of the head of the household



Among those living in households where the head is single, there is a clear difference to gender: the AROP among those that live in a household where the head is a single woman is considerably higher. This again reflects the lower activity rate of women, their lower earnings and often lower social security and pension benefits.

Next Graph 3 shows the Gini inequality measure for the population and three subgroups: workers, pensioners and the elderly. The overall Gini exceeds that of the working category, which is mainly because the overall population and its benefits are more heterogeneous than the earnings of the working population. The Gini of the pensioners and elderly are very close to each other and show a clear decrease over time. First, as a result of demographic ageing and the decrease of the average household size, the proportion of households where both pensioners and working people, decreases over time. As a result, the contribution of earnings to the equivalent income of pensioners and elderly decreases, which in turn will lower the inequality among these groups. Furthermore, given a constant indexation regime of pension benefits, Dekkers (2014) argues that large active cohorts moving into retirement may cause the pension benefits to converge between age groups, which causes inequality to decrease.

Graph 3 Gini to state

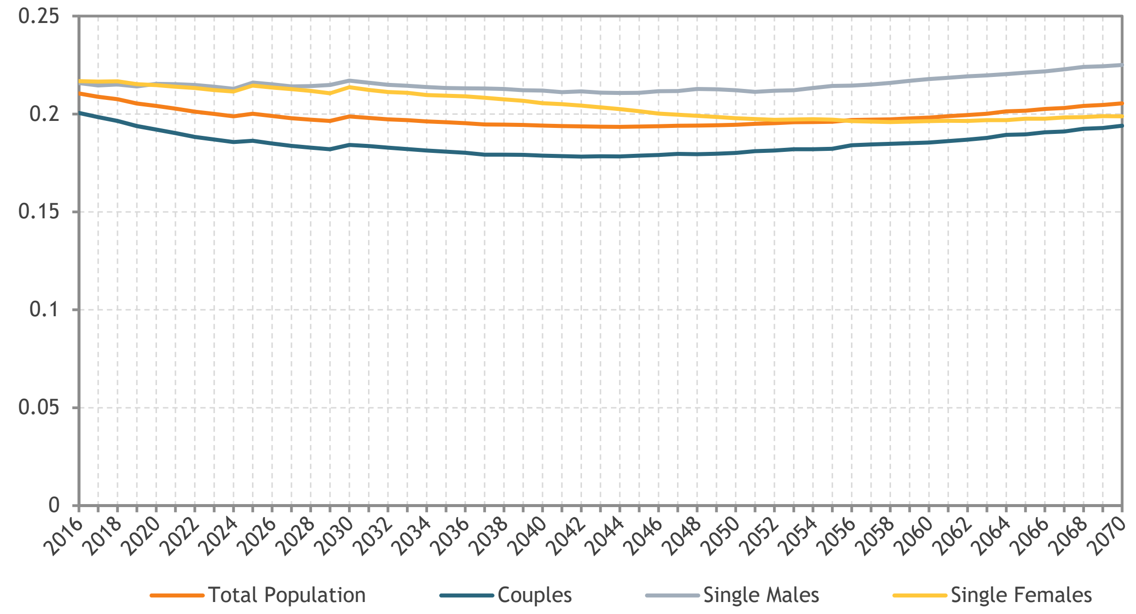


Other explanations for this decreasing inequality are essentially the same as for the decreasing poverty risk among the pensioners and elderly: the growth rate of the minimum provisions exceeding that of earnings until the mid-2030s; the increasing activity rate of women, which results the proportion of those without any benefits, and brings their pension benefits closer to those of men.

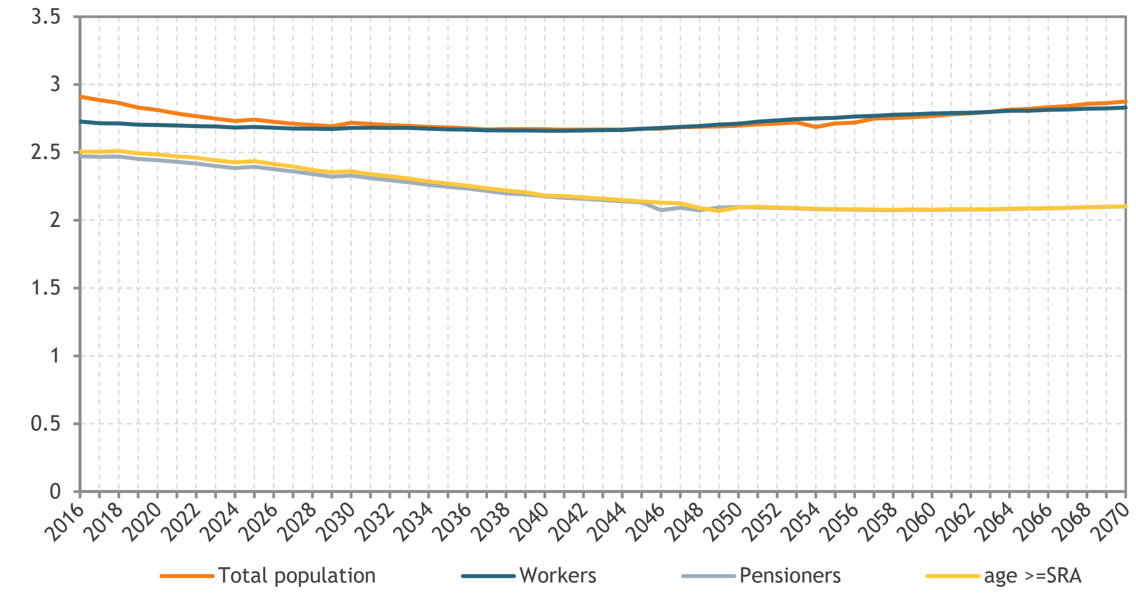
Finally, because of the redistributive characteristics of the first-pillar pension systems and the existence of a means-tested minimum benefit, the inequality among pensioners and elderly is lower than that of the working.

Graph 4 presents the Gini to the cohabiting status of the head of the household. Inequality among those living in single-head households is somewhat higher than among those living in households where the head is part of a couple. This confirms that the low or high income of one partner can be ‘cancelled out’ by the income of the other partner in the inequality measure.

Graph 4 Gini to cohabiting status of the head of the household



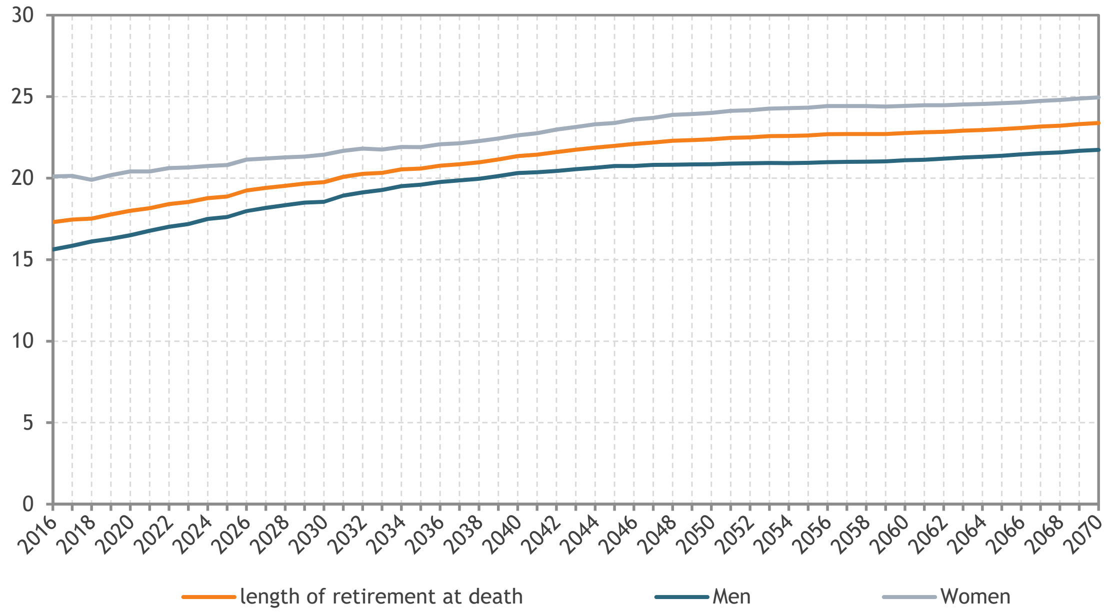
Graph 5 Income quintile share ratio (S80/S20) to state



Graph 5 shows the income quintile share ratio (S80/S20) of for the population and the subgroups of workers, pensioners and the elderly. The S80/S20 compares the income mass held by the 20% persons with the highest incomes to that held by the 20% of the persons with the lowest incomes. It is complementary to the Gini because it is more sensible to changes in the extremes of the income distribution. Still, these results are not that different from those presented earlier in Graph 3.

Next, we turn to the average length of retirement at death, the average length of career at death and the ratio of the two. Graph 6 shows the average length of retirement at death for all and for men and women separately.

Graph 6 Length of retirement at death

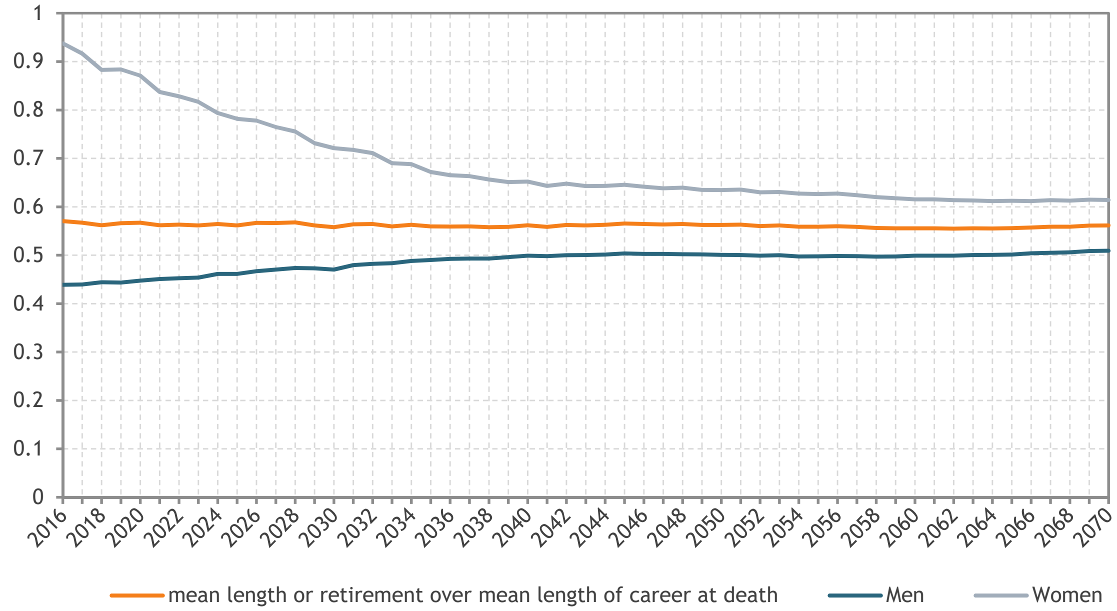


The length of retirement at death is a function of the entering rates and the life expectancy. As a result of the increases of the effective retirement age, the length of retirement at death *cet. par.* decreases. Increases in the life expectancy delay death, and therefore cause the length of retirement at death to increase. Seeing that the life expectancy at retirement increases continuously over the 2016-2070 simulation period by 5.1 and 4.7 years for men and women (EC, 2017c, Table I.1.4, 16), this clearly will cause the mean length of retirement to increase. The increases of the effective retirement age that result from increases of the SRA and other policy changes would kick in only in the second half of the simulation period, since we consider averages *at death*. This therefore would limit the increase of the duration of retirement only from the second half of the simulation period on. To see this, assume a typical male individual that retires in 2016 at the age of 65. His life expectancy at 65 is then 18 years (*op. cit.*), so he is expected to die in 2034. So aforementioned policy changes that caused people to delay (early) retirement following the reforms of 2011 and 2015 and thereafter, will have their impact only then.

Next, the below graph shows the length of career on the moment of death. This indicator increases considerably over the simulation period, reflecting the increased activity rate of women. However, this increase is also outspoken because of an omission in the data. The law that established the Bismarckian first-pillar pension system as we know it today was established in the years 1955 – 1957. A minority of those dying in the first decade of the simulation period may have entered the labour market before the pension system was created. Those that did do so, therefore have a shorter career than cohorts that entered (just) after the implementation of the pension system. This is why, in the 2011 administrative data that is the foundation of MIDAS, we observe a sharp decline in the average length of the career of the oldest cohorts of pensioners. This technical effect adds to the increase of the length of career at death.

Finally, Graph 7 shows the ratio of the average length of retirement at death and the average length of career at death. Here we see a different development between men and women. For men, this ratio increases over time, because the increase of the denominator exceeds that of the numerator. However, the life expectancy of women increases less than for men, while the activity rate of women increases considerably faster. Hence the ratio starts of higher (high life expectancy, low career length), but decreases over time and converges to that of men.

Graph 7 Mean length of retirement over mean length of career at death



2.4. Sensitivity tests

To test the potential sources of risk to future public expenditure developments, the AWG proposes different variant scenarios introducing a change or a shock to underlying assumptions in the projection framework. Most of these sensitivity tests can also be viewed as an assessment of the impact of any possible policy changes with quantifiable effect on key assumption variables. The combination of the base variant and sensitivity tests therefore shows what the key factors driving the simulation results are, and the potential sources of risk to future developments (EC, 2017c, 82). The exception is the last variant to be discussed below, which is not a sensitivity test but a policy scenario. In what follows we propose an assessment of the impact of some of these variant scenarios on the three adequacy measures presented above.

The AWG sensitivity tests simulated here are briefly described hereafter (see *op. cit*, chapter 5 for an extensive description):

– Higher/lower TFP growth (HP/LP): total factor productivity growth converges by 2045 to a steady-state growth rate which is 0.4 percentage points higher/lower than in the base scenario. This implies a change of +0.6/-0.6 percentage point of productivity growth.

- TFP risk scenario (RISK): total factor productivity growth is assumed to reach a 0.8% growth rate (instead of 1% in the baseline scenario) in 2045. This implies a change of -0.3 percentage point of productivity growth.
- Higher/lower employment rate (HE/LE): the employment rate for the age group 20-64 increases/decreases by 2 percentage points between 2018 and 2030 compared to the baseline.
- Higher employment rate of older workers (HE_OLD): the employment rate of older workers (55 and older) increases by 10 percentage points between 2018 and 2030 compared to the baseline.
- Higher life expectancy (HLE): progressive increase in life expectancy at birth reaching 2 years in 2070.
- Lower fertility (LF): fertility rate is assumed to be 20% lower compared to the baseline over the entire projection horizon.
- Linking retirement ages to life expectancy (LRA_TO_LE): automatic mechanism revising the retirement age with the evolution of life expectancy.

The names by which the scenarios are described will be used in the below tables and discussions. The three adequacy indicators will be presented for the elderly population in percentage-point difference to the baseline scenario. A positive value thus shows that the scenario results in an increase of the indicator relative to the baseline.

Table 4 Impact of variants on pension adequacy

	2016	2020	2030	2040	2050	2060	2070
Risk of poverty (AROP for the elderly (age>=SRA), deviation from the baseline in pp							
Baseline	7.585	7.762	7.321	6.002	5.090	4.600	4.109
Higher life expectancy (HLE)	-0.001	-0.020	0.055	0.178	0.126	0.180	0.270
Higher lab. Productivity (HP)	0.000	0.000	0.033	0.441	1.099	2.256	7.492
Lower lab. Productivity (LP)	0.000	0.000	-0.041	-0.345	-0.927	-1.354	-1.654
Higher emp. Rate (HE)	0.000	0.007	0.032	0.044	0.166	0.001	0.056
Lower emp. Rate (LE)	0.000	0.001	-0.130	-0.067	-0.172	-0.126	-0.070
Higher emp. Of older workers (HE_OLD)	0.001	-0.023	-0.312	-0.561	-0.705	-0.800	-0.705
Lower fertility (LF)	0.014	0.080	0.141	0.187	0.207	0.446	0.818
Risk scenario (RISK)	0.000	-0.017	-0.160	-0.301	-0.678	-0.932	-0.946
Policy scenario (LRA_TO_LF)	0.001	0.065	-0.022	0.033	0.088	-0.132	-0.116
Gini for elderly (aged>=SRA), deviation from the baseline in pp.							
Baseline	0.184	0.182	0.170	0.158	0.151	0.148	0.152
Higher life expectancy (HLE)	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Higher lab. productivity (HP)	0.000	0.000	0.000	0.003	0.010	0.017	0.027
Lower lab. productivity (LP)	0.000	0.000	0.000	-0.003	-0.008	-0.014	-0.021
Higher emp. rate (HE)	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001
Lower emp. rate (LE)	0.000	0.000	0.001	0.000	0.000	0.001	0.001
Higher emp. of older workers (HE_OLD)	0.000	0.000	-0.002	-0.003	-0.004	-0.005	-0.004
Lower fertility (LF)	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Risk scenario (RISK)	0.000	0.000	-0.001	-0.003	-0.006	-0.009	-0.012
Policy scenario (LRA_TO_LF)	0.000	0.001	0.000	0.000	0.001	-0.001	0.000
Income quintile share ratio (S80/S20) for elderly (aged>=SRA), deviation from the baseline							
Baseline	2.515	2.498	2.367	2.212	2.129	2.100	2.134
Higher life expectancy (HLE)	0.000	0.000	0.005	0.006	-0.001	0.007	0.009
Higher lab. productivity (HP)	0.000	0.000	0.004	0.043	0.114	0.192	0.289
Lower lab. productivity (LP)	0.000	0.000	-0.004	-0.041	-0.110	-0.172	-0.253
Higher emp. rate (HE)	0.000	-0.001	-0.007	-0.007	-0.001	-0.013	-0.012
Lower emp. rate (LE)	0.000	0.001	0.009	0.005	0.007	0.013	0.007
Higher emp. of older workers (HE_OLD)	0.000	-0.001	-0.027	-0.052	-0.052	-0.072	-0.093

Productivity variants are those with the highest impact on these three indicators. In 2070 and compared to the baseline, the at-risk-of-poverty rate increases by 183% for the variant HP, decreases by 40% for the variant LP and by 22% for the variant RISK. In terms of percentage points, these variations represent respectively +7.4, -1.6 and -0.9, the at-risk-of-poverty rate of the elderly in 2070 in the baseline being 4.01.

This positive relationship between productivity and the poverty risk of pensioners can be decomposed in two opposite effects. The level of pensions will benefit from higher wages. This is the direct effect whose development is very slow. Indeed, the full maturity of this effect appears after a complete career of 45 years benefiting from higher wages and, only for new pensioners or elderly. The direct effect will decrease the poverty risk of the elderly. The second and opposite effect operates through the poverty threshold. This is the indirect effect. Higher wages increase the poverty line, which in turn increases the poverty risk of the elderly. As this effect is stronger than the direct effect, the poverty risk of elderly increases when productivity increases.

Impacts of higher/lower employment variants are very limited. The at-risk-of-poverty rate of the elderly respectively increases by 0.06pp and decreases by 0.07pp in 2070 compared to the baseline scenario. As for productivity variants we find a positive relationship between employment rate and poverty risk of pensioners and the decomposition of this effect is also very similar. A higher employment rate leads to longer career and/or less assimilated periods (unemployment, disability, early retirement …). This will improve le level of pensions and reduce the poverty risk of pensioners. The development of this direct effect is – here again – slow because it operates through the composition and/or the length of career of new pensioners. And here also, the indirect effect runs via the poverty threshold. Indeed, more employment implies more incomes from work which leads to a higher poverty line.

The last two variants have the following common characteristic: an increase in the effective retirement age. The higher employment scenario for older workers (HE_OLD) reduces the poverty rate of the elderly by 0.7pp in 2070 to the baseline. The scenario linking the retirement age to the life expectancy (LRA_TO_LE) reduces the poverty rate of pensioners by 0.11pp in 2070 to the baseline. The effect of this last scenario is quite limited because the increase in retirement age start only from 2050. Increasing employment for old age categories benefits directly to the pensioners without having a (too strong) counter effect through the poverty threshold.

2.5. Adequacy and budgetary impact

Finally, the original problem of this study was to simulate indicators of pension adequacy while being as consistent as possible with the simulations and assumptions that have been used by the AWG in the simulation of pension sustainability. The below Table summarises the results by showing the impact of the simulation variants on public pension expenditures (in the first column) and the at-risk-of-poverty rate of the pensioners in the second column. Does a variant that reduces poverty increase the budgetary cost of ageing, or vice versa? Or, inversely stated, is there a variant that allows to reduce the cost of ageing while maintaining or even reducing poverty?

Table 5 Sensitivity tests: impacts on public pension expenditures (deviation from the baseline in p.p. of GDP) compared to the at-risk-of-poverty rate of pensioners (deviation from the baseline in p.p.); 2070

	Public pension expenditures*	At-risk-of-poverty rate of the elderly
HP	-1.8	7.50
LP	2.1	-1.66
RISK	1.1	-0.93
HE	-0.4	0.06
LE	0.4	-0.07
HE_OLD	-1.4	-0.71
HLE	0.8	0.27
LF	2.0	0.80
LRA_TO_LE	-1.1	-0.12

* Source: FPB, 2017, Table 23, page 26.

The first conclusion to be drawn from Table is that most variants show an inverse relation between sustainability and adequacy, represented by the AROP. The high-productivity variant (HP) reduces the cost of ageing, but at the cost of increasing poverty risk among the pensioners. The variant with low productivity reduces poverty, but at the cost of increased cost of ageing. The same goes for the RISK scenario. Some scenarios however increase the cost of ageing while also increasing the AROP. For example, the scenario with higher life expectancy will increase the cost of ageing, as there will be more elderly, but the AROP will also increase since the pensioners will get older and will therefore see their pension benefit decrease further. But, fortunately, the inverse holds as well. The variants with high and low employment reduce, respectively increase the cost of ageing, but the (indirect) impact on the poverty risk is limited. Finally, the variant with the higher employment rate of older active people (HE_OLD) results in a considerable reduction of the cost of ageing, while at the same time reducing the poverty risk among the elderly.

3. Country results for Sweden[8]

3.1. The model SESIM and its base data

SESIM is a general microsimulation model that can be used for a broad set of analyses. The model is a mainstream dynamic microsimulation model in the sense that the variables (events) are updated in a sequence, and the period between the updating processes is a year. All individuals are subject to a large number of possible events, reflecting real life phenomena, such as education, marriage, parenthood, work or retirement.

SESIM has a recursive structure, where different modules are executed in a predetermined order. The unit of simulation is the individual, but the household also plays a significant role. Many of the simulated processes refer to household as well as individual properties. The simulations start with the demography (mortality, adoption, migration, household formation and dissolution, disability pension, rehabilitation and regional mobility). In the next step, variables concerning education and the labour market (unemployment, employment etc.) is calculated. Every year the individuals are assigned a status. Each individual can have only one out of nine different statuses during a specific year. Every status is related to a source of income. Employment results in earnings; retirement brings pensions etc. Employed individuals have earnings. For others, for example unemployed, different rules are applied to obtain the income or wealth.

Rules for taxes, transfer and pensions are implemented in all relevant detail (i.e. public, occupational and private pensions). This include rules for all three pillars of pensions. All pensioners are assumed to claim full time pension since the model cannot not handle mixed statuses. However, pensioners can also earn work income. In the AWG analysis, the labour market is central, especially employment, unemployment, retirement and disability. The average effective retirement age is aligned to track the AWG labour market assumptions. Some pensioners continue to work after they started to pick up their public pension and might thus be counted as employed.

The primary database for SESIM, is the Statistics Sweden longitudinal database LINDA. The database is created from administrative registers and covers about 3.5 percent of the Swedish population. In 1999, the primary sample was 308 000 individuals. Including household members, the total sample size was 786 000 individuals. Some information, for instance pension rights, can be traced as far back as to 1960.

The most important exogenous economic variables in SESIM are inflation, real income growth per capita, interest rates. In this report relevant macro numbers follows the AWG assumptions. The calculations are made in current prices. The indexation rules are implemented in detail in the model. All items that are price indexed by legislation, have been income indexed from 2021 in the projections (for example the housing allowance for pensioners and the guarantee pension). It is also assumed that the rate of return on funded assets in the individual public DC funds and the individual occupational pension accounts will be the same for all individuals.

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8 This section is based on the Swedish pension fiche prepared for the AWG projections for age-related public expenditure 2018, previously presented for the EU EPC Ageing Working Group (AWG).

Since the beginning of the century the exit age from the labour market shows a strong increase. However, in the projections the exit age is fixed in line with the AWG assumptions. However, in the "Policy scenario", the age limits and the pension behaviour is shifted to increase the effective pension age in line with longevity.

3.2. An overview of the pension system

The Swedish public old-age pension system covers everyone who has worked or lived in Sweden and consists of an earnings-related component based on notional accounts, a private mandatory defined contribution system and a pension-income-tested minimum top-up, the guarantee pension. On top of that, most employees are covered by occupational pension schemes. The possibility to make tax-deductions for private pension savings was abolished in 2016.

3.2.1. Public pensions[9]

The earnings-related old-age pension system consists of a notionally defined contribution (NDC) PAYG component and a fully funded, defined contribution (DC) pension component. Both are based on lifetime earnings and individual accounts. In addition, there is a minimum pension-income-tested top up, the guarantee pension, which is financed by general taxes from the central government budget. The same pension rules apply to all persons regardless of occupational sector and for employees and self-employed alike. The old-age pension system is independent in the sense that income and expenditure are governed by a fixed set of rules, and not part of the Government budget. The system has a high degree of political independence as its rules are decided in agreement by a six-party working group in Parliament.

The earliest possible retirement age is 61 years for earnings related income pension and 65 years for the non-earnings-related guarantee pension. The retirement age is flexible, and individuals can claim benefits from the age of 61 without any upper limit. The decision to draw a pension does not mean that the employee must stop working. He or she can continue to work and earn new pension entitlements. Under the Employment Protection Act an employee is entitled to stay in employment until his or her 67th birthday.

The yearly income pension is calculated on the individual's pension entitlements at retirement and the expected remaining life length. Hence, if a person retires early, at the age of 61, the pension will be correspondingly smaller than if he or she decides to postpone retirement. The non-earnings-related guarantee pension is reduced in proportion to the time spent in Sweden, with a full pension awarded after 40 years of residence.

Pension rights are credited to the individual accounts for 18.5 percent of the annual pensionable income up to a ceiling amounting to 8.07 income base amounts. 16 percentage points are paid to the NDC PAYG system and 2.5 percentage points to the funded DC system. Contributions are also paid by the

[9] The description applies for the current legislation. However, in December 2017 there was an agreement in the parliamentary Swedish Pensions group, including higher age limits, better minimum pensions and improved management of the DC Premium pension funds. This means that the Swedish results presented in this paper underestimates pension income.

central government to cover pension entitlements credited for social insurances, such as benefits for unemployment, sickness, disability or parental leave.

3.2.2. Occupational pensions

Most employees in the public and the private sector, some 95 per cent of all female and 93 per cent of all male employees, are covered by semi-mandatory occupational pension schemes based on collective agreements between the unions and the employers' confederations. These occupational pension schemes, financed through employers' contributions, provide a supplement to the public system, and a top-up for incomes above the public pension system ceiling. Thus, these schemes are more important for high-income earners. There are four major occupational plans: blue-collar workers in the private sector, white-collar workers in the private sector, central government employees and local government employees.

3.2.3. Private pensions

The second part of the public system is a mandatory fully funded defined-contribution part, the Premium pension. The system is administered by the state and financed by a contribution rate of 2.5% of pensionable earnings, following the same transition rules as the PAYG system. In the National Accounts, however, this system is a part of household savings. Individuals can choose from several hundred funds when investing their capital. A government run default fund caters for people who do not make an active choice. The individual mutual funds earn a market rate of return. At retirement, at any age from 61 years, individuals can choose a fixed or variable annuity, in part or in full. It is possible to include a survivor's protection component for this part of the public system which will give a partner the right to accumulated funds. In this case the pension will be lowered to reflect the expected longer payment period.

Until 2016 it was possible to make tax-deductions for private pension savings voluntarily.[10]

3.3. Results for Sweden[11]

In this section a selection of indicators will be presented and discussed. This includes the at-risk-of-poverty (AROP) rates, the Gini and S80/S20.

3.3.1. What should the reader take into account when considering the simulation results?

- All indicators of poverty and inequality are calculated on equivalent after-tax income, i.e. total disposable household income adjusted for the size and composition of the household through the modified OECD scale[12].

10 Self-employed without occupational pensions still have the right to do tax-deductions.

11 See tables 1 and 2 or European Commission (EC), 2017c for a more detailed description of underlying assumptions and projection methodologies.

12 This assigns a value of 1 to the first household member, of 0.7 to each additional adult and of 0.5 to each child. The use of the OECD scale means that the results might differ from measures published by Statistics Sweden concerning the same group.

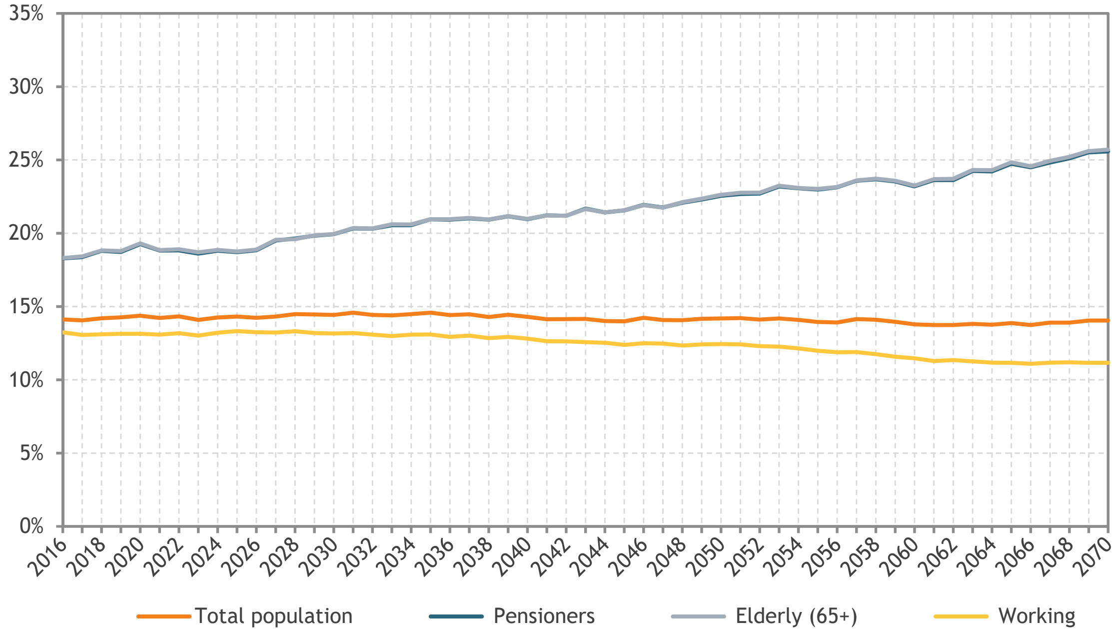
- The results are presented for different age groups, not working and pensioners strictly. This makes it easier to compare the results with different sources, e.g. EU-SILC. Working is defined as all individuals in active age between 20 and 64 years. Regarding the groups Pensioners and Elderly (65+) the difference is very small in the baseline scenario, as the retirement age is assumed unchanged.
- Households with negative disposable income have been removed in the calculation of the measures.
- The results are sensible to the choice of income indexation of minimum pensions and basic security. All types of pensions, benefits and thresholds in the pension and tax systems are income indexed from 2021 in the calculations, regardless if legislation states otherwise.
- The calculations are based on the current legislation and no account is taken for the agreement in the parliamentary Swedish Pensions group in December 2017. The agreement includes higher age limits, better minimum pensions and improved management of the DC Premium pension funds. The plan is that the new rules will entry in to force during the period 2020 to 2026.
  - The results in the baseline variant
    - At Risk of Poverty (AROP)

As with the above results for Belgium, the risk of poverty is defined as 60% of median equivalent household income. The results for Sweden are shown in Graph 8. The most striking feature is the increasing risk of poverty for 65+. The result is approximately the same for pensioners (i.e. individuals with old-age pension), as the average pension age is close to 65. This result, which is in broad lines comparable to the 2015 projections for Sweden (Dekkers *et al.*, 2015), is caused by a combination of increasing life expectancy and the assumption of a fixed retirement age at 65 years in the base scenario. The Swedish pension system is a NDC that works on an actuarial basis. At the time of retirement an annuity is calculated by dividing the individual's account value by a divisor reflecting unisex life expectancy at the specific date of retirement. So as a result of increasing life expectancy, the annuity decreases. The individual can counteract the negative effect on the annuity caused by increasing life expectancy by postponing the date of retirement, but the assumption of a fixed retirement age causes the increases in the activity rate to be limited and not enough to counter the first development. So pensions are gradually pressed down as the annuity divisors, which are based on the longevity, grow. The increase of the AROP of the elderly and pensioners can therefore also be interpreted as showing the consequences of the AWG's assumption on unchanged retirement age.

Additionally, the risk of poverty for the working age population is decreasing, resulting in approximately unchanged poverty risk development for the total population[13].

[13] Data is only presented from 2015 as there is a break in the time series 2013 to 2014 that makes comparisons over time problematic.

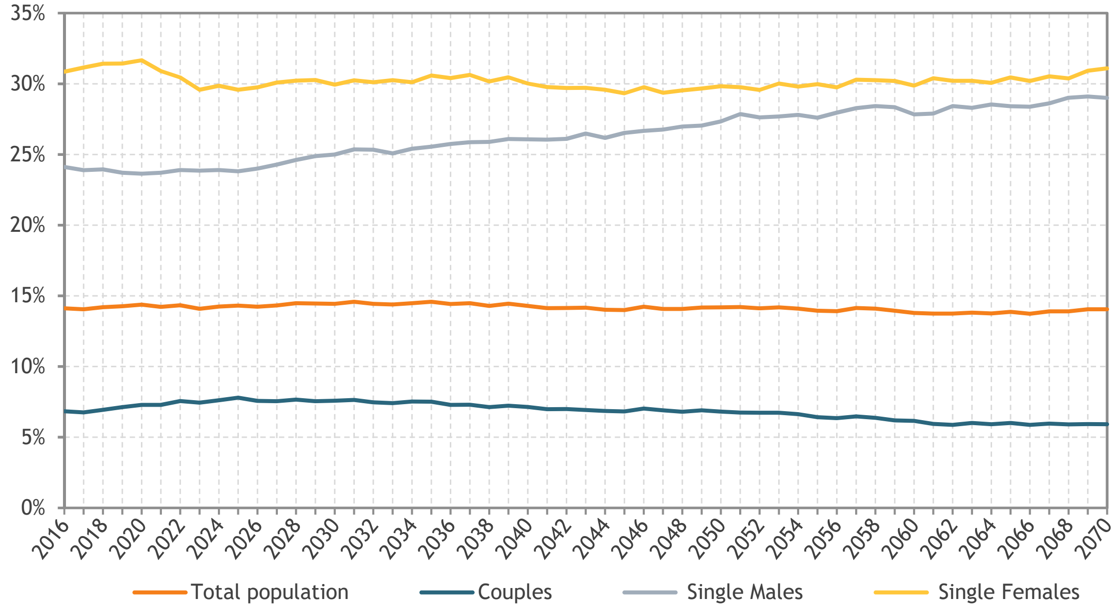
Graph 8 Poverty risk to state



Source: Ministry of Health and Social Affairs.

The AROP for different household types is stable with the exception for Single Male households (with or without children and without any age restrictions), see Graph 9. This might be explained by that many retired Single Woman already having minimum pension, and that this will be more common among Single men when the replacement rate decreases due to the increasing longevity.

Graph 9 Poverty risk to household type



Source: Ministry of Health and Social Affairs.

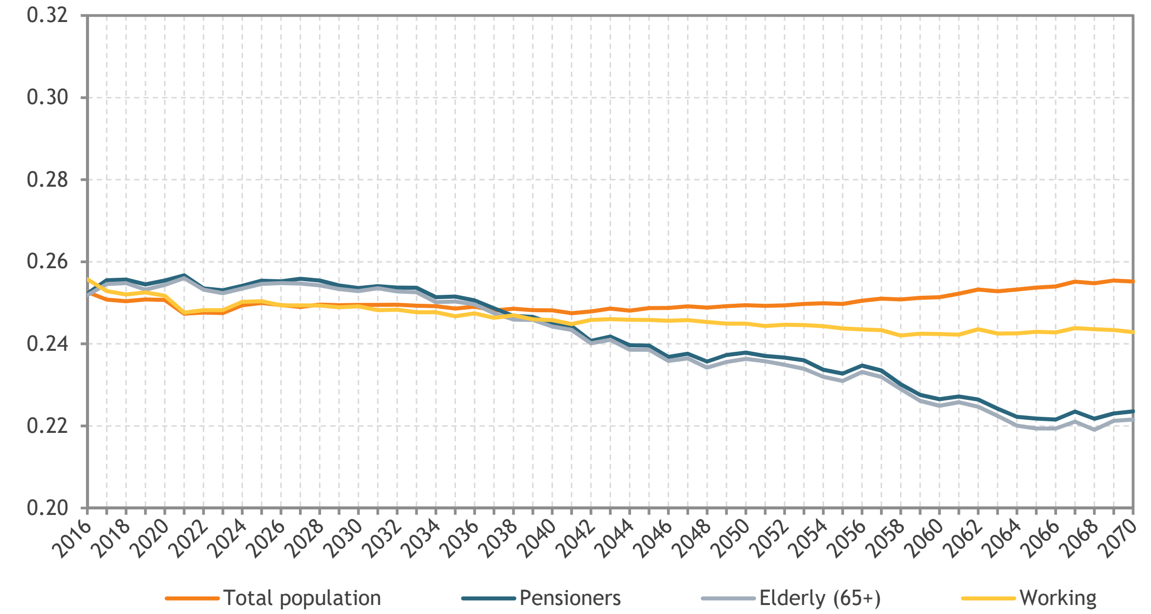
a. Gini inequality measure

The Gini inequality measure is calculated for each group separately. The Gini for the total population is expected to increase somewhat during the projection period, as can be seen in Graph 10.

On the other hand, the Gini will decrease for both the working age population and the pensioners. This is due to decreasing Gini within both the groups, at the same time as the difference between the groups is increasing. This in turn is due to gradually lower pension replacement rates.

Because of the increasing risk of poverty among 65+, the Gini for pensioners will fall relative to the total. The explanation for this is that more and more pensioners will get minimum guarantee pension that is limited by a ceiling and the same for all. That means that the income distribution for pensioners will become more compressed.

Graph 10 Gini to state

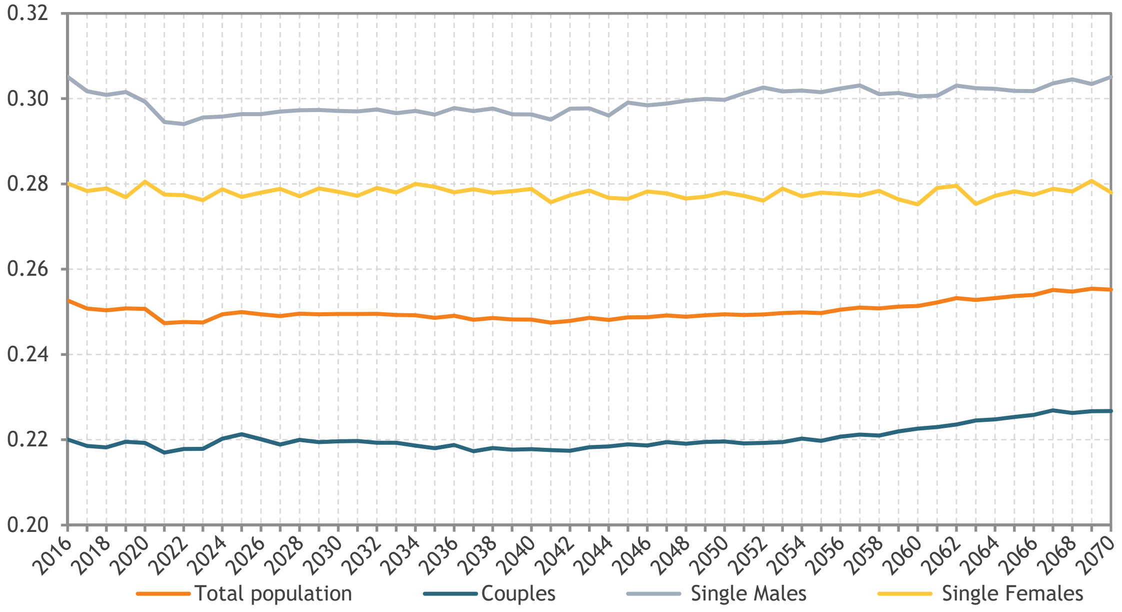


Source: Ministry of Health and Social Affairs.

- The development for the Gini for different household types is stable, but there is substantial differences between the different types. The low level for cohabiting households is explained by the equalization within the households and by the assumption that all household members have the same economic standard.
- The high level for single households are also explained by the fact that they are single income earners (in most cases) and thus no equalization occurs within the households.

Next, we turn to the Gini to household type. This is shown in Graph 11.

Graph 11 Gini to household type



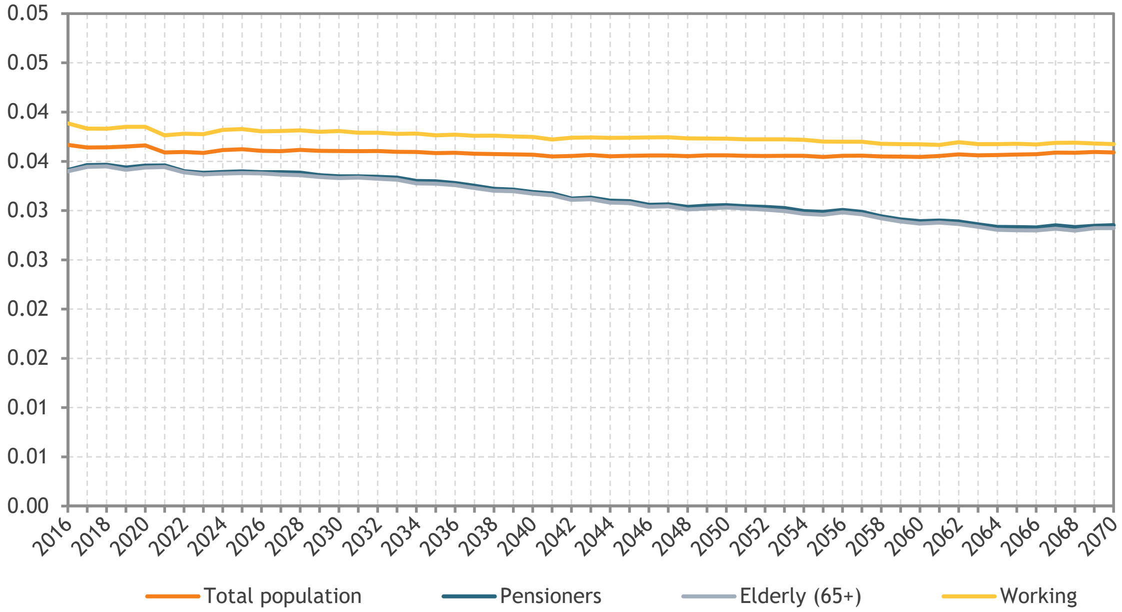
Source: Ministry of Health and Social Affairs.

b. The Income quintile share ratio S80/S20

The Income quintile share ratio S80/S20 compares the sum of income earned by the 20% persons with the highest incomes to that held by the 20% of the persons with the lowest incomes. It is complementary to the Gini because it is more sensible to changes in the extremes of the income distribution.

Graph 12 shows the Income quintile share ratio (S80/S20) to state.

Graph 12 Income quintile share ratio (S80/S20) to state

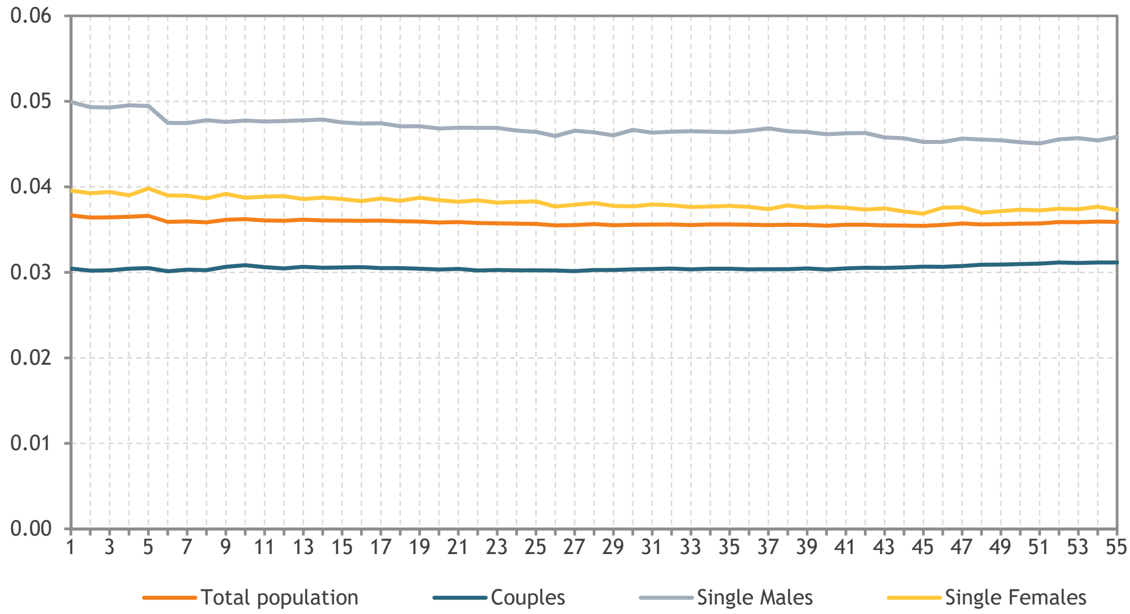


Source: Ministry of Health and Social Affairs.

Overall the Income quintile share ratio shown in Graph 12 tells the same story as the Gini in Graph 10. However, the Income quintile share ratio for the total is flat, in contrast to the Gini that is increasing slightly. The Income quintile share ratio measures show a slightly decreasing trend for the working age population and especially for 65+. The reason for the latter is the same as for the Gini, i.e. that more pensioners will get minimum guarantee pension that is on the same level for all. The calculations are of course stylized compared to the real world. To recreate the variety techniques for variance reduction are used. However, in such a long horizon as here, 2070, the quality of the results is an open issue. Especially the results for the Income quintile share ratio might be sensible, as they are calculated in the tails of the income distribution.

Next, we present the Income quintile share ratio (S80/S20) to household type. This is shown in Graph 13. First of all, the regarding different household types development is stable but the level differs. The S80/S20 for cohabiting is lower than the total. For single men and women, the Income quintile share ratio is expected to fall somewhat. This is probably explained by many of the pensioners living in single households, especially women, and that the decreasing replacement rate leads to a more compressed income distribution within this group. Contrary to the Gini for the Total is the Income quintile share ratio stable. This might be explained by the properties of the measures where the Gini is more sensible to changes in the middle of the income distribution and the quintile share ratio more sensible to what happens in the tails of the distribution. The series seems to be more or less unchanged over the projection period. If one looks sharp there is a small increase for Single men. The reason for this might be the same as for the Gini, i.e. that also more Single men will get minimum pension.

Graph 13 Income quintile share ratio (S80/S20) to household type



Source: Ministry of Health and Social Affairs.

c. Length of retirement

Contrary to the previous report (Dekkers *et al.*, 2015), some countries now present indicators based on the average length of retirement at death; the ratio of the average length of retirement at death over the average length of career at retirement. This is the only indicator that has an apparent aggregate-level counterpart provided in AWG projections.

The average length of retirement is calculated by the Commission as the difference between "life expectancy at average effective exit age and the average effective exit age itself", and where the latter comes from the Commission's Cohort Simulation Model and the former from Eurostat's projections. For any simulation year x, the Commission takes the ratio of the average length of retirement of those dying in x and the average length career of those reaching retirement in that year. Obviously, these are not the same people. Use of a longitudinal model makes it possible to overcome this problem, and follow the same individuals. These differences make it hard to compare the results between the Commission's and the model results. The latter should therefore be seen as complementary to the former. Due to the time restriction, no longitudinal results have been calculated for Sweden. Instead we have chosen to present the numbers from the AWG pension fiche below. Although not fully comparable, the general picture is similar to the other countries.

The length of retirement at death is a function of the exit age from the labour market and the life expectancy. As a result of the assumption about a constant effective exit age (from 2020) and an increasing life expectancy, the length of retirement at death increases. The life expectancy at retirement increases continuously until 2070. The stable exit age result in a stable length of the contributory period for men but an increase for women, reflecting the increased activity rate of women. For men the ratio of the average length of retirement at death and the average length of career at death, is growing contrary than for women, where the growth of the ratio is mitigated by the longer contributory period.

Table 6 Labour market effective exit age and expected duration of life spent in retirement - Men and women

	2017	2020	2030	2040	2050	2060	2070	Peak year
MEN								
Average effective exit age (CSM) (II)	65,9	65,6	65,6	65,6	65,6	65,6	65,6	2017
Contributory period	41,1	41,0	40,0	36,7	38,8	38,3	39,9	2021
Duration of retirement	18,3	18,6	19,5	20,3	21,1	21,9	22,7	2070
Duration of retirement/contribution period	0,4	0,5	0,5	0,6	0,5	0,6	0,6	2044
WOMEN								
Average effective exit age (CSM) (II)	64,7	64,4	64,4	64,4	64,4	64,4	64,4	2017
Contributory period	39,1	39,9	39,8	37,5	40,4	40,0	41,5	2064
Duration of retirement	21,8	23,0	24,0	24,9	25,8	26,7	27,5	2070
Duration of retirement/contribution period	0,6	0,6	0,6	0,7	0,6	0,7	0,7	2047

Source: Commission services

3.3.2. Sensitivity analysis

Beside the baseline scenario AWG also decided to make an additional set of eleven sensitivity scenarios in order to quantify the responsiveness of results to changes in key drivers, such as macroeconomic, population and policy variables. The combination of the base variant and sensitivity tests therefore shows the key factors that is driving the simulation results, and the potential sources of risk to future developments.[14]

The sensitivity scenarios can be divided into three groups:

1. Productivity (higher / lower/ risk)

2. Demographics (higher life expectancy, lower migration)

3. Labour market (higher employment, older workers, policy)

In the sensitivity scenarios the pension age is normally based on the current pension behaviour. However, in the Older workers' scenario and the Policy scenario, the age limits and the pension behaviour is shifted in line with the AWG labour market assumptions in order to increase the average exit age. In the model this is technically achieved by having older cohorts mimic the labour market behaviour of younger cohorts. In the policy scenario also, all relevant age limits are increased with 2/3ds of the increase in longevity, approximately keeping the percentage of adult life spent at retirement constant. This is in line with the agreement in the parliamentary Swedish Pensions group in December 2017.

Note that all systems (tax brackets, ceilings etc.) are assumed income indexed and will grow at the same pace as GDP in the calculations.

The results are presented as deviations from the "baseline" in the same manner as in the AWG pension fiches. Tables 7-10 below shows the values of the three adequacy indicators for different age groups (Total, 20-64, 65+). Together they provide an interval – in a strictly non-statistical sense of the word – of the simulation results. In the text below the results are commented briefly for the different indicators. The focus will be on the effects for the group Elderly (65+) and will therefore exclude household types.

a. At Risk of Poverty (AROP)

The general picture is the increasing risk of poverty for the Elderly (65+). This is to a large extent the result of the AWG's assumption about a fixed effective exit age, except for the Older workers and the Policy scenarios.

- In the Policy and the Older workers' scenario the increased employment among elderly, resulting in a higher exit age, the hike in Risk of Poverty is mitigated by that more Elderly (65+) works. Still, the increase in the poverty risk in these scenarios ends up higher than in the baseline scenario. This is partly explained by that the relevant age limits are only increased with 2/3ds of the increase in longevity and that some groups, for example disability pensioner, has left the labour market before the current age limits and thus are unable to prolong their working lives.
- After the first decades the risk of poverty will increase in the Policy scenario, due to that more individuals are working, thus raising the median income, at the same time as the impact on paid out pensions is limited. The prolonged working careers will gradually lead to higher pensions, and the risk of poverty compared with the baseline will start to decrease around 2050. In the longer run the

[14] See sections 1.4 and 2.4 or the Swedish AWG pension fiche for details about the scenarios.

effect will level out depending on the projected development of the longevity and the related changes in the pension age limits.

- Higher productivity as well as higher employment rate increases the poverty risk for the group Elderly (65+) as the income for group Working age increases immediately, which causes the poverty line (defined as 60% of the median income) to increase as well. This is the indirect effect of a productivity change on poverty of the elderly. But there is also a direct effect, being that the income for pensioners will increase as well, as productivity and wages increases, albeit with a time lag. Hence, the indirect effect outweighs the direct effect and a higher productivity will therefore increase the poverty risk of the Elderly substantially. However, note that the poverty is not growing in absolute terms, only relative to the Working population. Following the same line of reasoning, mutatis mutandis, the Lower productivity scenario and the Risk scenario lower the poverty risk of the Elderly.
- The effects in the sensitivity scenarios are small on the group Working compared to the effect on Elderly (65+), particularly for the productivity scenarios. Unlike for Elderly (65+), the poverty risk for Working age (20-64) is decreasing slightly in the Baseline scenario. The aggregated effect of this will be an approximately unchanged risk of poverty for the total population.
- The increased risk of poverty in the Policy scenario in the group Working age (20-64) is explained by that more people work under this scenario and that this pushes up the poverty line.

A quick comparison with the Belgian results shows that the negative impact for pensioners of the higher employment rate for older workers (HE_OLD) and the policy scenario (LRA_TO_LE) is the opposite in Belgium where the direct effect on the pensions outweighs the indirect effect on the poverty line. The impact of an increasing overall employment rate (HE) and a higher productivity (HP) hinges on two countering effects: the indirect effect that causes the poverty rate of the elderly to increase, and the direct effect that reduces it; especially in the short run. In Sweden, the indirect effect exceeds the direct effect, so that the poverty risk of the elderly increases. In Belgium, the two effects more or less cancel each other out in the high-employment scenario, to that the impact on the poverty risk of the elderly is nearly absent. Like in Sweden, increasing productivity will increase the poverty risk of the elderly in Belgium. The arguments on the direct and indirect effects are also the same, but there is an additional effect that is more important in Belgium than in Sweden.

In Sweden the NDC pensions in payment are growing with average earnings. However, for the individual the replacement rate from the public NDC pension will decrease when the individual grows older, as the payments are frontloaded, i.e. the pensioners receive a share of the real economic growth in advance. The indexation of the NDC pension is then reduced during the pay-out time by subtracting 1.6 per cent from the yearly income indexation.[15]So as productivity and wages grow faster, so do ongoing pensions. In Belgium, in contrast, the indexation regime for on-going pensions is independent on productivity. A higher productivity scenario will therefore result in a (relative) deterioration of on-going benefits and therefore cause the poverty risk of the elderly to go up.

[15] Technically this is achieved by calculating the annuity factor with a 1.6 per cent discount factor, resulting in a higher initial benefit than a straightforward application of the actuarial principles would give. For details see annex 2 in The Swedish AWG pension fiche.

b. Gini inequality measure

The effects of the scenarios on the income distribution are complex; they depend on the trajectory of different variables, and the development in different subgroups. In this context it is again important to remember that all systems (tax brackets, ceilings etc.) are income indexed. In some cases, it is impossible to determine the sign of the effects on theoretical grounds only.

- As a result of the assumption pertaining to the fixed pension age, the drop in income inequality among the Elderly in the baseline scenario is more considerable than for the population as a whole, something which is also the case for Belgium. Among other things, the fixed retirement age causes an increasing proportion of pensioners to gather around the minimum pension level.
- The decrease in the baseline scenario in the Gini for Elderly (65+) is also explained by the historic increase in the participation rate for women, i.e. that woman that entered the labour market before approx. 1995 had a shorter contributory period on average than men. This effect is expected to fade out until about 2030.
- The most evident effects on the Gini for the Elderly (65+) are in the Older Workers and the Policy scenarios. The reason for this is that the fraction of pensioners will decrease and more individuals 65+ will work, thus raising the median income.
- Also, the effect in the productivity scenarios is considerable for the Elderly (65+) due to that more/less pensioners will gather around the level of the minimum pension.
- In the Policy scenario the Gini for the total population and Working population (20-64) is lower compared to the Baseline, but higher for Elderly(65+). This might be explained by that more individuals 65+ have earnings.

In the Higher labour productivity scenario, the Gini is decreasing for the group Elderly (65+), and consequently increasing in the Lower productivity and the Risk scenarios. This is the reversed results compared to those presented for Belgium in section 2.4, and is again the result of the fact that the indexation of on-going pensions is independent from productivity in Belgium. As wages grow faster in a high-productivity scenario, the differences in pensions between young pensioners (who retired shorter ago and therefore have less impact of the relatively lower indexation) and old pensioners (who have more impact of the relatively lower indexation) increases, and this causes the Gini of the elderly to increase in Belgium. In Sweden, this effect does not appear since pension benefits in average increases with the productivity.

c. Income quintile share ratio (S80/S20)

- The effects on S80/S20 are generally small and similar to the effects on the Gini when looking on sign and rank.
- In the same way as for the Gini the effects are most obvious for the Elderly (65+) in the Policy scenario, and to some extent the Older workers scenario, as more people work after 64.
- Again, the effects of the productivity scenarios for the Elderly (65+) might be explained by that more/less pensioners will gather around the level of the minimum pension, as the impact of the growing wages will affect the pensions with a substantial time lag but the earnings immediately. For

the Total and Working (20-64) groups the effects are close to zero, except for the scenarios with higher employment and Lower fertility.

Table 7 Risk of poverty (AROP) for different groups under different scenarios (deviation from the baseline in p.p.)

	2016	2020	2030	2040	2050	2060	2070
Total							
Baseline	**14,1**	**14,4**	**14,4**	**14,3**	**14,2**	**13,8**	**14,0**
Higher life expectancy (2 extra years)	-0,1	-0,2	-0,2	-0,1	-0,2	-0,1	-0,2
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,1	0,1	0,1	0,5	1,1
Lower lab. productivity (-0.25 pp.)	0,0	0,0	0,0	-0,1	-0,2	-0,2	-0,5
Higher emp. rate (+2 pp.)	0,0	0,0	-0,2	-0,2	-0,1	0,0	0,0
Lower emp. rate (-2 pp.)	0,0	0,2	0,1	0,2	0,1	0,0	0,2
Higher emp. of older workers (+10 pp.)	0,0	-0,1	-0,1	0,1	-0,1	-0,1	0,0
Higher migration (+20%)	0,2	-0,2	-0,1	-0,1	0,1	0,1	0,0
Lower migration (-20%)	-0,2	-0,1	0,0	0,1	-0,2	-0,1	0,2
Lower fertility	0,3	0,3	0,7	0,8	0,9	0,7	0,2
Risk scenario	0,0	0,0	-0,1	-0,1	-0,1	-0,2	-0,6
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,2	0,2	0,3	0,4	0,7	0,6
Elderly (65+)							
Baseline	**18,3**	**19,3**	**19,9**	**21,0**	**22,6**	**23,3**	**25,7**
Higher life expectancy (2 extra years)	0,0	-0,4	0,0	0,2	-0,1	-0,2	-0,4
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,1	0,8	1,2	2,3	3,9
Lower lab. productivity (-0.25 pp.)	0,0	0,0	0,0	-0,5	-1,7	-1,7	-3,2
Higher emp. rate (+2 pp.)	0,0	0,2	0,7	1,1	1,1	1,6	1,5
Lower emp. rate (-2 pp.)	0,0	0,1	-0,8	-0,9	-1,3	-1,1	-1,3
Higher emp. of older workers (+10 pp.)	0,0	0,0	0,2	0,5	-0,1	0,1	0,4
Higher migration (+20%)	-0,1	-0,5	-0,5	-0,1	0,4	0,6	0,1
Lower migration (-20%)	0,1	0,4	0,5	0,4	-0,6	-0,3	-0,2
Lower fertility	0,3	0,4	1,3	1,7	1,4	0,5	-1,7
Risk scenario	0,0	0,1	-0,6	-0,2	-1,2	-1,2	-2,1
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,1	0,5	0,6	-0,2	0,6	0,1
Working							
Baseline	**13,2**	**13,1**	**13,2**	**12,8**	**12,4**	**11,5**	**11,2**
Higher life expectancy (2 extra years)	0,0	-0,1	-0,1	-0,2	-0,4	-0,3	-0,4
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,1	-0,1	-0,2	0,0	0,2
Lower lab. productivity (-0.25 pp.)	0,0	0,0	0,1	0,0	0,1	0,2	0,2
Higher emp. rate (+2 pp.)	0,0	0,0	-0,4	-0,7	-0,6	-0,5	-0,5
Lower emp. rate (-2 pp.)	0,0	0,2	0,4	0,5	0,5	0,5	0,6
Higher emp. of older workers (+10 pp.)	0,0	-0,2	-0,6	-0,4	-0,5	-0,5	-0,5
Higher migration (+20%)	0,2	0,0	0,1	-0,1	0,1	0,1	0,1
Lower migration (-20%)	-0,2	-0,2	-0,2	-0,1	-0,2	-0,1	0,1
Lower fertility	0,3	0,1	0,4	0,1	0,1	0,0	-0,2
Risk scenario	0,0	-0,1	0,0	-0,1	0,1	0,1	-0,1
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,3	-0,1	-0,1	0,0	0,4	0,3

Source: Ministry of Health and Social Affairs.

Table 8 Gini for different groups under different scenarios (deviation from the baseline in p.p.)

	2016	2020	2030	2040	2050	2060	2070
1 Total							
Baseline	**25,3**	**25,1**	**25,0**	**24,8**	**24,9**	**25,1**	**25,5**
Higher life expectancy (2 extra years)	0,0	-0,1	-0,1	0,1	0,0	0,1	0,2
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,0	-0,1	0,1	0,1	0,1
Low er lab. productivity (-0.25 pp.)	0,0	0,0	0,1	0,0	0,0	0,0	0,1
Higher emp. rate (+2 pp.)	0,0	-0,1	-0,2	-0,1	-0,2	-0,2	-0,2
Low er emp. rate (-2 pp.)	0,0	0,0	0,2	0,3	0,2	0,3	0,3
Higher emp. of older w orkers (+10 pp.)	0,0	-0,1	-0,1	-0,3	-0,4	-0,4	-0,3
Higher migration (+20%)	0,1	0,0	-0,1	0,0	-0,1	0,0	0,0
Low er migration (-20%)	0,0	-0,1	0,1	0,1	0,0	0,1	0,1
Low er fertility	0,1	0,1	0,3	0,4	0,5	0,7	0,8
Risk scenario	0,0	0,0	-0,1	0,0	0,0	0,0	0,0
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,1	-0,1	-0,3	-0,5	-0,7	-0,8
3 Elderly (65+)							
Baseline	**25,2**	**25,4**	**25,3**	**24,4**	**23,6**	**22,5**	**22,2**
Higher life expectancy (2 extra years)	0,6	-0,1	-0,2	0,0	-0,2	-0,2	-0,4
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,0	-0,3	-0,7	-1,0	-1,3
Low er lab. productivity (-0.25 pp.)	0,0	0,0	0,2	0,1	0,2	1,2	1,7
Higher emp. rate (+2 pp.)	0,0	0,0	-0,2	0,3	0,0	0,2	-0,2
Low er emp. rate (-2 pp.)	0,0	0,0	0,1	0,3	-0,2	0,0	0,1
Higher emp. of older w orkers (+10 pp.)	0,0	0,2	0,4	0,3	0,2	0,5	0,7
Higher migration (+20%)	0,5	0,0	0,1	0,4	0,0	0,2	0,1
Low er migration (-20%)	0,3	0,0	0,0	-0,2	-0,1	-0,3	0,1
Low er fertility	0,4	-0,1	-0,1	-0,1	-0,4	-0,2	-0,1
Risk scenario	0,0	0,0	0,1	0,2	0,4	0,5	0,7
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,1	0,6	1,2	1,4	2,7	2,9
4 Working							
Baseline	**25,6**	**25,2**	**24,9**	**24,6**	**24,5**	**24,2**	**24,3**
Higher life expectancy (2 extra years)	-0,2	-0,1	-0,1	0,0	-0,1	0,0	0,0
Higher lab. productivity (+0.25 pp.)	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,2
Low er lab. productivity (-0.25 pp.)	0,0	0,0	0,0	0,0	0,2	0,2	0,3
Higher emp. rate (+2 pp.)	0,0	-0,1	-0,3	-0,3	-0,3	-0,4	-0,3
Low er emp. rate (-2 pp.)	0,0	0,1	0,3	0,4	0,4	0,4	0,4
Higher emp. of older w orkers (+10 pp.)	0,0	-0,2	-0,4	-0,4	-0,5	-0,5	-0,5
Higher migration (+20%)	0,0	0,0	-0,1	0,0	0,0	0,0	0,0
Low er migration (-20%)	-0,1	-0,1	-0,1	0,0	-0,1	0,1	0,1
Low er fertility	-0,1	0,0	0,0	0,0	0,2	0,2	0,2
Risk scenario	0,0	0,0	-0,1	0,0	0,1	0,1	0,1
Policy scenario: linking retirement age to increases in life expectancy	0,0	-0,1	-0,3	-0,3	-0,4	-0,5	-0,5

Source: Ministry of Health and Social Affairs.

Table 9 Income quintile share ratio (S80/S20) under different scenarios (deviation from the baseline)

	2016	2020	2030	2040	2050	2060	2070
1 Total							
Baseline	**3,67**	**3,66**	**3,60**	**3,57**	**3,56**	**3,54**	**3,59**
Higher life expectancy (2 extra years)	-0,01	-0,02	-0,01	0,01	0,00	0,01	0,01
Higher lab. productivity (+0.25 pp.)	0,00	0,00	0,00	-0,02	0,00	0,01	0,01
Low er lab. productivity (-0.25 pp.)	0,00	0,00	0,01	0,00	0,01	0,01	0,01
Higher emp. rate (+2 pp.)	0,00	-0,01	-0,04	-0,03	-0,03	-0,03	-0,04
Low er emp. rate (-2 pp.)	0,00	0,01	0,04	0,04	0,04	0,04	0,05
Higher emp. of older w orkers (+10 pp.)	0,00	-0,02	-0,03	-0,05	-0,06	-0,06	-0,05
Higher migration (+20%)	0,02	-0,01	-0,01	0,00	0,00	0,00	-0,01
Low er migration (-20%)	-0,01	-0,02	0,01	0,01	-0,01	0,01	0,02
Low er fertility	0,03	0,03	0,07	0,07	0,09	0,12	0,11
Risk scenario	0,00	0,00	-0,01	-0,01	0,01	0,00	-0,01
Policy scenario: linking retirement age to increases in life expectancy	0,00	-0,02	-0,02	-0,04	-0,07	-0,06	-0,08
3 Elderly (65+)							
Baseline	**3,40**	**3,44**	**3,33**	**3,17**	**3,03**	**2,87**	**2,82**
Higher life expectancy (2 extra years)	0,07	-0,02	-0,03	-0,01	-0,03	-0,02	-0,04
Higher lab. productivity (+0.25 pp.)	0,00	0,00	-0,01	-0,04	-0,09	-0,12	-0,15
Low er lab. productivity (-0.25 pp.)	0,00	0,00	0,03	0,01	0,04	0,15	0,20
Higher emp. rate (+2 pp.)	0,00	-0,01	-0,03	0,04	0,00	0,03	-0,02
Low er emp. rate (-2 pp.)	0,00	0,00	0,00	0,04	-0,02	0,00	0,01
Higher emp. of older w orkers (+10 pp.)	0,00	0,02	0,06	0,05	0,03	0,06	0,08
Higher migration (+20%)	0,07	0,00	0,01	0,06	0,01	0,03	0,01
Low er migration (-20%)	0,04	0,00	-0,01	-0,02	-0,02	-0,04	0,01
Low er fertility	0,06	-0,02	-0,02	-0,02	-0,04	-0,02	-0,01
Risk scenario	0,00	-0,01	0,01	0,03	0,05	0,07	0,08
Policy scenario: linking retirement age to increases in life expectancy	0,00	-0,01	0,10	0,22	0,24	0,40	0,41
4 Working							
Baseline	**3,89**	**3,85**	**3,81**	**3,75**	**3,73**	**3,67**	**3,68**
Higher life expectancy (2 extra years)	-0,03	-0,03	-0,02	0,00	-0,02	-0,01	0,00
Higher lab. productivity (+0.25 pp.)	0,00	0,00	-0,01	-0,02	-0,01	0,00	-0,02
Low er lab. productivity (-0.25 pp.)	0,00	0,00	0,00	0,00	0,03	0,03	0,04
Higher emp. rate (+2 pp.)	0,00	-0,01	-0,07	-0,08	-0,07	-0,08	-0,08
Low er emp. rate (-2 pp.)	0,00	0,02	0,06	0,07	0,09	0,10	0,09
Higher emp. of older w orkers (+10 pp.)	0,00	-0,04	-0,12	-0,10	-0,12	-0,11	-0,11
Higher migration (+20%)	0,01	-0,01	-0,02	-0,02	-0,01	0,00	0,00
Low er migration (-20%)	-0,03	-0,04	0,00	0,02	-0,01	0,03	0,03
Low er fertility	0,01	0,02	0,02	0,03	0,06	0,08	0,07
Risk scenario	0,00	0,00	-0,02	-0,01	0,02	0,02	0,01
Policy scenario: linking retirement age to increases in life expectancy	0,00	-0,03	-0,07	-0,09	-0,11	-0,11	-0,11

Source: Ministry of Health and Social Affairs.

3.4. Adequacy and budgetary impact

The AWG only analysed the scenarios from a fiscal perspective and no analysis of the effects on the adequacy and the income distribution was done. When reading about the sensitivity analysis for the adequacy measures it might be interesting to contrast these results against the budgetary costs that was presented in the Swedish AWG pension fiche[16].

[16] The Swedish pension system and pension projections until 2070, Ministry of Finance of Sweden (2017).

Table 10 Public and total pension expenditures under different scenarios (deviation from the baseline in p.p.)

	2016	2020	2030	2040	2050	2060	2070
Public Pension Expenditure							
Baseline	8,2	7,6	7,2	6,8	6,6	7	7
Higher life expectancy (2 extra years)	0	0	0	0,1	0,2	0,2	0,3
Higher lab. productivity (+0.25 pp.)	0	0	0	0	0	0	0
Low er lab. productivity (-0.25 pp.)	0	0	0	0	0,1	0,1	0
Higher emp. rate (+2 pp.)	0	0	-0,2	-0,2	-0,1	-0,2	-0,2
Low er emp. rate (-2 pp.)	0	0	0,2	0,2	0,2	0,2	0,2
Higher emp. of older w orkers (+10 pp.)	0	-0,1	-0,4	-0,3	-0,3	-0,3	-0,3
Higher migration (+20%)	0	-0,1	-0,3	-0,3	-0,3	-0,3	-0,3
Low er migration (-20%)	0	0,1	0,3	0,4	0,4	0,4	0,3
Low er fertility	0	0	0	0,1	0,4	0,7	1,1
Risk scenario	0	0	0	0	0,1	0	0
Policy scenario: linking retirement age to increases in life expectancy	0	-0,1	-0,4	-0,4	-0,5	-0,8	-0,7
Total Pension Expenditure							
Baseline	10,7	10,4	10,7	10,6	10,2	10,5	10,2
Higher life expectancy (2 extra years)	0	0	0	0	0,2	0,3	0,4
Higher lab. productivity (+0.25 pp.)	0	0	0	-0,2	-0,3	-0,4	-0,5
Low er lab. productivity (-0.25 pp.)	0	0	0	0,2	0,4	0,6	0,6
Higher emp. rate (+2 pp.)	0	0	-0,3	-0,2	-0,2	-0,2	-0,2
Low er emp. rate (-2 pp.)	0	0	0,2	0,3	0,2	0,2	0,2
Higher emp. of older w orkers (+10 pp.)	0	-0,1	-0,5	-0,3	-0,3	-0,3	-0,4
Higher migration (+20%)	0	-0,1	-0,4	-0,6	-0,6	-0,5	-0,4
Low er migration (-20%)	0	0,1	0,4	0,6	0,7	0,7	0,5
Low er fertility	0	0	0	0,2	0,6	1,1	1,6
Risk scenario	0	0	0	0,1	0,2	0,3	0,3
Policy scenario: linking retirement age to increases in life expectancy	0	-0,1	-0,6	-0,7	-0,6	-1	-0,8

Source: Commission Services

There is no clear-cut trade-off between the budgetary impact of a scenario and the impact on the poverty risk and inequality among the elderly, relative to the base scenario. The budgetary cost will decrease compared to the baseline in the scenarios with higher employment, remain approximately unchanged in the productivity scenarios and increase in the demographic scenarios (higher life expectancy, lower migration).

– In the higher employment scenarios (Older workers, Policy) it is a win-win situation; the risk of poverty will decrease at the same time as the pension expenditure as a share of GDP decreases.

– In the productivity scenarios the budgetary cost as a share of GDP remains approx. unchanged. In the case with higher productivity the risk of poverty will increase, but at the same time the disposable income for pensioners will grow, but not as much as for the working population. Regarding the scenarios with lower productivity the reverse applies; the risk of poverty as well as the disposable income decreases.

– Finally, in the demographic scenarios it is lose-lose; higher expenditures and increasing risk of poverty. Also the disposable income decreases.

4. Country results for Italy

4.1. The dynamic microsimulation model T-DYMM of Italy

In the occasion of the SPC WG-AGE microsimulation project, in February 2018 the Treasury Dynamic Microsimulation Model (T-DYMM) was employed in order to estimate a number of pension adequacy/inequality indicators. The dynamic microsimulation model T-DYMM simulates individuals' transitions over the life cycle (births, deaths, marriages, educational and labour market decisions, retirement) and analyses their condition at retirement. It uses as its starting point an updated longitudinal dataset AD-SILC that links survey (EU-SILC) and administrative (INPS) data. Moreover, these data are also used to estimate conditional probabilities of transition across alternative employment states and parameters of wage equations. The estimated coefficients are then used to simulate transition probabilities and wage dynamics in T-DYMM. T-DYMM shares its ancestry with MIDAS-Belgium, though the two models have been developed independently from each other (see Caretta *et al.*, 2013; Dekkers and Van den Bosch, 2016).

T-DYMM consists of three main modules linked to each other by recursive feedback:

1) A Demographic module;

2) A Labour market module;

3) A Pension module.

Like all other models used in this exercise, T-DYMM is a dynamic ageing model, where individual statuses are updated annually by means of probabilistic transitions. Lastly, it is a closed model, meaning that migration flows are not considered, sharing this characteristic with the Belgian model MIDAS, whereas the Swedish model SESIM does include immigration and emigration.

Demographic patterns are aligned to ESSPOP 2015 projections from Eurostat, while macroeconomic variables such as GDP growth, labour productivity and employment are aligned to AWG 2018 projections.

Before turning to the next paragraph which contains a description of the Italian pension system, a number of caveats that are relevant for understanding the results produced by T-DYMM should be discussed briefly:

a. Because T-DYMM does not yet include a "migration module", the sample composition loses representativeness as time goes on. By the end of the simulation period, the sample is reduced by about 35%;

b. A "wealth module" is not developed within T-DYMM, i.e. all the resources people have are those coming either from their labour income or from public welfare;

c. Being based on administrative data (with the original main purpose of estimating pension amounts), T-DYMM only accounts for legal labour market dynamics and incomes. This can be relevant especially in the first years of the simulation, where the elderly, who may have spent a significant portion of their active years in the informal labour market, display higher figures of the AROP rate compared to the latest Eurostat data;

d. For the scope of the SPC WG-AGE project, and due to time constraints, T-DYMM's incomes are all expressed in gross amounts. This causes a bias in our results as the redistributive effects of the Italian taxation system are not, de facto, included. This is in discordance with the vast majority of studies on inequality and adequacy indicators, that would normally employ net values;

e. While the pension module is updated to the most recent interventions, not all social protection measures could be implemented within T-DYMM at this time, in particular for individuals in active years, for whom a new set of measures has been set in place by very recent legislation.

4.2. An overview of the Italian Pension system

With the 1995-pension reform (law 335/1995), the Italian pension system adopted a Notional Defined Contribution (NDC) scheme, based on an actuarial equivalence between contributions paid and pension payments after retirement.

The previous Defined Benefit (DB) regime is in effect for all pensions whose first annuity had been withdrawn prior to the adoption of the reform, and it still applies pro-rata for the computation of new pension benefits to contributions accrued until 1995 – or until 2011 for workers with at least 18 years of contribution at the end of 1995. Under the previous regime, the pension was calculated as a percentage of the reference wage, obtained multiplying 2% by the years of contribution, up to a maximum of 80% (1988 and 1992 reforms established a set of rates, decreasing with higher levels of wage, spanning from 2% to 0.9%). The reference wage is an average of wages/labour income related to the last part of one's career, indexed to prices up to the year before retirement. The number of annual wages considered in the average computation varies depending on sector, time period to which the contribution is referred and retirement age.

Under the NDC scheme - introduced by the 1995 reform and extended to workers with long careers in the 2011 reform (law 214/2011) - the pension is calculated as the product of the total contributions paid during the whole working life, net of the interests accrued on a rate equal to the 5-year moving average of nominal GDP growth rates, and a actuarial "transformation coefficient", the calculation of which is based on life expectancy at retirement and on a "discount rate" chosen to be equal to 1.5%[17]. As a consequence, the pension amount is proportional to the contribution rate, the contribution period and the age of retirement. Due to the actuarial properties of the transformation coefficients, they increase with the age of retirement between 57 and 70. For younger and older age groups, the minimum and maximum values are being used.

Underlying the DB/NDC pension regimes lies an "old-age social allowance". It is a means-tested program financed by general revenues, providing flat-rate social assistance benefits to the poor elderly.

[17] Since the Italian system also awards survivor's pensions, "transformation coefficients" also take into account the probabilities of leaving a surviving spouse, the average outliving period and the portion of the original pensions transferred to survivors.

The eligibility conditions for both retirement and social allowances for the elderly are automatically linked to changes in life expectancy every three years (every two years starting from 2019) and they have been rapidly tightened for women with the 2011 reform. While the pensionable age was still 65/60 years for men/women respectively in 2010, it has been drastically increased in the last eight years: in 2018, full harmonization has been reached for the first time at 66 years/7 months – this applying to both males and females, and to all professional categories in the public and in the private sector.

In line with the regulatory-institutional structures of most European countries, the Italian pension system as reformed in 2011 confirms two types of retirement: a) old-age retirement which requires at least 20 years of contributions, an age requirement set by law (66 years/7 months in 2018) and an amount of pension at least equal to 1.5 times the minimum treatment (€ 761 in 2018)[18]; b) early retirement, obtainable either 3 years before the statutory retirement age, with the same 20 years of contribution but a higher initial level of benefit (2.8 times the minimum, € 1420 in 2018)[19], or with 42 years/10 months of contributions for male workers and 41 years/10 months for female workers[20].

Starting in 2013, all age requirements (including those for old-age social allowances) and the contribution requirement for early retirement are indexed to changes in life expectancy at 65 as measured by ISTAT with reference to the previous three years. The update occurs every three years and, starting from the adjustment subsequent to 2019, every two years, on the basis of an entirely administrative procedure. In addition, starting from 2013, the transformation coefficients are updated with the same periodicity as the adjustments to life expectancy.

All pensions are indexed to CPI inflation, but only amounts below 3 times the “minimum” (€ 1,522 a month in 2018) are fully indexed, while partial indexation is awarded for higher pensions.

4.3. Simulation results for Italy in the base variant

In this section, a selection of indicators produced by T-DYMM for Italy will be presented and discussed. This includes the at-risk-of-poverty (AROP) rate, the Gini index, the income quintile share (S80/S20) ratio, and the average length of retirement at death. Contrary to the results for Belgium and Sweden, note that all indicators of poverty and inequality are based on equivalent before-tax income, i.e. total gross household income corrected for the size and composition of the household through the modified OECD scale.

a. Poverty risks

The risk of poverty is again defined by confronting the gross equivalent household income of individuals with the threshold of 60% of median gross equivalent household income. The next figure show the resulting poverty risks for the population as a whole, for the elderly (i.e. those aged the SRA or more) and pensioners, and for those working.

18 The income requirement only applies to workers “fully-enrolled” in the NDC scheme (those who have started working after 1995). For NDC workers who cannot accrue either the minimum years of contributions or the level of benefit to be entitled to an old-age pension, the statutory retirement age is increased by 4 years and the number of years of contributions is reduced to 5.

19 This option only viable for workers “fully-enrolled” in the NDC scheme.

20 These contribution requirements are also linked to changes in life expectancy and are periodically updated.

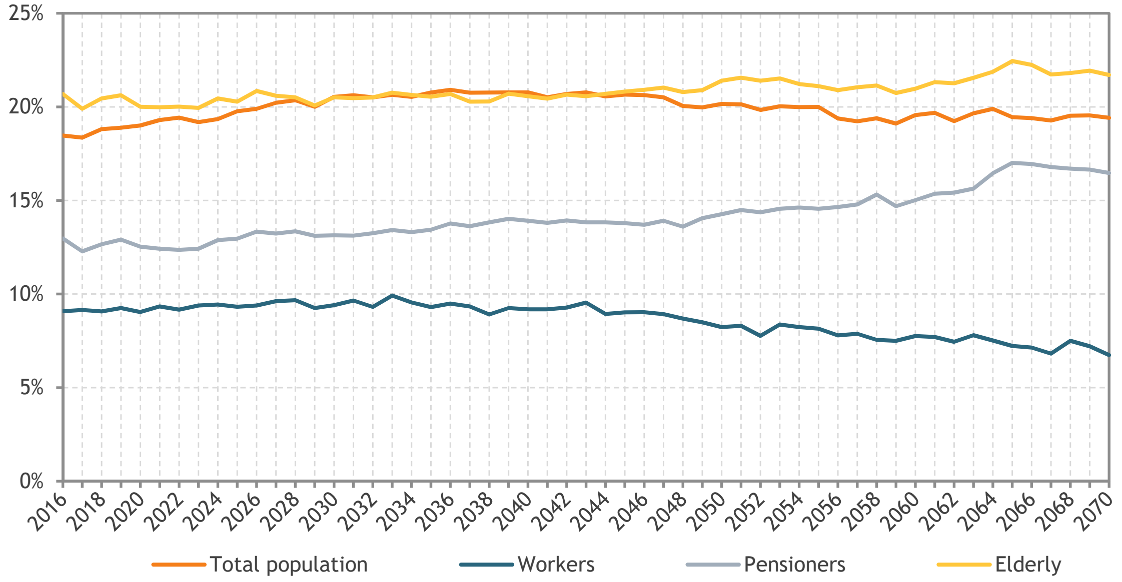
In Italy, the poverty risk of the elderly (65+) is comparable to that of the population as a whole. This is different to Sweden and Belgium, where it is respectively higher and lower[21]. However, while in both countries the difference between elderly and pensioners is negligible, in Italy the poverty risk of the elderly is about 60% higher than that of pensioners at the beginning of the simulation. There are various possible reasons for this, and they hinge on those that retire before age 65 and are therefore pensioners but not elderly. There are two possibilities to access early retirement. First of all, all workers may retire at any age before the SRA if they have a career of at least 42 years and 10 months, for men and 41 years and 10 months for women in 2016. Secondly, those enrolled in the pension system after 1995 and whose pension is completely organised through the NDC may retire up to a maximum of three years earlier than the SRA, as long as they have 20 years of contributions and a pension not inferior to a rather high predetermined level (€ 1420 in 2018, i.e. 2.8 times the minimum). As a result, those that will be observed to be in retirement before the SRA will have enjoyed longer, more rewarding careers and higher pension benefits, and will therefore show a lower poverty risk, than the average pensioner.

This difference is reinforced by the fact that the elderly are older than the pensioners, which cet. par. implies that the former retired a longer time ago than the latter. Given an indexation regime where pension benefits are indexed to prices, this means a gradual erosion of pension benefits relative to the development of wages as pensioners get older. This age differential might therefore provide a secondary explanation for the observed differences in poverty risks.

It is however important to note that, by 2070, the gap between the poverty risk rates of pensioners and elderly reduces from the initial 60% to 37%. This pattern is attributable to the increasing level of participation to labour, especially among women: while at the beginning of the simulation period many women within the stock of the elderly population do not own an earnings-related pension, by the end of the simulation period that occurrence is more common. At the same time, as the simulation goes on and the average retirement age increases, it is not rare to find elderly (+65) people still working, thus comparatively bettering the position of the group in terms of disposable income.

[21] For completeness' sake, it should be added that the definition of 'elderly' are all those aged 65 or more in Sweden and Italy, whereas it is all those aged the standard retirement age (SRA) in Belgium. This is also 65 in the first decade of simulation, but then increases to 66 in 2025 and 67 in 2030. See section 2.2 for a more extensive discussion.

Graph 14 Poverty risk to state

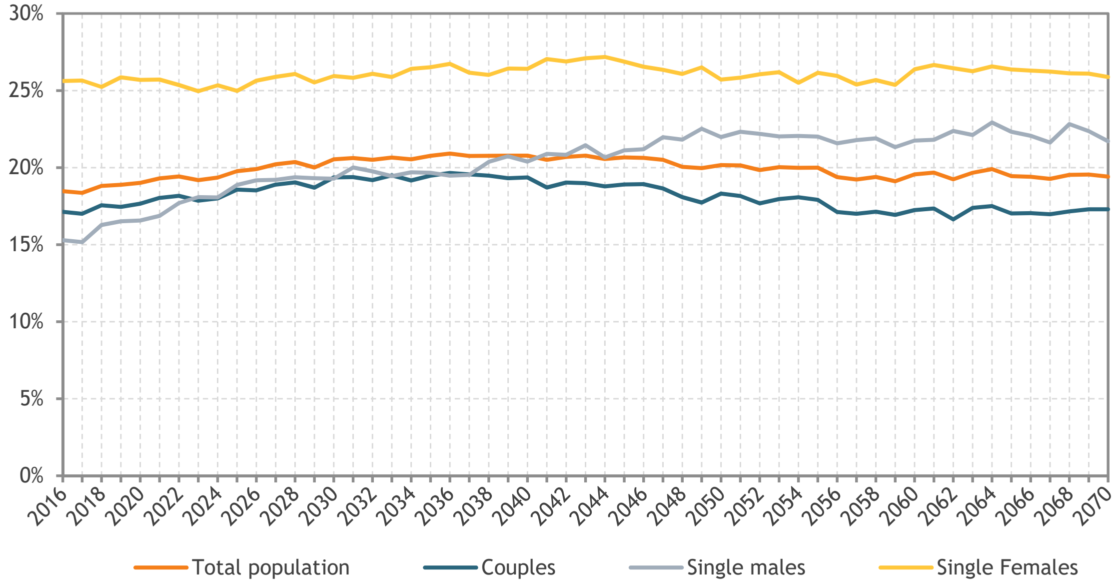


However, the difference between elderly and pensioners may be explained, it is apparent that the poverty risks among both pensioners and elderly gradually increase over time; a development less strong than in Sweden, but in contrast to the developments in Belgium.

The NDC scheme would on average award lower pensions compared to the previous DB scheme. While individuals with long and flat careers are not significantly impacted by the variations in the pension computation method, the positions of workers experiencing exponential and short careers is may be set to worsen. If exponential careers are generally correlated to wealthy working positions, the same cannot be said for workers with short/intermittent careers, who may have had trouble entering the labour force and/or keeping a steady job and, under NDC rules, are then subject to higher poverty risks once they grow old.

The actuarial correction mechanism inherent to NDC schemes also needs to be taken into account. In the case of Sweden, the AWG assumes a constant effective exit age (from 2020) in Sweden, and the actuarial correction lowers the benefit ratio and significantly raises the poverty risks among pensioners and elderly. To a lesser extent, this is also the case in Italy. The Italian AWG report shows considerable increases of the effective retirement age (due to the automatic link between increases in life expectancy and retirement ages), but not as fast as the SRA and therefore as life expectancy. Thus, the actuarial correction is at work here also, lowering the benefit ratio and increasing the poverty risk, though this pattern is less visible than in Sweden. Finally, T-DYMM microsimulations show that, while the effective retirement age grows by around five years throughout the simulation period, the same does not happen to the years of contribution made to the pension system. In the labour market simulated within the model, women in particular seem to have trouble building a longer, stable career.The next figure presents poverty risks to household type.

Graph 15 Poverty risks to household type

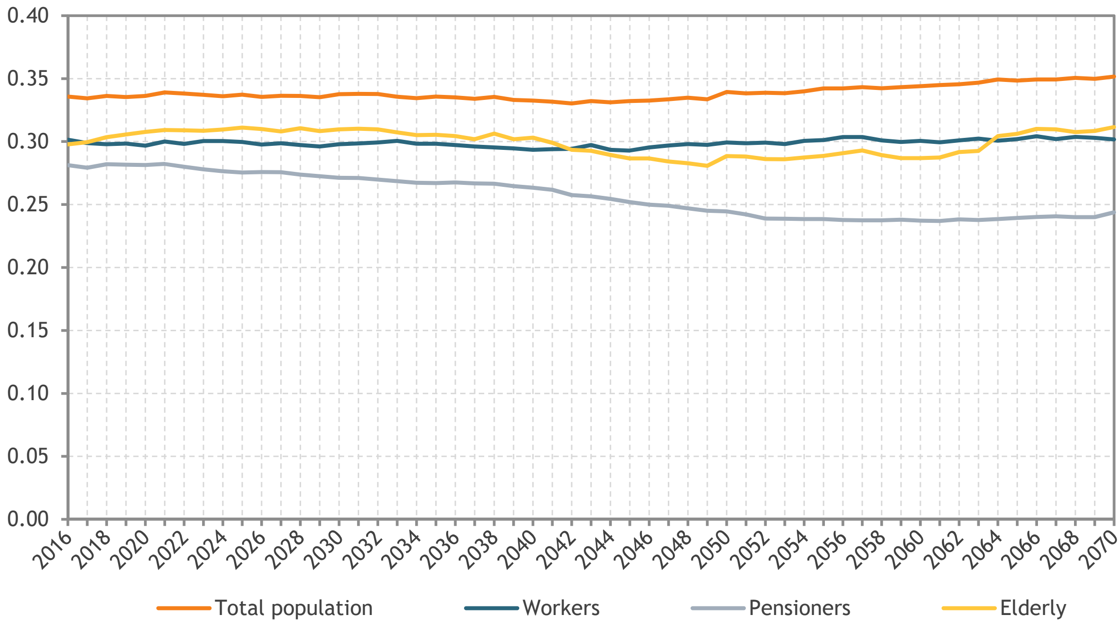


Like in the cases of Belgium and Sweden, the poverty risk of couples is the lowest, and the poverty risk of single women is considerably higher than that of single men, whose position ranges between the two other groups.

b. Gini inequality measure

The following figure presents the Gini index calculated for each group separately.

Graph 16 Gini to state

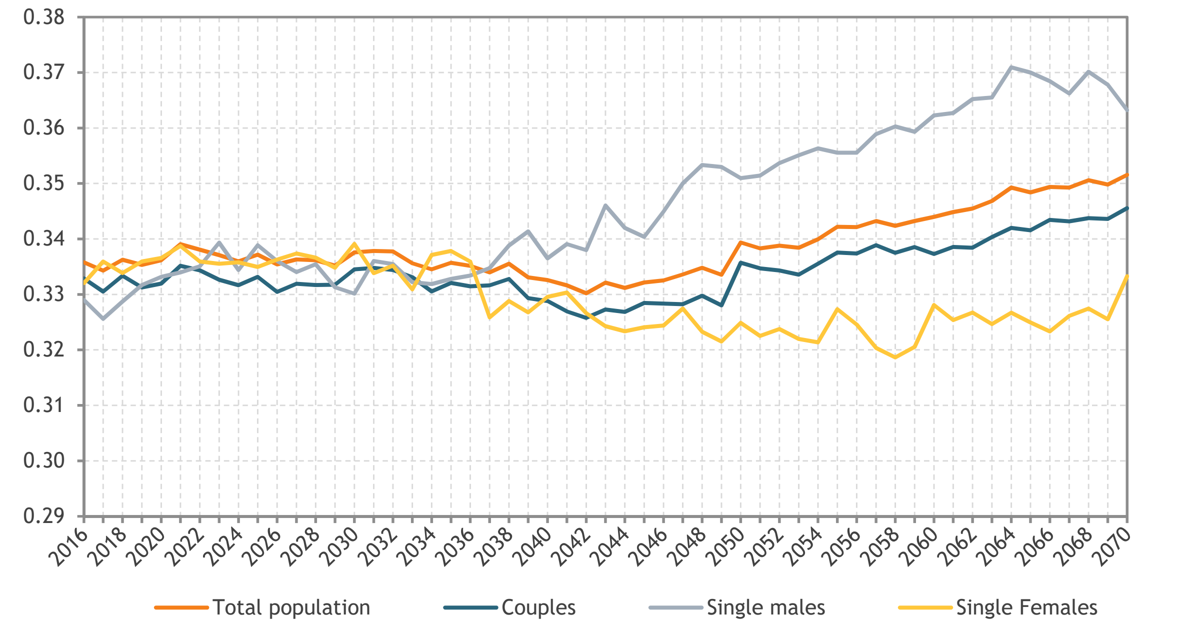


Like in the cases of Belgium and Sweden, inequality among elderly and pensioners decreases in absolute terms but also relative to the population as a whole and the working population.

As previously mentioned, a traditional DB system does not award the same internal rate of return to all contributions made to the system. Those earnings made early in one's career have a lower impact on the pension benefit than those made at the end of the career. By contrast, all contributions are awarded the same internal rate of return in an NDC system (and a points system). Thus, those that have long and flat careers (i.e. with comparably high contributions further away in the past), benefit, while those with exponential and short careers are penalised relative to a DB system. All in all, the gradual implementation of the NDC therefore reduces inequality among the pensioners. For what concerns the elderly, the rise of the index in the last years of the simulations is attributable to the fact that more and more workers start populating the category of "over 65" as the simulation goes on.

Next, we consider the inequality to household type. Here we see that inequality among single males exceeds that of couples, like in Belgium and Sweden. However, and contrary to the other countries, inequality among single women is considerably lower and decreasing. This is because women usually have shorter careers, an effect exacerbated by the gender earnings gap. This is combined with increased longevity – increasing the proportion of elderly women – and pensions that are indexed to prices only. As a result, the proportion of women having a pension benefit from the means-tested "old-age social allowance" increases, and the inequality with the group therefore decreases.

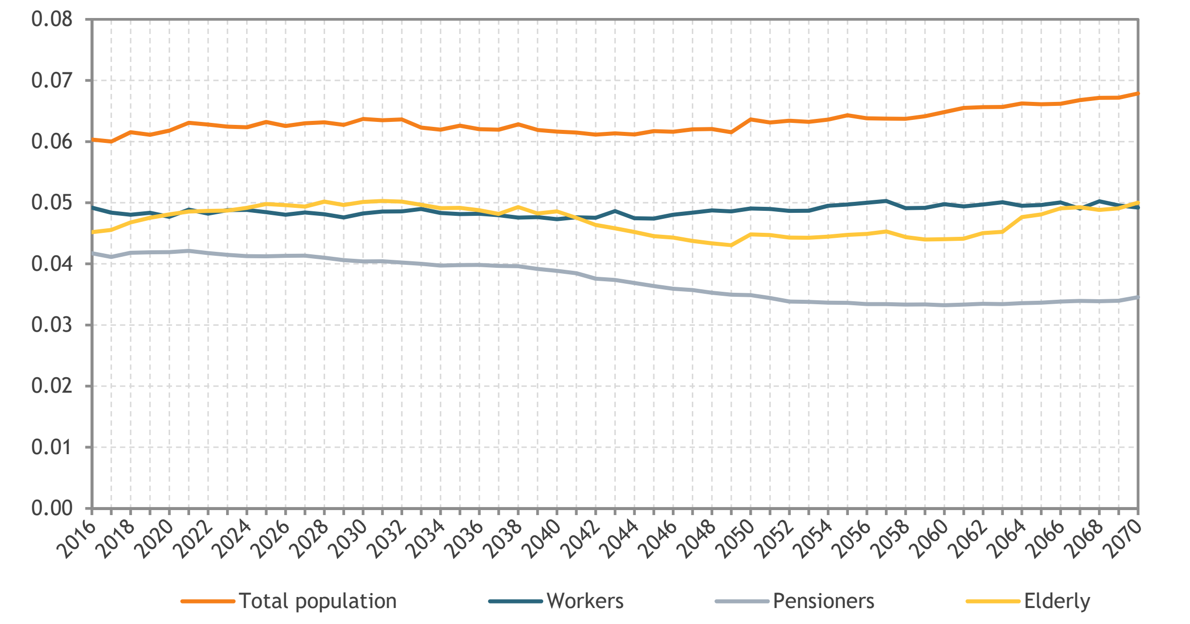
Graph 17 Gini to household type



c. The income quintile share ratio S80/S20

The next graph shows the income quintile share ratio to status.

Graph 18 Income quintile share ratio (S80/S20) to state



Like in the cases of Belgium and Sweden, the results for the S80/S20 tell the same story as the Gini index, but the positive difference between inequality of the total population and that of the workers is more outspoken in the former than in the latter, suggesting that this difference is more outspoken in the upper and lower tails of the income distribution.

d. Length of retirement

The below figure shows the average length of retirement at death. Contrary to the results of the other countries, the Italian results for this indicator are shown in two variants:

- In the "No-choice" variant, individuals access retirement as soon as they satisfy any type of requirement;
- In the "Choice" variant, individuals who meet early-pension requirements only retire if their replacement rate is at least equal to 0.62 (value of the ARR in 2013, according to the Adequacy Report of 2015) or if they are unemployed.

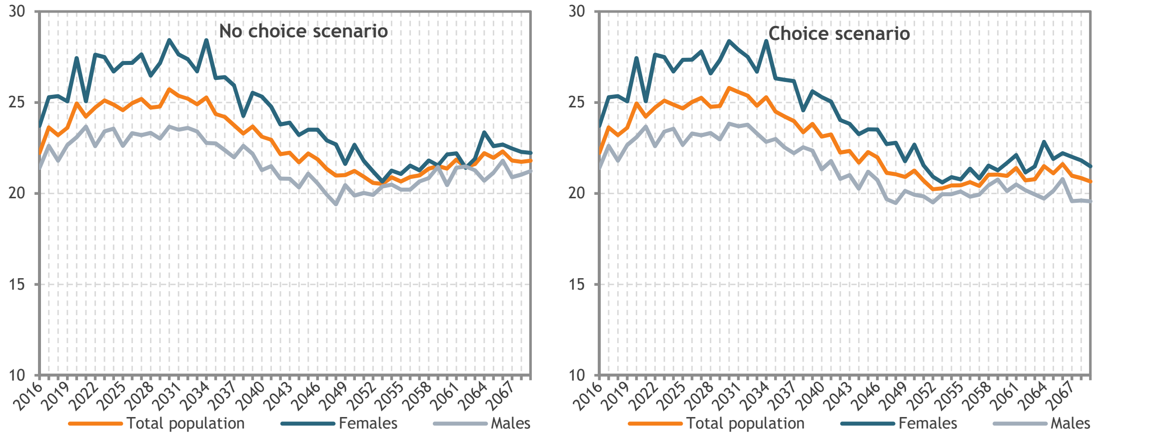
The reason for presenting the results in the two scenarios is that the 1995 and 2011 pension reforms have moved the Italian pension system towards an NDC scheme. The transition, however, has been rather slow and the economic incentives typical of an actuarially fair system are only expected to start operating in a decade. To take into account the possible behavioural impact of the increased actuarial neutrality of the system, we have opted to assume an alternative behaviour in addition to the "No choice" scenario where individuals are assumed to retire as soon as possible. In contrast, the "Choice" scenario assumes that agents who qualify for early retirement (often workers who have had successful careers) take into account the potential amount of their pension and possibly increase it.

Thus, the first scenario reflects the age at which people can retire, whereas the second scenario reflects the age at which people would retire in order to keep their relative benefit at a pre-determined "desirable" level. Since people would value rest as their sole interest and therefore access retirement as soon as possible, the "No-choice" scenario can be seen as an upper bound of the average length of retirement; the "Choice" scenario includes (albeit simplistically) the level of the benefit in the decision-making process and therefore produces lower levels of the average length of retirement[22].

The figure below shows the average length of retirement at death according to the two scenarios. During the first decades of simulation the average length of retirement at death would include pensioners who have retired in the 1990s or early 2000s. This was prior to the entry into force of the 1995 and 2011 reforms, when retirement ages were lower, especially for women, and the average length of retirement therefore was comparably high. Furthermore, the link between life expectancy and the eligibility conditions for old-age and early-retirement pensions, as well as the old-age social allowance have only been operational since 2013. By 2030, as the older pensioners go extinct and the recent rules start showing results, the average length of retirement would start decreasing and the differences between genders would start narrowing (SRA has been equalised for all workers regardless of gender in 2018). After 2050, figures are steady around 21-22 years.

The difference between the "two-Choice" and "No-choice" scenarios is small and only noticeable starting from 2050. Variations are nearly not visible for female workers between the "Choice" and "No-choice" scenario: due to labour market conditions, female workers struggle to achieve contributory and income requirements for early retirement, thus cannot take advantage of any option to choose.

Graph 19 Average length of retirement at death following the two scenario's



22 Within the Italian NDC rules, workers can choose to keep working up until 4 years beyond the SRA, thus reducing their life expectancy at retirement and increasing their pension benefits. Because the SRA has already increased significantly in the past few years (and is expected to furtherly increase), our "choice" scenario sets the SRA as the upper-limit for choice-makers.

4.4. Simulation results for Italy in the high employment variant

The Italian team simulated the effect of a "high employment scenario" using the T-DYMM microsimulation model. This allows for a joint assessment of an increase of the employment rate relative to the base scenario. In the country fiche that Italy submitted to the AWG (MEF, 2017, 26 and Figure A5.5, 85), an upward change in the employment rate immediately translates into a corresponding increase of GDP growth. This causes the ratio of pension expenditure to GDP to decrease relative to the baseline.

The next table shows the results on the poverty risks (AROP) of the total population, the elderly and the workers.

Table 11 Impact of ageing under the high employment scenario on the poverty risk of the elderly and working in Italy (baseline, variant, and deviation from the baseline)

	2016	2020	2030	2040	2050	2060	2070
TOTAL							
Baseline	18.47	19.01	20.54	20.78	20.16	19.56	19.42
High emp. Rate	18.52	19.05	20.68	20.53	20.2	19.02	18.91
deviation in pp	0.05	0.04	0.14	-0.25	0.04	-0.54	-0.51
Elderly (65 +)							
Baseline	20.69	20.01	20.51	20.57	21.4	20.97	21.71
High emp. Rate	20.76	20.75	22.15	21.59	22.16	21.54	22.46
deviation in pp	0.07	0.74	1.64	1.02	0.76	0.57	0.75
Working							
Baseline	9.08	9.04	9.41	9.18	8.24	7.76	6.74
High emp. Rate	9.1	9.06	9.63	9.15	8.49	7.64	7.07
deviation in pp	0.02	0.02	0.22	-0.03	0.25	-0.12	0.33

This variant shows that the reduction of pension expenditures that come with a higher employment rate comes with a cost, which is the increase in the poverty risks of the non-working groups in Italy, and especially the elderly. In this, and not surprisingly, the results from Italy are more in line with those from Sweden than from Belgium. As explained before, the impact of an increasing overall employment rate hinges on two countering effects: the indirect effect – via a higher proportion of workers that drives up median income and the poverty threshold – that causes the poverty rate of the elderly to increase, and the direct effect that reduces it, especially in the short run. In Italy, like in Sweden, the indirect effect appears to exceed the direct effect, so that the poverty risk of the elderly increases, again especially in the short run. Later on, these workers who worked more will enter into retirement with higher benefits, and the direct effect will therefore gain strength, thus the poverty risk will go back again to the base level. In Belgium, as said, the two effects more or less cancel each other out in the high-employment scenario, to that the impact on the poverty risk of the elderly is nearly absent.

5. Conclusion

The present study, that has been carried out in the context of the SPC WG-AGE, has seen teams from Belgium, Sweden and Italy use their dynamic microsimulation models to simulate the possible developments of pension adequacy while taking into account the set of economic and demographic projections developed by the AWG, as well as the joint assumption of unchanged policy besides already legislated pension reform. As such, the results of this exercise allow to complement the AWG simulations of pension expenditures in a context of demographic ageing by projections on pension adequacy.

Contrary to the other countries, the cost of pensions shows a continuous increase in Belgium. This is because demographic ageing is stronger than the cost-reducing effects of, among other things, the increasing employment rate and the increase of the average exit age. The latter developments however result in a higher pension benefit after retirement, thus bringing down the poverty risk among pensioners. In Italy, pension spending would remain stable at first, then increase until about 2040, after which a strong decrease would set in again. The increase before 2040 would be the result of low productivity growth and the transition of large cohorts into retirement. The subsequent decrease, however, would be the result of the gradual replacement of the stock of pensioners that had earned a benefit under the old DB regime by those that have a benefit under the NDC regime that was implemented in the 1995 and 2011 reforms. The less generous (particularly to intermittent careers) NDC regime would drive the benefit ratio down and may push the poverty risk up. Gross pension expenditure in Sweden is expected to remain roughly constant, among other things driven by comparably high net immigration. However, the actuarial correction for longevity produced by the adoption of the NDC system in 1996 would drive the benefit ratio down. This decrease would be reinforced by the AWG assumption of a constant labour market exit age, and would result in a considerable increase of the poverty risk among the elderly. While Italy has also adopted an NDC scheme, the contemporary implementation of an automatic adjustment of retirement ages to increases in life expectancy is set to counterbalance most of the effect of the actuarial correction. In any event, the performance of the labour market will be crucial in assuring longer, stable careers to older workers, essential to adequate levels of pension in an NDC scheme.

Next, the project makes these simulations not only for the base scenario, but also for a number of simulation variants. The first of the broad conclusions is that there is in many cases a trade-off between sustainability and the poverty risk among pensioners. The results for Belgium show that a variant that reduces (increases) the cost of ageing, in several cases does so at the cost of a comparative increase (decrease) of the poverty risk among the elderly. There are however exceptions to this rule, and differences between countries. In Belgium, for example, the scenario with a higher employment rate for older workers reduces the costs of ageing while also reducing the poverty risk among the elderly. This is not the case in Sweden, where the poverty risks end up higher than in the base scenario. Likewise, the increase of the overall employment rate results in a reduction in the budgetary costs of ageing in all three countries under scrutiny. However, and for reasons outlined in the body of this report, the impact of this on the poverty risk among the elderly or pensioners is different. Compared to the baseline, the poverty risks increase in Sweden and Italy, while the difference is negligible in Belgium.

Although the three models used in this project differ in scope and size, and have not been developed with a focus on international comparison, this project demonstrates how dynamic microsimulation can be used to bridge the gap between the assessment of pension sustainability and adequacy in comparative perspective. As such, it shows the potential of these simulation techniques in Europe.

6. Appendices

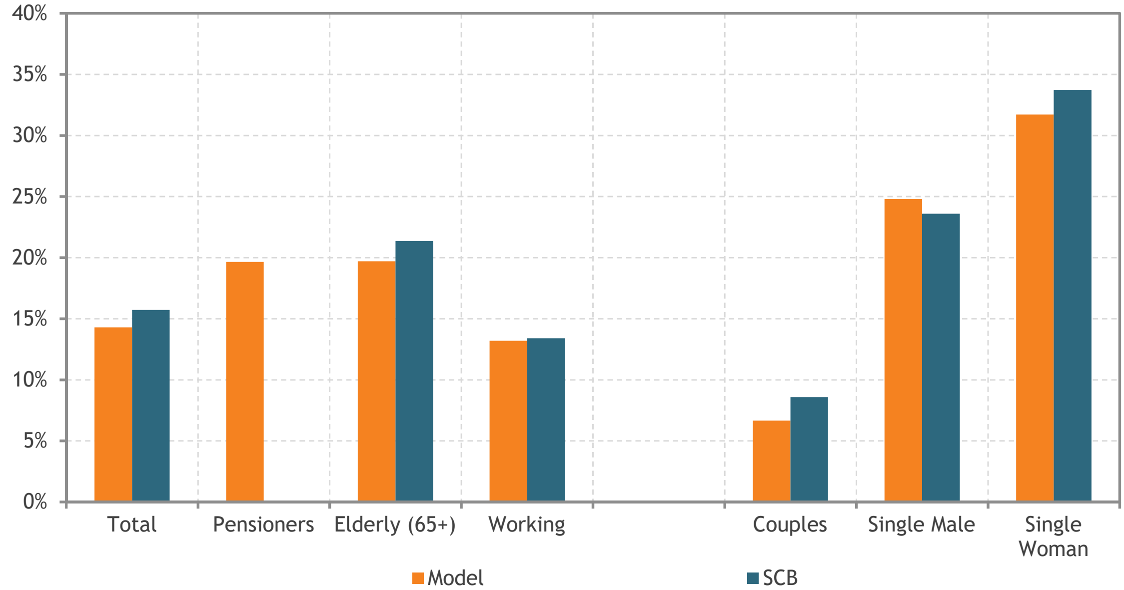
6.1. Comparison between outcomes from Statistics Sweden and the simulation results of SESIM

The following graphs shows the simulation results of SESIM and official outcomes from Statistics Sweden for the different indicators and groups. The level of all the indicators are quite comparable between Statistics Sweden (SCB) and the SESIM model among the different groups. Although the observed year 2015 is based on a simulation since 1999 the deviation between the model and the outcome shows a similar pattern, and the ranking is not changed for any of the groups for the different indicators.

Some observations:

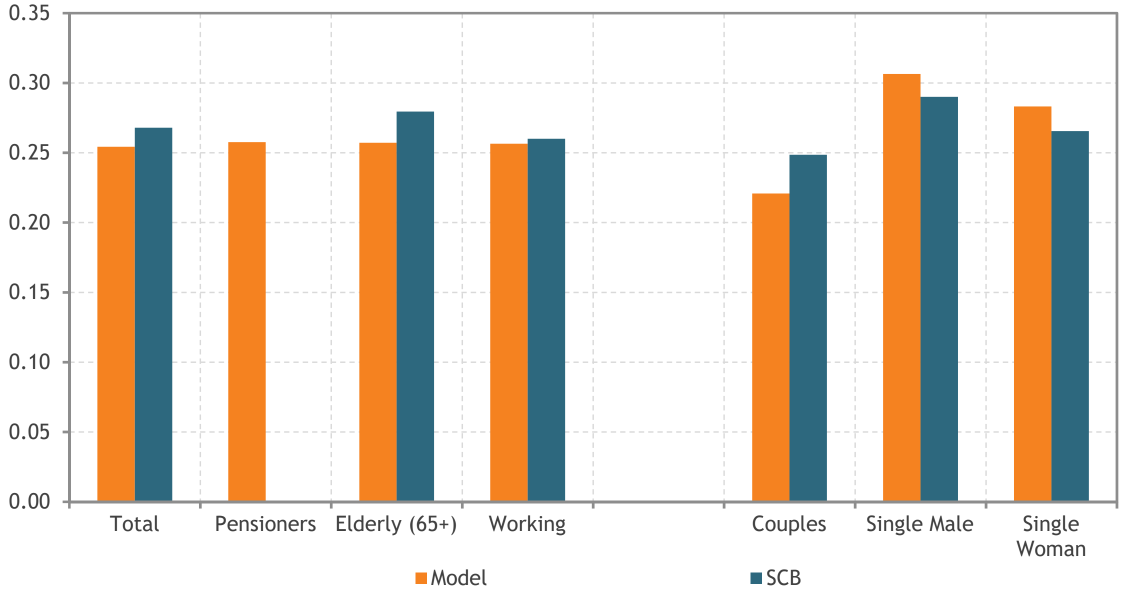
- In general, there do not seem be any bias compared to the published outcome.
- The small but systematic under estimation of the median income might be explained by different definitions of household disposable income in SESIM and the outcome data (e.g. a more complete set of income items).

Graph 20 Poverty risk (AROP), Outcome vs model simulation 2015



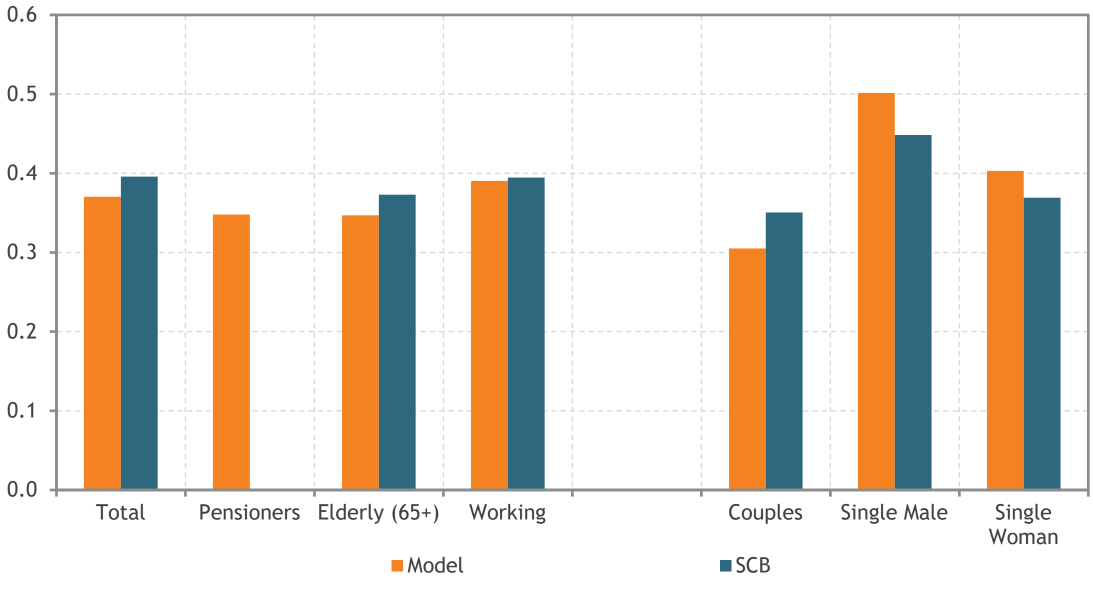
Source: Statistics Sweden and Ministry of Health and Social Affairs

Graph 21 Gini for different groups, Outcome vs model simulation 2015



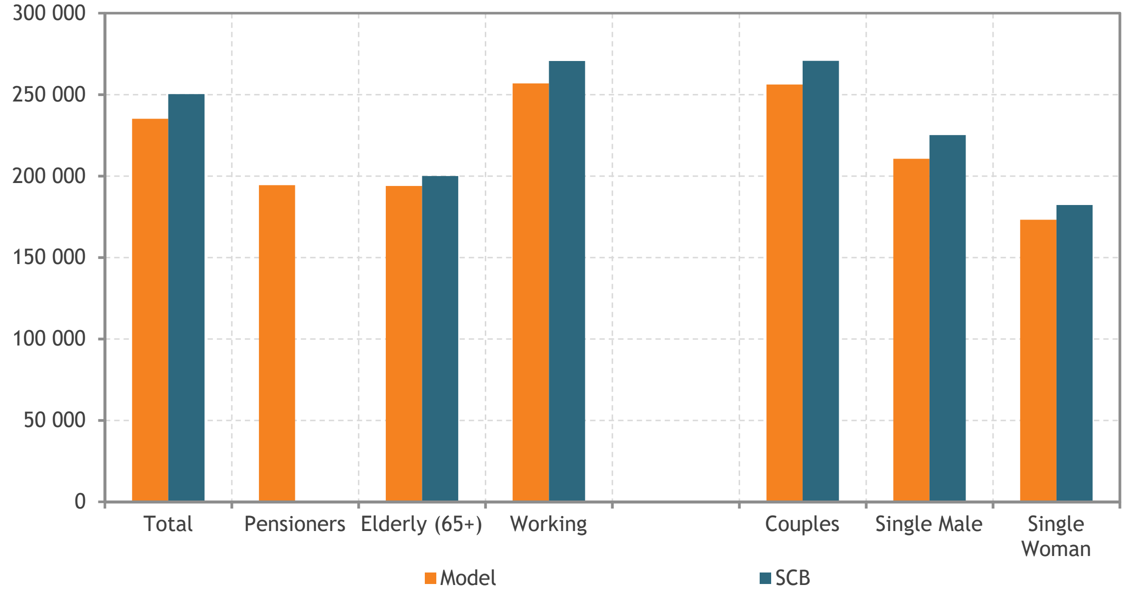
Source: Statistics Sweden and Ministry of Health and Social Affairs

Graph 22 Income quintile share ratio (S80/S20) for different groups, Outcome vs model simulation 2015



Source: Statistics Sweden and Ministry of Health and Social Affairs

Graph 23 Median equivalized disposable income for different groups, Outcome vs model simulation 2015



Source: Statistics Sweden and Ministry of Health and Social Affairs

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