WP 6.1
16 October 2013

UNITED NATIONS STATISTICAL COMMISSION and ECONOMIC COMMISSION FOR EUROPE

STATISTICAL OFFICE OF THE EUROPEAN UNION (EUROSTAT)

Joint Eurostat/UNECE Work Session on Demographic Projections
organised in cooperation with Istat
(29-31 October 2013, Rome, Italy)

Item 6 – Actual and potential use of demographic projections at national and international level

Indexation of the pension age to projected remaining life expectancy in The Netherlands

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Abstract

In 2012, a law has been passed to increase the state pension age in The Netherlands gradually from 65 in 2012 to 67 years in 2021. To set the pension age after 2021, an indexation procedure is used in which the pension age tracks the increases in remaining period life expectancy at age 65. The state pension age is fixed 5 years in advance, based on the then most current life expectancy projection of Statistics Netherlands. The age of entitlement for the supplementary collective pensions is fixed 12 years in advance, and hence is based on an earlier edition of the mortality projections.

This paper discusses the indexation procedure and its consequences. This new application of the mortality projections has changed the requirements for the projection model. Transparency and robustness are now more important. Statistics Netherlands has introduced a new mortality projection model in 2012, in part to better meet these new requirements. Communicating to the general public about the uncertainty in life expectancy projections has also become more important. Under the new pension system, life expectancy projections also imply projections for the future pension age. People will be planning their financial future based on these projections and therefore should be informed about their considerable uncertainty.

Under the new system, the definitions of potential labour force and grey pressure, which are a function of the pension age, become dynamic. Using Statistics Netherlands' 2012 stochastic population projections, we show how this affects the level and uncertainty of the future pension age, the number of pensioners, the potential labour force and the grey pressure. One attractive feature of the new system is that it makes projections of grey pressure and number of pensioners much more certain. The indexation procedure cancels out much of the uncertainty in this projection that is related to the future development of life expectancy. Projections for the potential labour force, however, acquire additional uncertainty.

Introduction

When the General Old age Act was passed in The Netherlands in 1957, it created a state pension system that entitled all residents aged 65 and older to monthly benefits. At that time, the expected remaining lifetime for those receiving the benefits was 15 years. In the explanatory memorandum that accompanied the bill it was suggested that, should life expectancy increase further, it might be necessary to raise the entitlement age. In 2012, more than half a century later, this suggestion was implemented. By this time, the remaining period life expectancy at age 65 had increased to almost 20 years.

The new legislation introduced a 2 year increase of the state pension age to compensate, partly, for the increases in life expectancy since 1957. For the longer term, it included an indexation of the pension age to life expectancy. Future increases in life expectancy would automatically result in additional upward adjustments of the pension age. The indexation mechanism in the bill uses the life expectancy projections of Statistics Netherlands as input.

This new application for its mortality projections meant that Statistics Netherlands had to rethink its extrapolation model and publication strategy. This paper describes the adjustments that were made. In the last section, results are presented from the stochastic population projections to show how the indexation of the pension age affects demographic ageing indicators such as grey pressure and their uncertainty.

The Dutch pension system

The pension system in The Netherlands consists of two “pillars”. The first pillar, the state pension, is meant to cover the basic needs. On average, it comes to 10 thousand euros per year. There is no dependence on income level, but those living with a partner receive less than those living alone. The state pension is financed through a pay-as-you-go system, which means that those working are paying the benefits for those already retired. Demographic grey pressure is therefore an important indicator for the financial sustainability of this system.

The second pillar consists of collective supplementary pensions. These are financed through a savings based system, where, in principle, each generation pays for its own retirement benefits. This pension system is organized by economic sector and run by non-government agencies with representatives of employers and labour unions on the board. The supplementary pensions depend on the average income earned during the working life. Because the system is savings-based, fluctuations in the size of successive generations, like the babybust at the end of the 1960s, do not affect its financial sustainability. However, if life expectancy increases more strongly than expected, the premiums payed into the system by the older generations may in retrospect have been too low. This has been happening in The Netherlands, where the rate of increase of life expectancy at older ages has risen dramatically since 2002. The downturn on the stock markets in 2008 and the current low interest rates have further worsened the outlook for the supplementary pensions. As a result, cuts have been made both in the benefits for the current retirees and in the entitlements for younger generations.

The indexation procedure

The law of 2012 implemented the following adjustments in the state pension age. (1) The entitlement age is raised gradually from 65 years in 2012 to 67 years in 2021. (2) From 2022 onwards, each year a further increase with 3 months is implemented if this is warranted based on the developments in life expectancy.

To check whether a further increase is warranted, the following formula is used

$$V = (L - 18.26) - (P - 65) \quad , \qquad (1)$$

where P is the pension age at that time, L is the period life expectancy at age 65 and 18.26 is the average period life expectancy at 65 for the years 2000-2009. The life expectancy used in this formula is gender-neutral (calculated on data for men and women combined).

If V is larger than 0.25 years, the pension age is increased by 3 months. If it is smaller, the pension age remains unchanged.

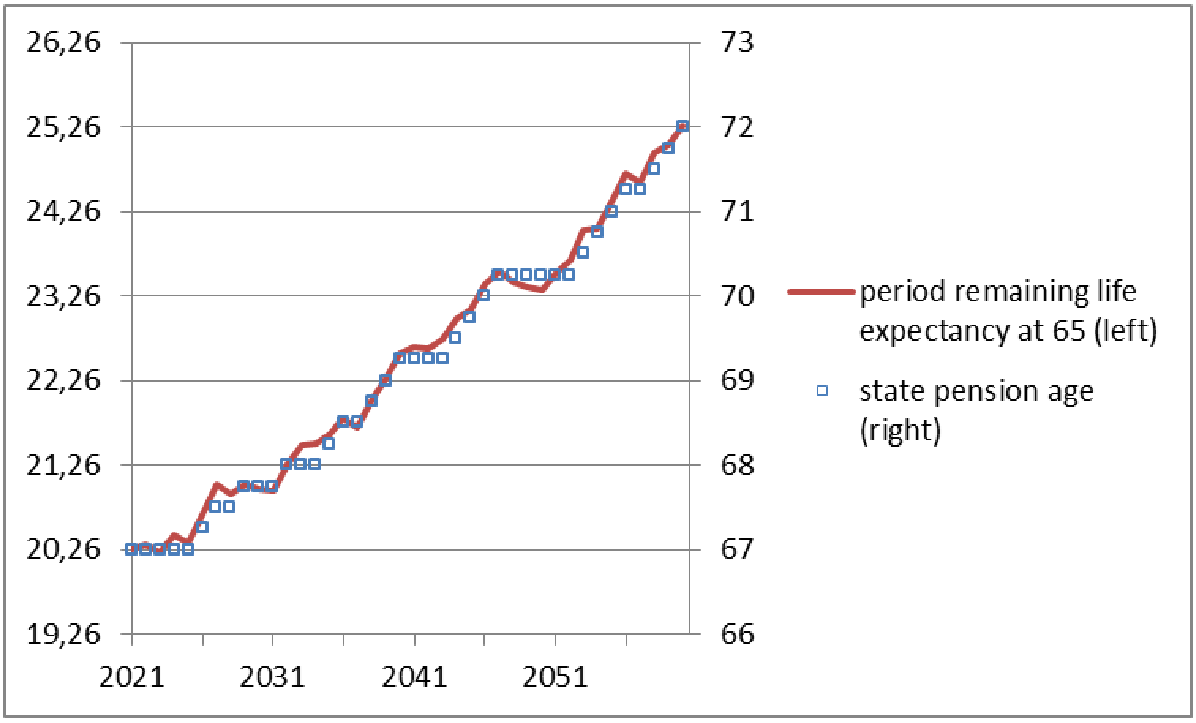
Figure 1 illustrates how the pension age would develop under an imagined time path for future life expectancy. If life expectancy decreases, the pension age remains unchanged. If life expectancy increases strongly, the pension age increases no faster than 3 months per year. In this way, the indexation procedure dampens the effects of year to year fluctuations in life expectancy.

For both employers and employees it is important to know in advance what the pension age in a certain year will be. For that reason, a choice was made to use projected life expectancies to evaluate equation (1) 5 years in advance. The life expectancy projections of Statistics Netherlands are used for this purpose. So, in figure 1, the solid line does not in fact refer to the actual period life expectancy per calendar year, but to the projection for this life expectancy made 5 years earlier.

Most countries that use life expectancy estimates in their pension system chose to use observed rather than projected life expectancies, and there are good reasons for doing so (Brunborg, 2007). For one: there are generally accepted methods for calculating period life expectancies, but not for projecting them. The reasons for choosing to work with projections in the new Dutch system are not known at Statistics Netherlands. Perhaps it was felt that the projections provide the best estimates for the remaining lifespan of future pensioners and should therefore be used.

For the supplementary pensions, a similar system is used to index the pension age to life expectancy as for the state pension. However, in this case it was decided to use steps of one year instead of 3 months, because the computations for the savings-based system would become too complex and expensive otherwise. Also, it was decided to fix the pension age not 5 but 12 years in advance. This means that a much earlier edition of the projections is used to set the entitlement age for the supplementary pensions than for the state pension.

Figure 1: development of the state pension age, according to the indexation procedure, for a fictional time path for remaining life expectancy at 65



New requirements for the mortality projection method

Until 2010, Statistics Netherlands used a complex mortality projection model based on assumptions for trends in mortality by cause of death and age group. The assumptions were based partly on an extrapolation of recent trends, partly on arguments and expert opinions. For some causes of death, like lung cancer among women, a change in the trend was assumed based on developments of risk factors (e.g. smoking). The assumptions were presented to an expert panel, discussed and in some cases adjusted.

The main advantage of this model was that it produced not only a projection, but also a storyline. Which causes of death would diminish most strongly and why? This helped when communicating about the results to the general public. A problem was that the model had many parameters and required a large number of subjective decisions, which tended to change between editions of the projection. This made the projection procedure less transparent. In particular, it was hard to justify adjustments in successive projections.

With the new pension law, it became desirable to have a more mechanical projection procedure, based on extrapolation. In this way, adjustments between successive projections could be explained by changes in the observed trends and in that way more objectively justified.

Not only transparency has become more important as a result of the new pension law, also robustness. Periods of acceleration or deceleration of the pace of mortality reductions should not influence the projection too strongly. The entitlement age for the supplementary pension is set using a projection that is made 7 years earlier than the one used to fix the state pension age. Preferably, the results of these two projections should be close. Otherwise, people will be receiving one type of pension much earlier than the other type.

Partly because of these considerations, Statistics Netherlands switched to a new model for the 2012 mortality projections (Stoeldraijer *et al*, 2013). The method was developed in collaboration with the

University of Groningen. It is a variant of a model used in 2010 by the National institute for health and the environment (RIVM) (Janssen and Kunst, 2010; Janssen *et al.*, 2013). The method aims to improve the robustness and accuracy of the projections by using stable long term trends for the extrapolations. This is done by basing the long term trend not only on the observed developments in The Netherlands, but also in other Western European countries. Furthermore, the effects of changes in smoking behaviour are modelled separately, because these give rise to nonlinearities in the mortality trends. The model is briefly described in the appendix at the end of this paper.

Communicating about uncertainty

As a result of the new pension law, Statistics Netherlands' life expectancy projections now also imply projections for the future pension age. If they are published without an explanation about their uncertainty, people may interpret them as a guarantee that their pension will start at the projected age and not plan for other possibilities. The fact that the pension age is adjusted with incremental steps of 3 months could be taken to imply that life expectancy can be forecasted to within a 3 months accuracy. Adjustments between successive projections by a larger amount than that, which will inevitably happen, could be met with anger or disbelief.

For this reason, it was decided to publish projections of the pension age only in terms of probability distributions or with uncertainty intervals. Projections of life expectancy are also accompanied by intervals wherever possible.

Figure 2 shows a probability distribution for the pension age by year. The sizes of the coloured segments in each column represents the probability that the pension age will be in that one-year age range. The age range with the highest likelihood for every year is labelled. In 2025, the state pension age is very likely between 67 and 68 years, by 2060, it is probably in the range of 70 to 73 years. This figure is complex and readers will often not immediately understand what is being shown. However, it does provide a good image of the uncertainty. Because no single projection is shown, a discussion of this kind of figure will automatically focus on age-intervals and likelihoods. This kind of figure was used in a publication aimed at people working in the pension industry.

Figure 3 shows a more traditional time plot for the pension age with confidence intervals. This is easier to understand at first sight. Although the interpretation of the confidence intervals is quite technical. It can also be used to compare different projections, as is shown here. This figure was used in the publication that accompanied the 2012 projections (Van Duin and Stoeldraijer, 2012), which was aimed at policymakers and the general public.. A problem with this kind of figure is that the sharp upper and lower boundaries suggest that the estimates of the level of uncertainty are themselves very certain.

Figure 2: probability distribution of the state pension age by calendar year

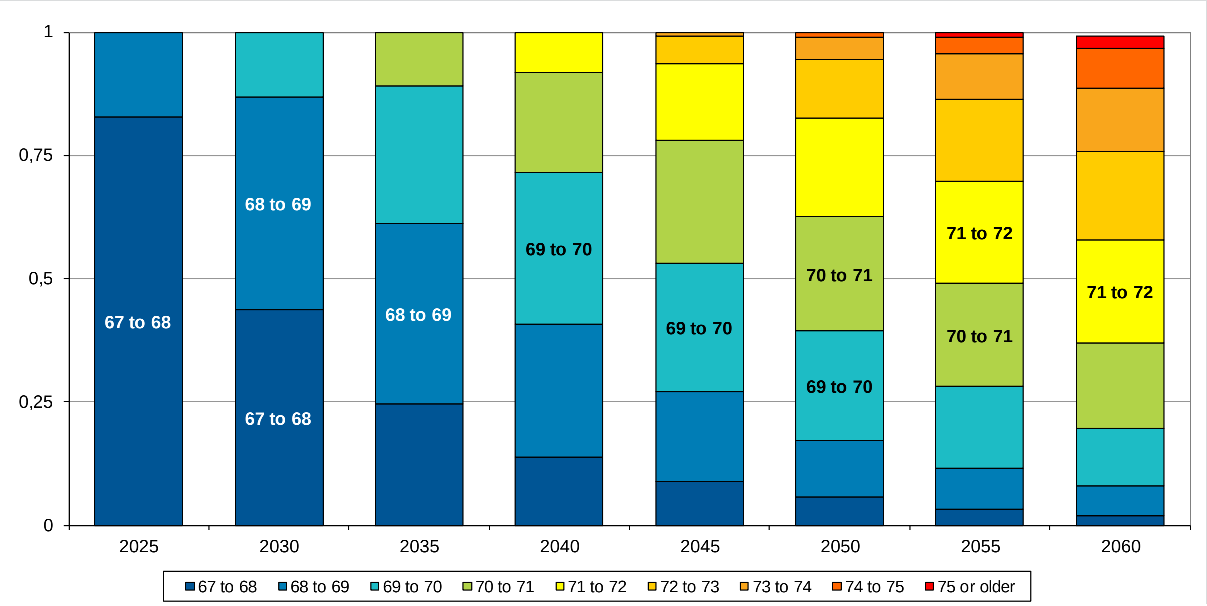
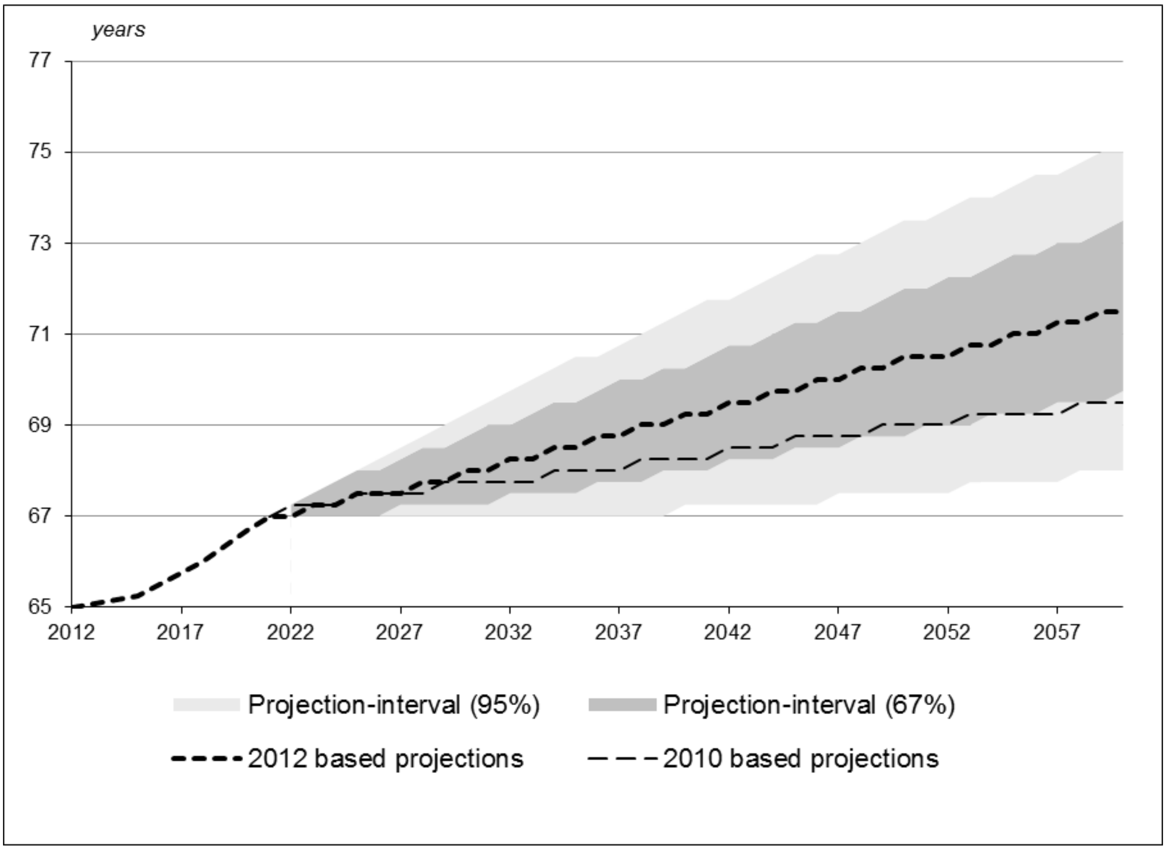


Figure 3: state pension age, calculated from the 2012- and 2010-based life expectancy projections, with 67 and 95 per cent projection intervals



New demographic indicators

Under the new pension system, the definitions of potential labour force and grey pressure, which are a function of the pension age, become dynamic. The potential labour force is defined as "that part of the population that, given its age, is eligible for participation in the labour process". Clearly, if the pension age increases, the "age of eligibility for labour participation" increases as well. As a result, the potential labour force gets a twofold time-dependence.

For the 2012 projections, Statistics Netherlands has published both about the static and dynamic potential labour force, defined as

$$PLF_{static}(y) = N(20\text{-}64, y), \qquad (2)$$

$$PLF_{dynamic}(y) = N(20 - X_{pension}(y\text{-}1), y), \qquad (3)$$

where $N(x_0\text{-}x_1, y)$ denotes the population between ages x_0 and x_1 on januari first of year y and $X_{pension}(y)$ denotes the state pension age in year y. Because we are looking at the population at the start of the year, the pension age in the previous year should be used.

Similarly, the number of elderly can be defined in a static and dynamic way as

$$E_{static}(y) = N(65 \text{ or older}, y), \qquad (4)$$

$$E_{dynamic}(y) = N(X_{pension}(y\text{-}1) \text{ or older}, y) \qquad (5)$$

And grey pressure is defined as

$GP_{static}(y) = E_{static}(y) / PLF_{static}(y)$ (6)

$GP_{dynamic}(y) = E_{dynamic}(y) / PLF_{dynamic}(y)$ (7)

Effects of the new pension law on ageing indicators and their uncertainty

Figures 4-6 shows the results for the three demographic indicator using the static and dynamic definition. The results for the 2012-based projections are shown, with uncertainty intervals calculated using stochastic populations projections. The method for the stochastic projections had to be extended in order to intervals for the dynamic quantities. Because the pension age is determined using projected instead of observed life expectancy, the forecast errors introduce an additional element of uncertainty, which had to be incorporated into the simulations.

Figure 4 shows the projected number of elderly, according to both definitions. Clearly, increasing the state pension age is an effective cost-saving measure. The number of people that qualify for a state pension in 2040 is reduced from 4.7 to 3.9 million. After 2040, the number of elderly in the 2012-based projections remains almost constant according to the static definition, but it decreases according to the dynamic definition.

If we compare the forecast-intervals for the two quantities, we find that the dynamic number of elderly can be forecasted with much greater accuracy than the static number. The uncertainty in the future number of elderly for the intermediate term is mostly due to uncertainties in the development of life expectancy. The indexation procedure cancels out most of this uncertainty. A secondary result of the new pension policy is therefore that it makes the future number of pensioners much more predictable. The 95 per cent interval for the static number of elderly in 2040 has a width of 1.2 million people. For the dynamic number, the width is only 0.3 million.

Figure 5 shows the results for the static and dynamic potential labour force. The static potential labour force is expected to decrease from 10.1 to 9.3 million people between 2013 en 2040. The dynamic potential labour force is expected to be at the same level in 2040 as currently. By that time, 800 thousand people aged 65 or older are in the potential labour force, 8 per cent of the total size. How many of these will also be in the actual labour force depends on to what extend the labour force participation of the elderly will increase along with the rising pension age.

The projections for the dynamic potential labour force are more uncertain than those for the potential labour force. The width of the 95 per cent interval in 2040 for the static quantity is 1.5 million people, for the dynamic quantity 1.9 million people. The unpredictability of fertility rates and international migration mostly determine the uncertainty for the static potential labour force. For the dynamic version, there is an additional uncertainty from life expectancy through the pension age.

Figure 6 shows the results for grey pressure. Dynamic grey pressure is expected to rise from 0.28 now to 0.39 in 2040, instead of to 0,51 for static grey pressure. Like for the number of elderly, the uncertainty intervals are much narrower for the dynamic quantity, because indexation of the pension age with life expectancy cancels out the main source of uncertainty.

Figure 4: The number of elderly in the Netherlands (static and dynamic definition)

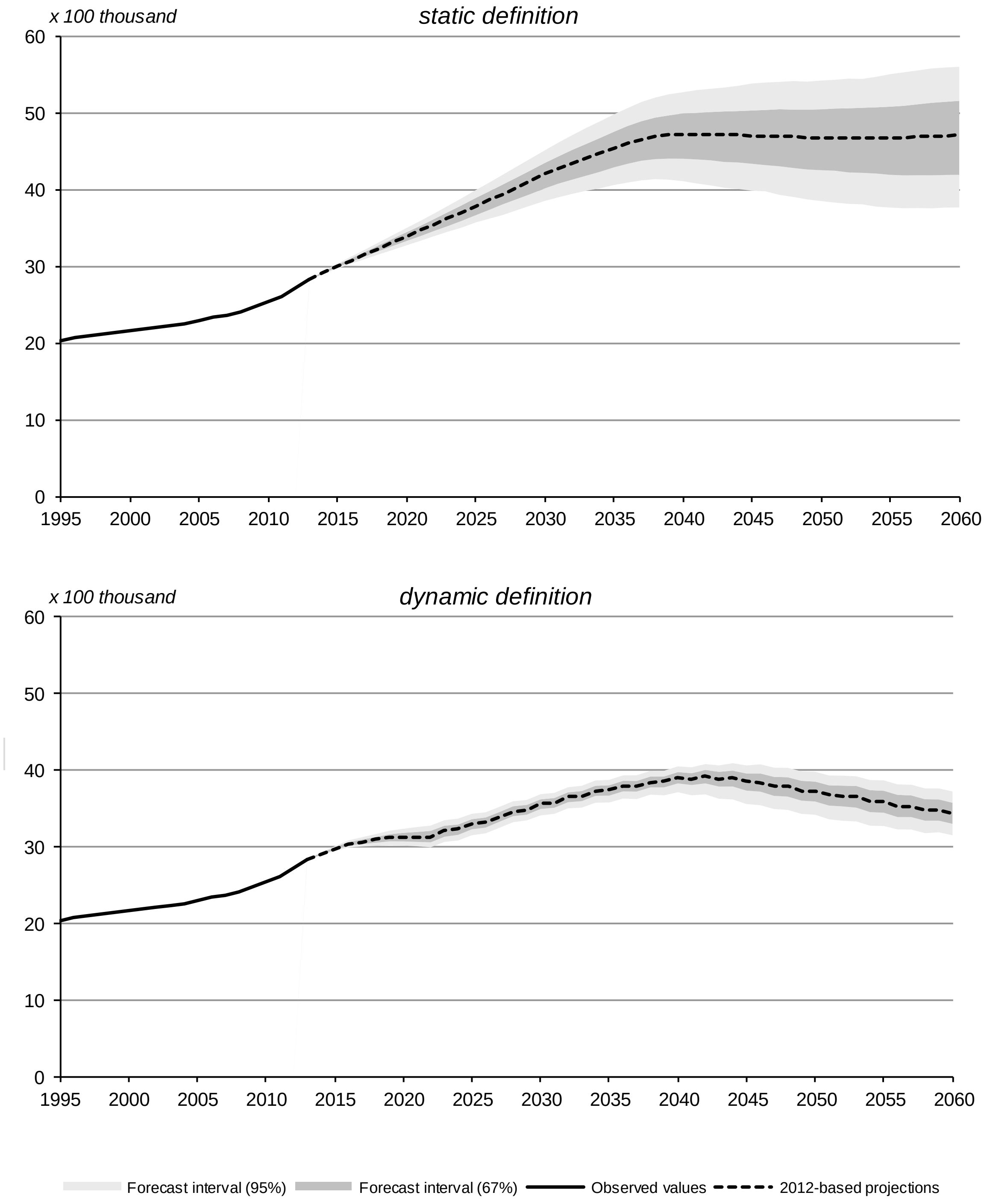


Figure 5: The potential labour force for the Netherlands (static and dynamic definition)

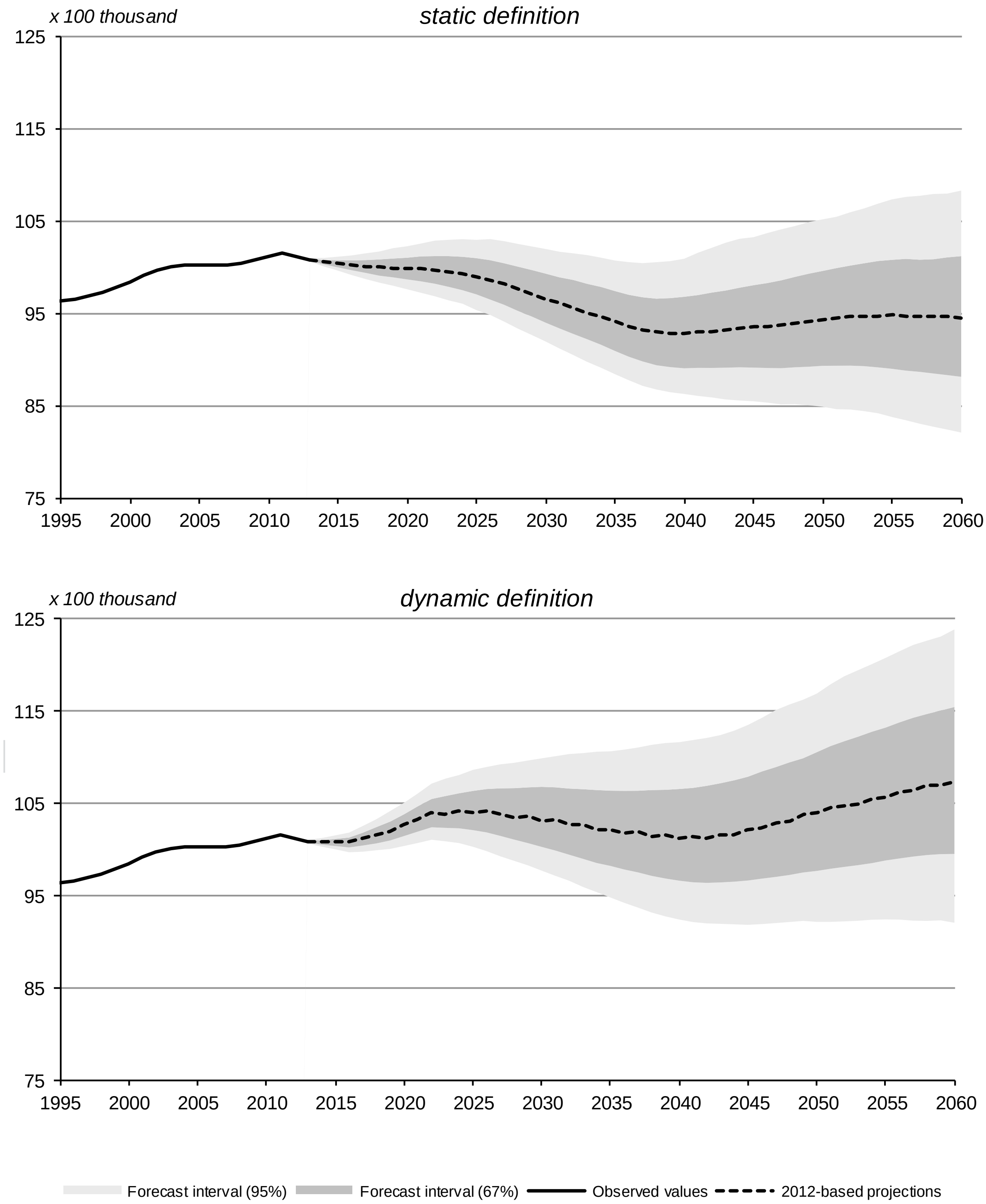
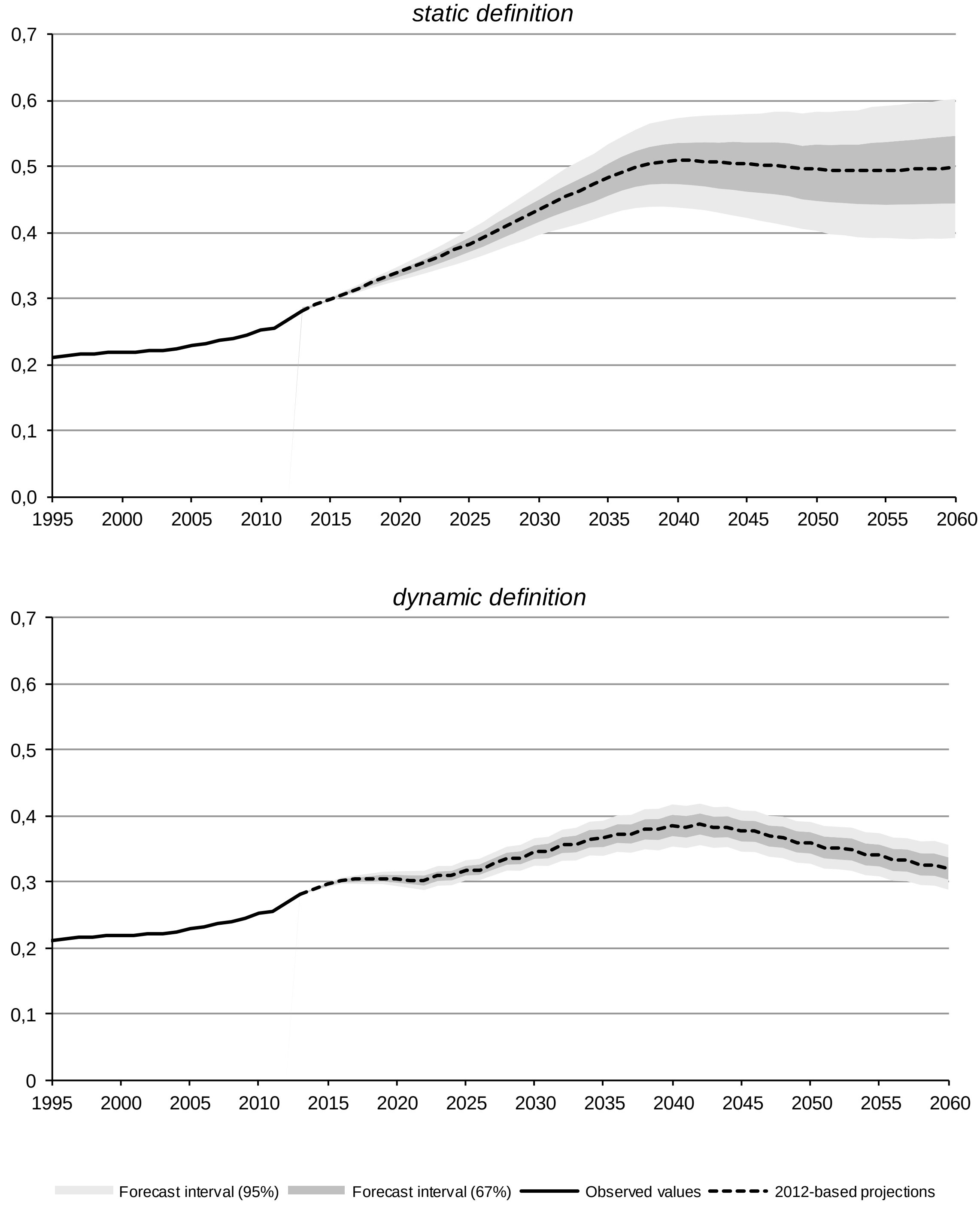


Figure 6: Grey pressure for the Netherlands (static and dynamic definition)


static definition
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dynamic definition
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2035
2040
2045
2050
2055
2060
Forecast interval (95%)
Forecast interval (67%)
Observed values
2012-based projections

References

Brunborg, H. (2007). Life expectancy adjustments in the Norwegian pension reform, Joint Eurostat/UNECE Work Session on Demographic Projections, Bucharest.

Duin C. van en L. Stoeldraijer (2012), Bevolkingsprognose 2012-2060: Langer leven, langer werken [Population forecast 2012-2060: Living longer, working longer], www.cbs.nl (published 13-12-2012)

Janssen, F. & A. Kunst (2010), The future of Dutch life expectancy. In: A.H.P. Luijben & G.J. Kommer (eds.), Towards Better Health, the Dutch 2010 Public Health Status and Forecasts Report.

Janssen, F., L.J.G. van Wissen and A.E. Kunst (2013) Including the smoking epidemic in internationally coherent mortality projections. Demography 50(4): 1341-1362.

Li, N. en R. Lee, 2005, Coherent mortality forecasts for a group of populations: an extension of the Lee-Carter method. Demography, 42(3), 575–94.

Rostron, B., 2010, A modified new method for estimating smoking-attributable mortality in high-income countries, Demographic Research, 23, 399–420.

Stoeldraijer, L., C. van Duin, F. Janssen (2013), Bevolkingsprognose 2012-2060: Model en veronderstellingen betreffende de sterfte. [Population forecast 2012-2060: Model and assumptions on mortality] Bevolkingstrends June 2013, pp. 1-27

Appendix: Statistics Netherlands' new mortality projection model

In the new mortality projection model, smoking and non-smoking related mortality are projected separately, then combined to forecast total mortality. For non-smoking related mortality, a coherent forecasting method is used which imposes that The Netherlands follows the common trend of the Western European countries in the long term.

Figure A1 shows the development of life expectancy in The Netherlands and 10 other Western European countries since 1950. The lines for individual countries show a much less stable trend than for the group as a whole. The lines for the eleven countries converge until around 1980. Since then, different countries have had periods of above- or below-average increases in life expectancy, but the group as a whole has improved at a steady pace. The spread in life expectancy across the countries has remained more or less the same, showing neither convergence nor divergence. This suggest that, for the longer term, using the trend of the group rather than of The Netherlands itself yields a more robust and probably also a more accurate forecast.

Figure A2 shows life expectancy calculated from all-cause mortality and life expectancy calculated after exclusion of smoking-attributable mortality. The method of Rostron (2010) was used to estimate the percentage of smoking-attributable mortality from the observed lung cancer mortality rates. Smoking has strongly influenced the development of Dutch life expectancy since the 1950s. One of the most striking things is that the trajectories for men and women become very similar when the effects of smoking are excluded.

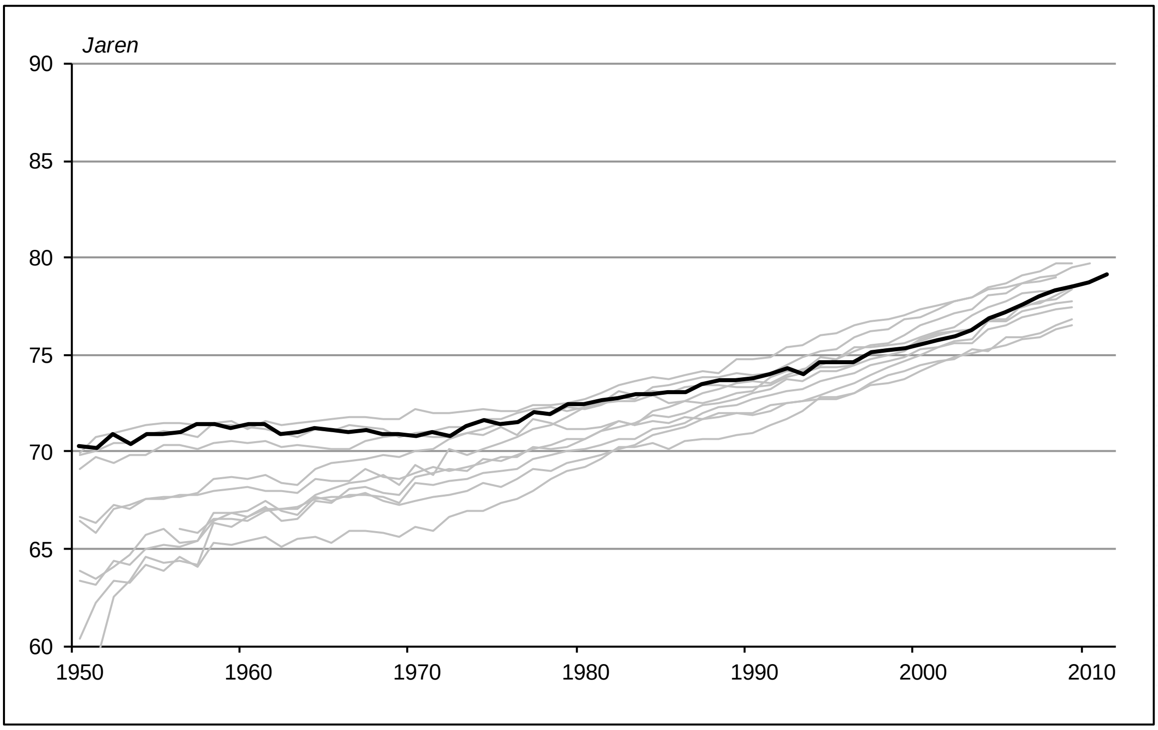
Non-smoking related mortality is forecast using the Li Lee method (Li and Lee, 2005). In a first step, a Lee Carter projection is made for the group of western European countries. In a second step, a projection is made for The Netherlands in which it is imposed that the long term trend converges to the trend for the group.

The projection of smoking related mortality is based on an extrapolation of cohort and period trends in lung cancer mortality. From the projected lung cancer mortality rates, the future proportion of smoking related mortality is calculated using Rostron's regression method. From this, and the Li Lee-projection for non-smoking related mortality, the total mortality rate is calculated.

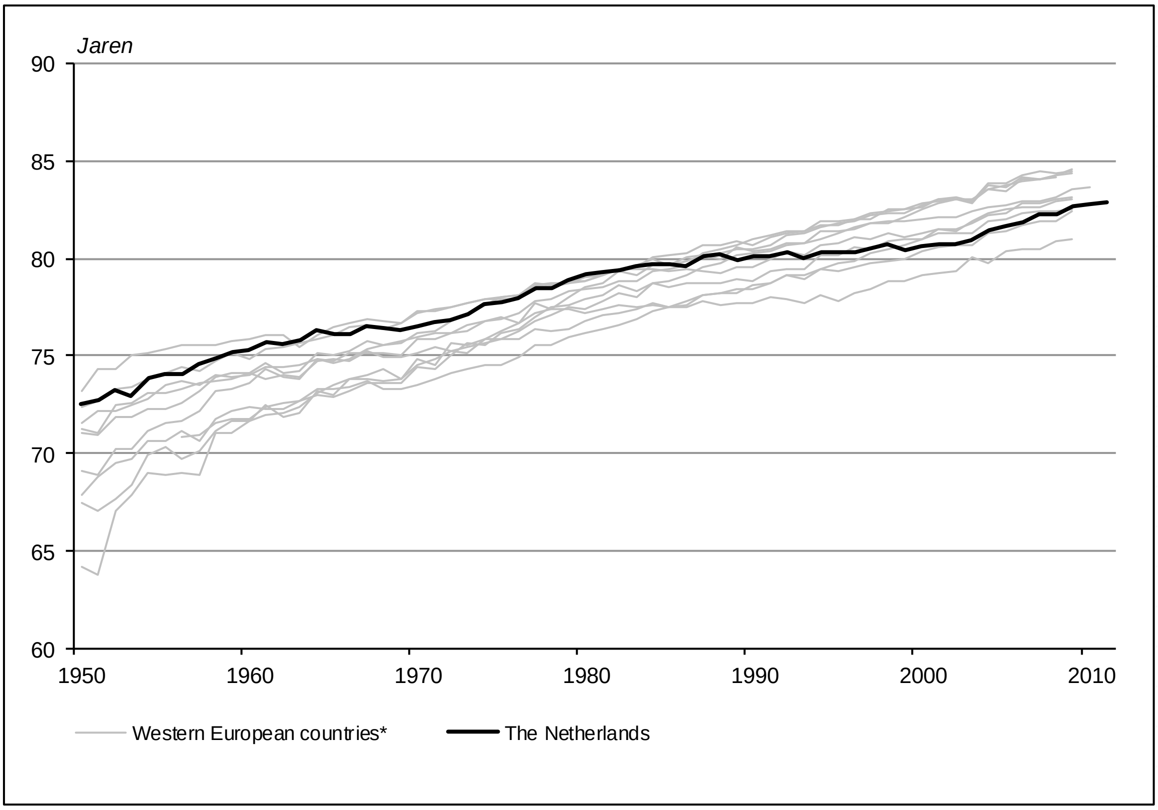
There are similarities between the forecasting model now used by Statistics Netherlands and the model used in the EUROPOP convergence scenario. Both models use coherent forecasting, where the long term trend is estimated on data from a group of countries. A main difference is that Statistics Netherlands' method imposes convergence of the mortality trend, not the level. Also, the short term trends in the Netherlands are strongly related to changes in smoking behaviour, which leads to differences between the two projections. Figure A3 compares life expectancy at birth according to the old and new projections of Statistics Netherlands with the 2010 EUROPOP scenario. For men and women, life expectancy at birth in 2060 is 2.5 years higher in the 2012-based projections than two years earlier. Most of this difference can be attributed to using the Western European rather than the Dutch mortality trend for the long term. The 2010-based projections were somewhat more pessimistic than the EUROPOP scenario, the 2012-based projections are somewhat more optimistic.

Figure A1: Life expectancy at birth for the Netherlands and 10 other Western European countries

men



women



*Denmark, Finland, France, Germany, Italy, Norway, Spain, Sweden, Switzerland, England & Wales; source Human mortality database

Figure A2: Life expectancy for the Netherlands, calculated with and without smoking attributable mortality

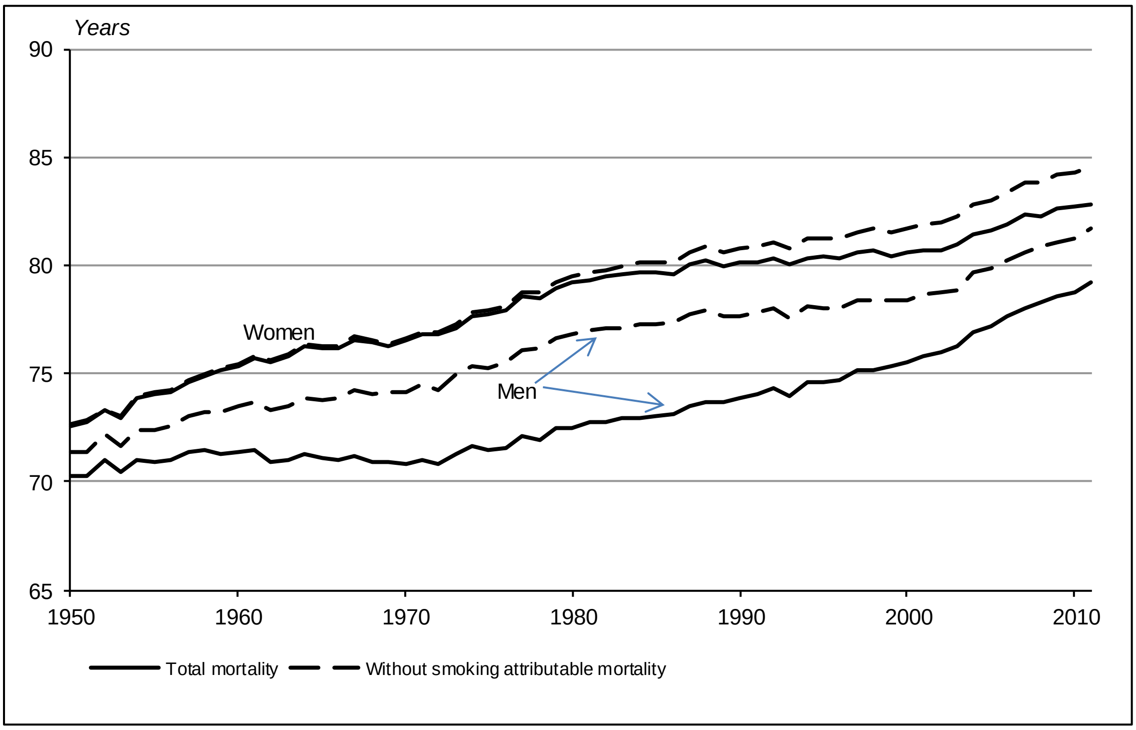


Figure A3: Projected life expectancy for the Netherlands, Statistics Netherlands (2012) and EUROPOP (2010)