REGERINGSKANSLIET

Memorandum

1 November 2005

Ministry of Finance Sweden

Economic Affairs Department
Olle Sundberg
E-mail olle.sundberg@finance.ministry.se

Implementation of AWG demographic and labour market assumptions in the dynamic microsimulation model Sesim

1 Introduction

This document contains a description, mainly in the form of diagrams, of how, and how well, the ageing working group (AWG) demographic and labour market assumptions concerning the 2005 pension calculations has been implemented in the Swedish microsimulation model Sesim.

The model

Sesim is a dynamic and stochastic microsimulation model. The main purpose of micro-simulation is to model and simulate the whole distribution and not only the mean values of the variable of interest. One of its main advantages is that it permits heterogeneous behaviour; every individual or household is not assumed to behave as the average economic agent. The main reason for focusing on dynamic models is that they allow for an evaluation of the long run effects. Dynamic models are designed to incorporate behavioural response as well as simulating the policy environment. Dynamic, in the Sesim sense, means simulating the attributes of each person at time t+1 using the attributes at time t. Sesim is also a stochastic simulation model, which means that the statistical models include a random component. In the simulation a Monte Carlo technique is used to generate a stochastic process. Thus, to model participation in the labour force, we will first estimate an econometric model (using e.g. a logit model) and calculate the probability of labour force participation rate. Next, we draw a uniform distributed (0, 1) random number. If this number is smaller than the estimated probability of labour force participation, we assign labour force participation to that individual; otherwise he is assigned to be out of the labour force.

Sesim is a mainstream dynamic MSM in the sense that the variables (events) are updated in a sequence, and the space in time between the updating processes is a year. The start year is 1999 and every individual included in the initial sample (>100 000) then goes through a large number of events, reflecting real life phenomena, like education, marriage, having children, working, retirement etc. Every year the individuals are assigned a status, reflecting their main occupation during the year. Every status is related to a source of income, working gives earnings, retirement's gives pensions etc. The tax and benefit systems are then applied and after tax income is calculated. If this simulation is repeated for a long time period life-cycle income for individuals can be generated.

Calibration or aligning

Due to the Monte Carlo simulation, the number of generated events at repeated simulation does not have to be the same. The Monte Carlo variation can be problematic in evaluating the results from a simulation. If, for instance a change in a tax rate is evaluated, then due to the Monte Carlo variation, it is difficult to isolate the pure tax effect from the stochastic Monte Carlo effect. One approach could be to repeat the simulations a number of times and use the average result, or increase the sample size, since this reduce the effect of the stochastic simulation. Another approach is to calibrate, or align, the model to an a priori defined target. The later method also makes it possible to implement different exogenous assumptions in the model. At the same time the aligning changes the effects of the estimated equations, it might disturb the interaction between different variables. An example of this is the aligning of the labour market. The appropriate balance between to align or not, depends on the actual situation. For example aligning the labour supply by age group, instead of only by the macro levels, might violate the fact that different groups is more or less sensitive to a change in the aggregate demand for labour.

2 Demographics

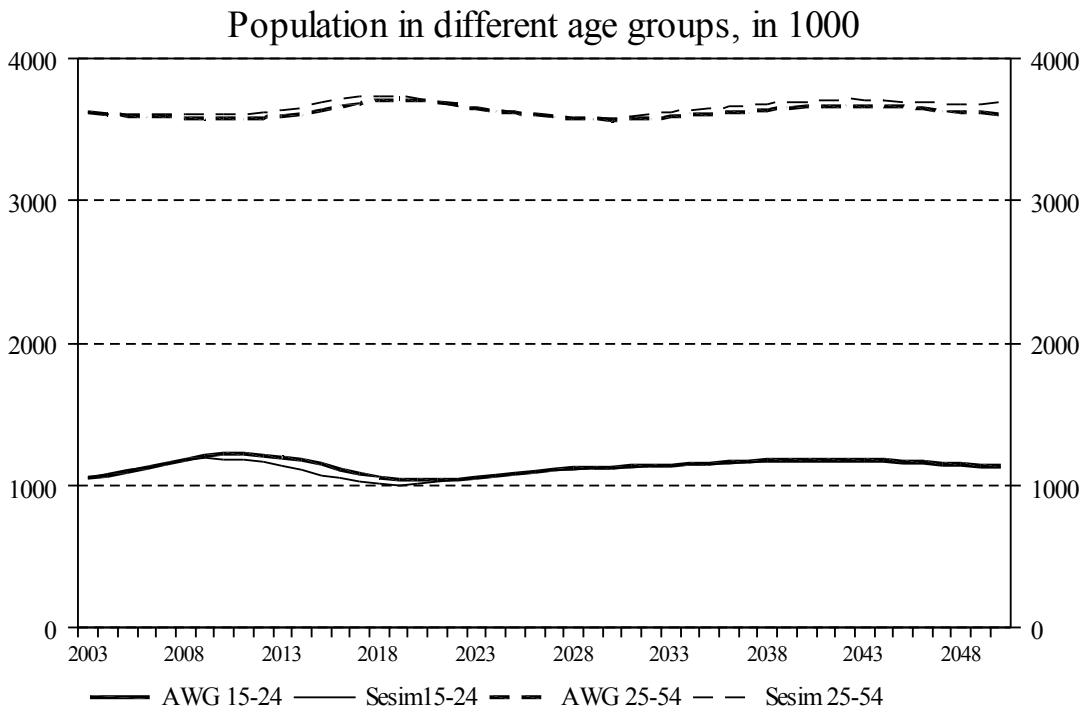
To run Sesim the following input is required for the demographic calculations:

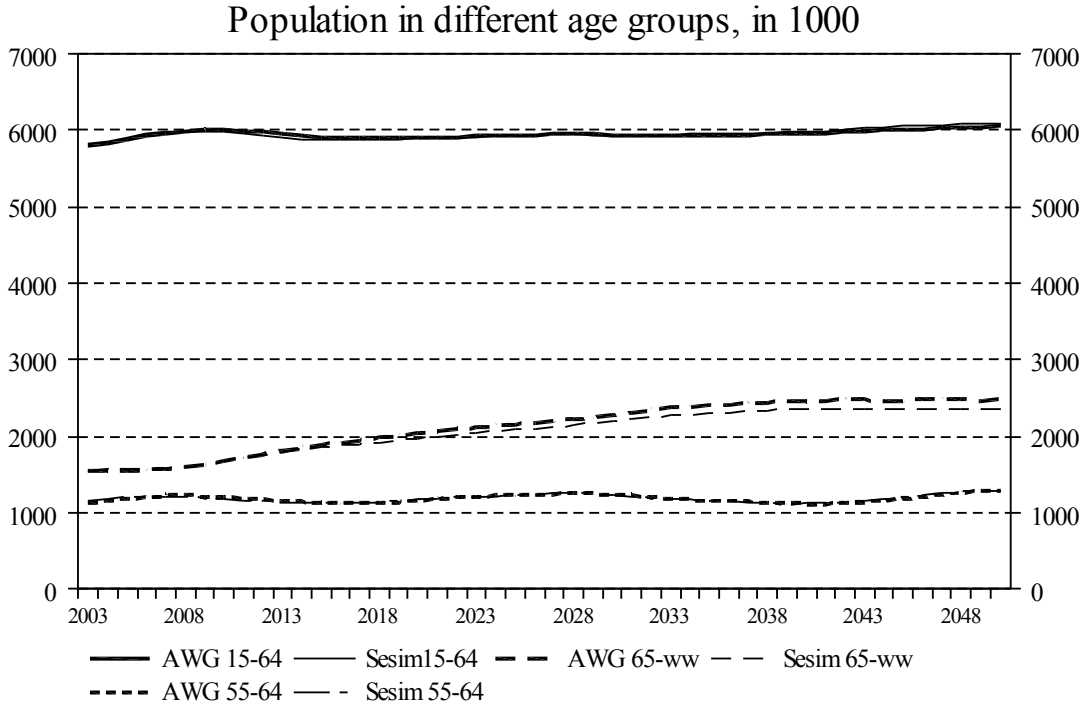
1. Mortality: Average death risks per year, age and sex.
2. Fertility: Number of newborn children per year.
3. Gross migration, divided into persons born in Sweden and abroad):
    - Number of emigrants per year
    - Number of immigrants per year

To achieve the correct population the number of births, deaths and migration are aligned to the AWG scenario by age group. The migration is only aligned at the aggregate level, and consequently the age profile is endogenous.

When implementing the mortality assumptions there are some differences between the Statistics Sweden and the Eurostat standard. In the Eurostat population projections, mortality assumptions are expressed in terms of mortality rates and not risks or probabilities. That is because rates are calculated based on a period-cohort observation plan (events by age follow the definition of age reached during the year) that is different from the period-age that requires the calculation of probabilities. The later is the normal practise in Sweden, and thus the way it's implemented in Sesim. To get the numbers right the mortality rates have been converted to risks. Also, the model is aligned to the number of deceased, and not by probabilities, which is the default method.

Concerning migration the Eurostat model does not distinguish neither between persons born in Sweden and abroad nor emigrants and immigrants. Instead the assumptions are formulated as net migration by sex and single year of age. In Sesim the gross migration flows are modelled in four parts; emigration of Swedish- and foreign-born individuals, and immigration of Swedish- and foreign-born individuals. One reason to model the gross flows is to get the correct picture of the number of persons with Swedish pension rights living abroad. To achieve the AWG net flows the gross numbers have been calculated using the pattern from the latest Statistics Sweden demographic forecast. In the diagrams below the population generated by Sesim and the AWG assumptions for a number age groups are presented. There are small differences between the assumptions and the numbers generated in the model. The main picture is that the differences are relatively small.

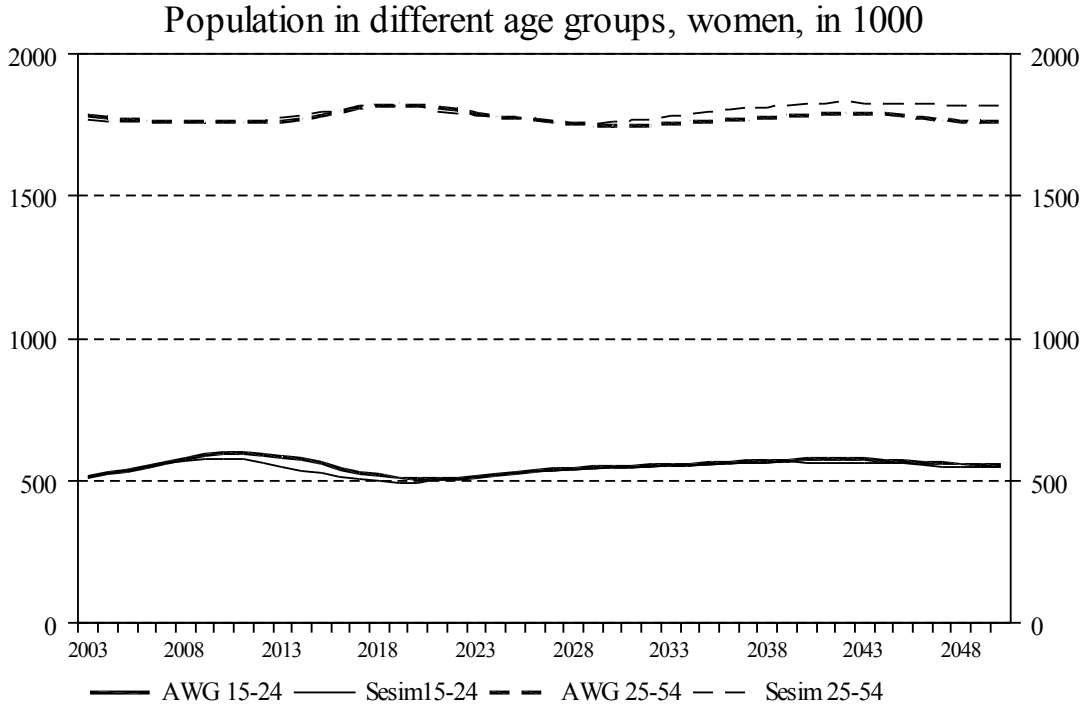


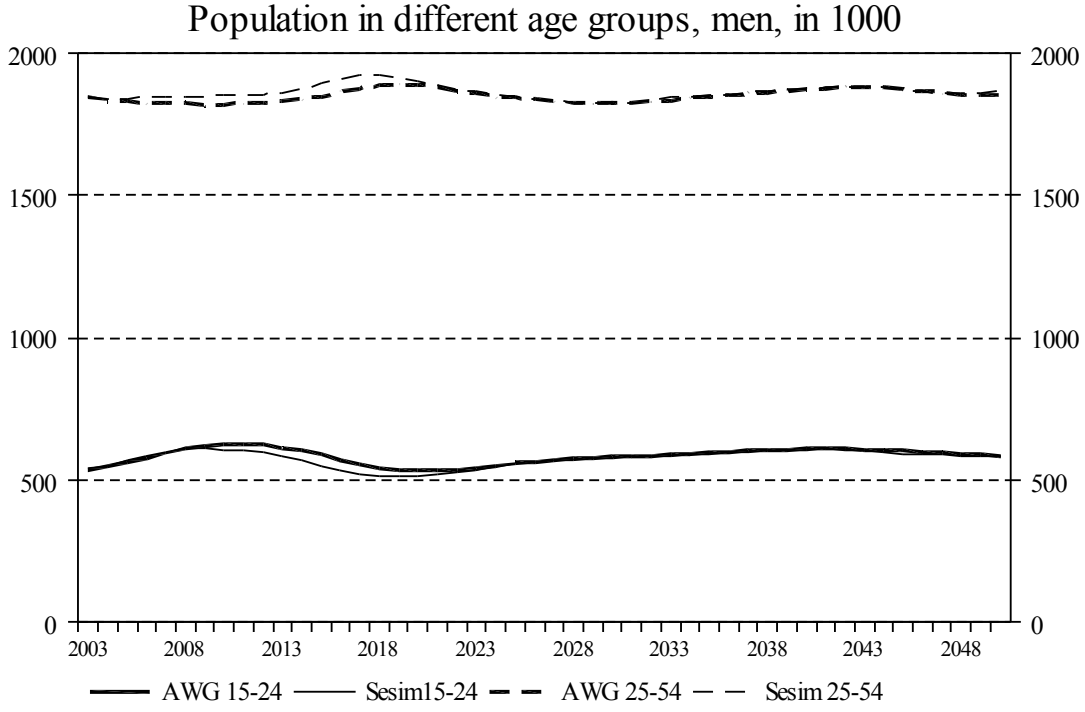


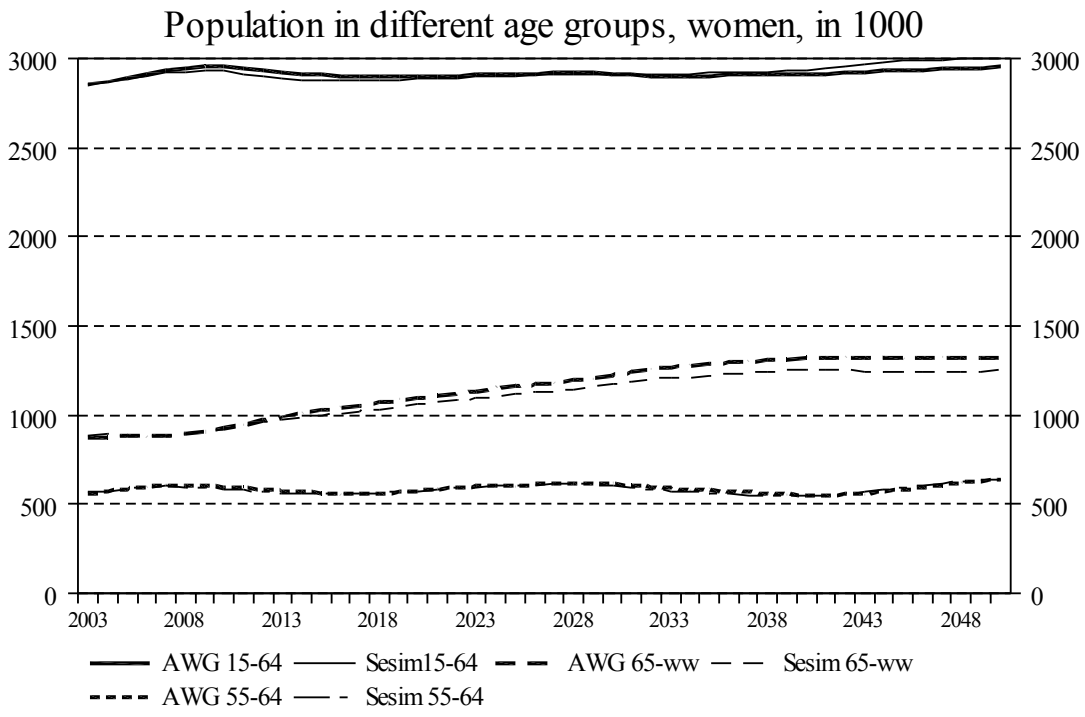
Population by sex

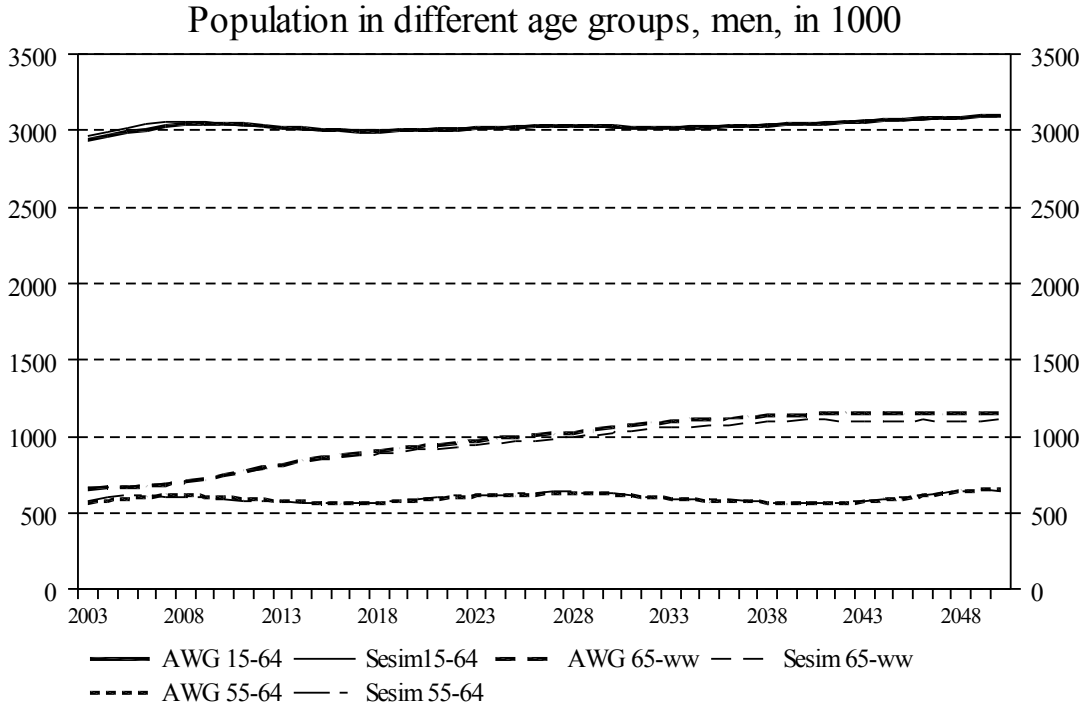
I the section below the same age groups as above have been divided in men and women. The differences are reasonably small, but in some cases there appears to be a bias that can be worth to analyze more in detail when revising the model, e.g. for women aged 25-54 years that is slightly overestimated during the second half of the period. It is possible that the

reason for the bias is that the model is aligned by numbers and not by probabilities, which is the default method.





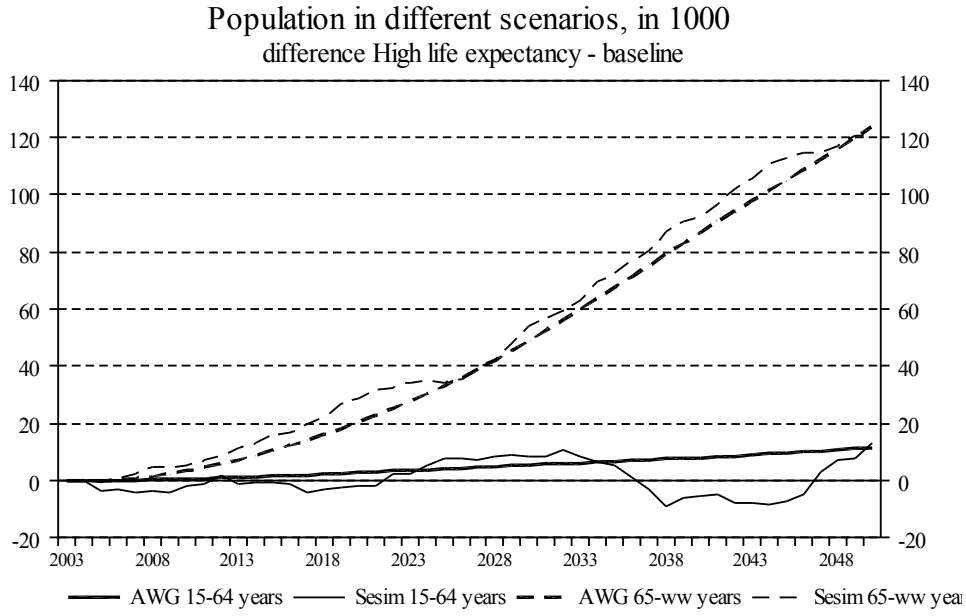




Different scenarios

The demographic scenario is the same in all sensitivity tests except for the alternative with high life expectancy, where there is a 15% decrease in age-specific mortality rates (ASMRs) by 2050, via a linear increase from 0% in 2004, that leads to an increase in life expectancy at birth of roughly 1-1.5 years by 2050. The diagram below exhibits the difference

between the scenarios for the active and the retired generations in the AWG-assumptions and in Sesim.



The population in the active ages 15-64 years are basically the same in the two scenarios, but the age group above 65 is about 120 thousand individuals bigger in the high life expectancy scenario. The aligning of the population in Sesim is OK, and the differences between the scenarios are reproduced in the model. Though, there appears to be a slight under estimation in the baseline scenario and a slight over estimation in the high life expectancy scenario. The volatility around AWG assumptions is a result of the stochastics and the limited sample size. When looking on smaller groups the models stochastic properties becomes more obvious.

3 The labour market

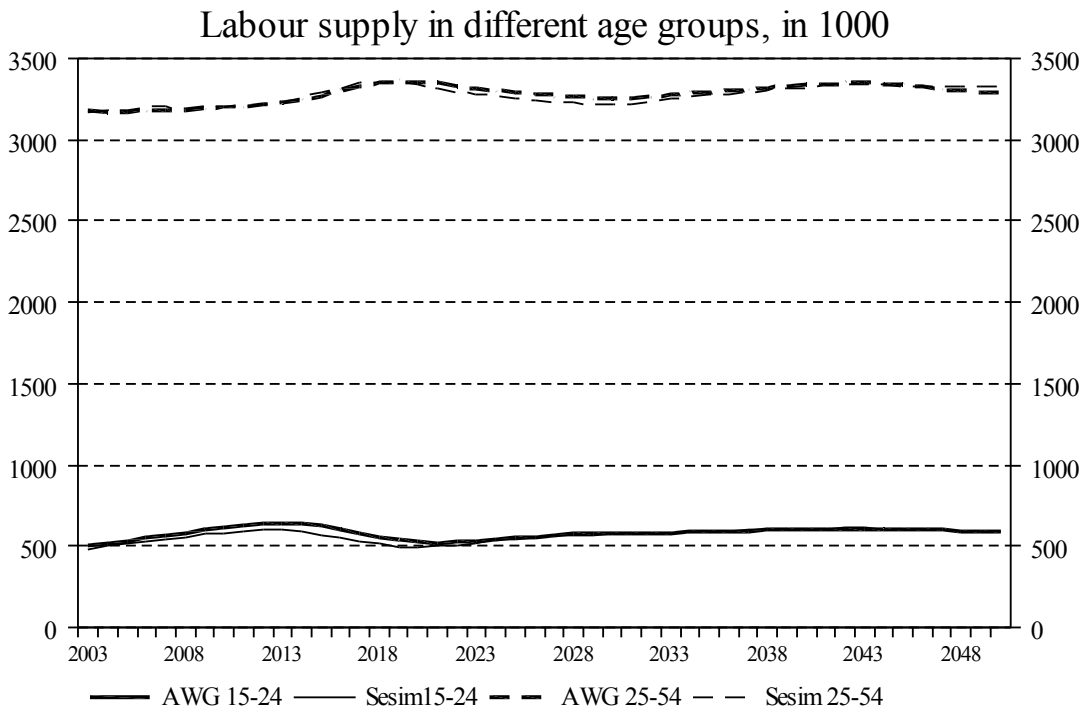
The labour market calculations include a module for the retirement decision. The date of retirement can be decided according to an endogenous model, but in these calculations the retirement age is fixed at 65 (it is also possible to allow for some variation around this age). Thus, no dynamic effects on the labour supply are taken into account in these calculations, although it's realistic to assume a higher effective retirement age as an effect of the pension reform and a rise in the longevity. The labour market module also includes a model for sick leave, unemployment and employment.

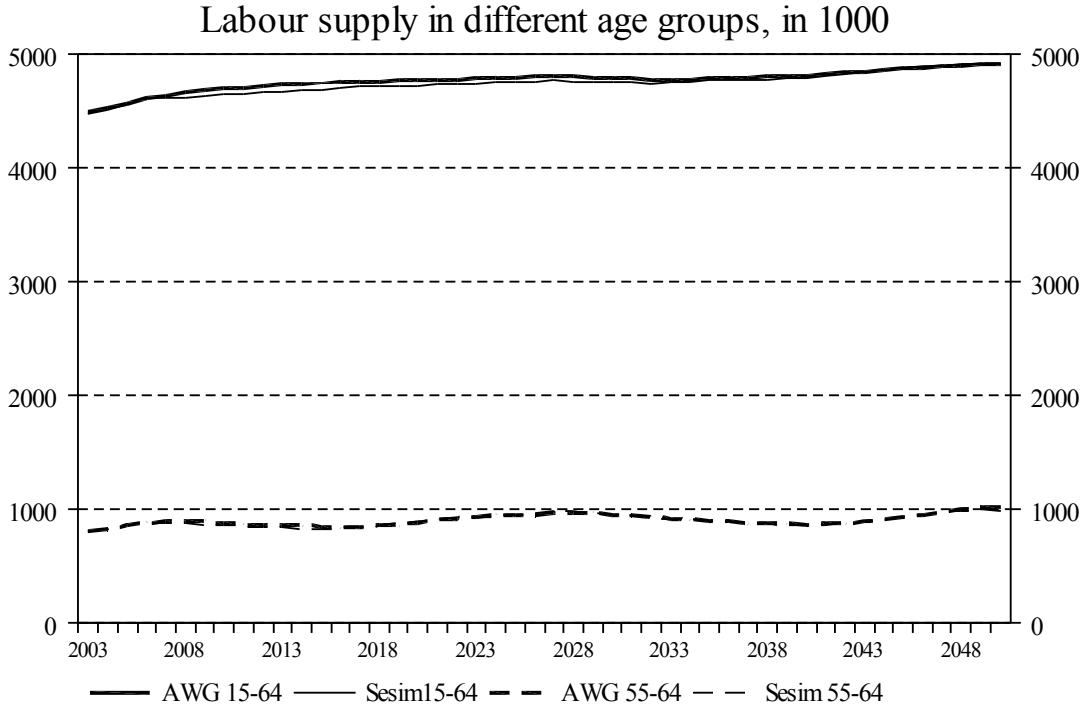
The labour market is more complicated to align to exogenous macro assumptions as a result of the way the model works. Every year the individuals are assigned a status, reflecting their main occupation during

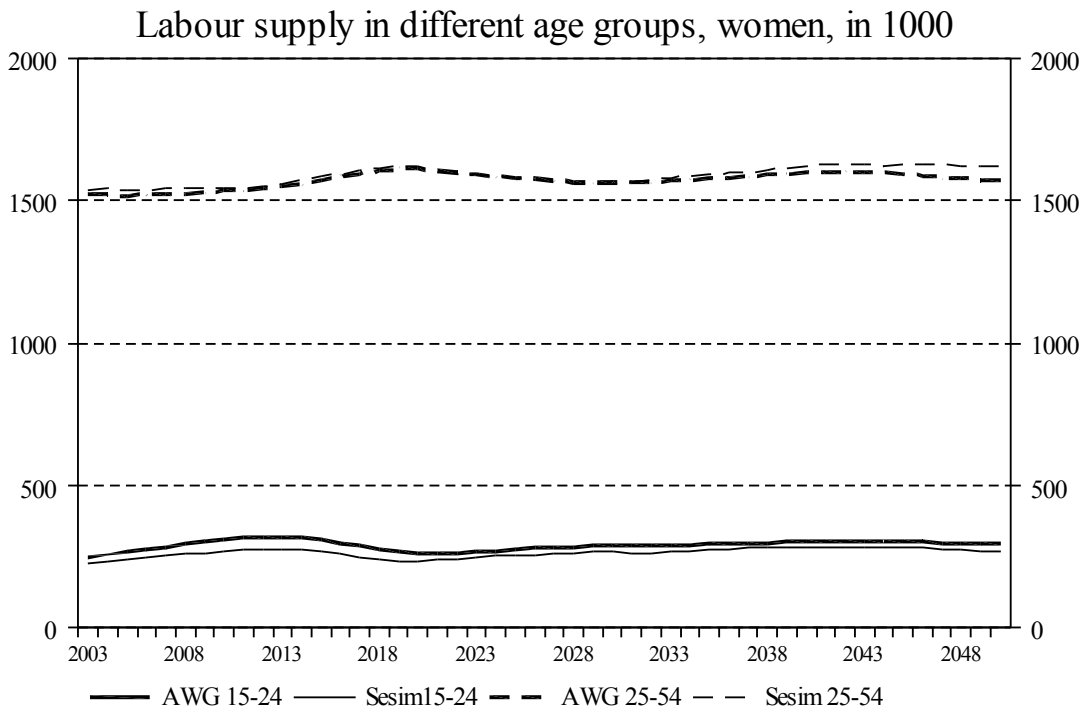
the year. Every status is related to a source of income, working gives earnings, retirement's gives pensions etc. In realty often individuals have their income from different sources. Therefore the classification of individuals into different statuses in the start data is a time-consuming ad hoc procedure, and the definitions are not as clear-cut as for macro statistics.
In the calculations the model is aligned in order to achieve exogenous average unemployment and participation rates in the age group 15 to 64 years. In the model, as well as in reality, no individuals aged 15 years or younger has work as their major activity. In Sweden less than one percent retires after age 65, in the sense that they does not have any public old age pension, although the proportion that continues to work is higher. In the AWG assumptions 11-13% continues to work after age 64. The participation rate has been adjusted to reproduce the wider AWG definition, which includes individuals between 15 and 71 years, by a proportional adjustment in the age group 16-64 years.
The age profiles for the labour market variables are endogenous and not aligned to the AWG-assumptions for different cohorts though. The results of the pension calculations are rather robust against different assumptions about different labour market age profile assumptions. The reason for this is that even unemployment and other types of absence generate pension rights within the new Swedish pension system.

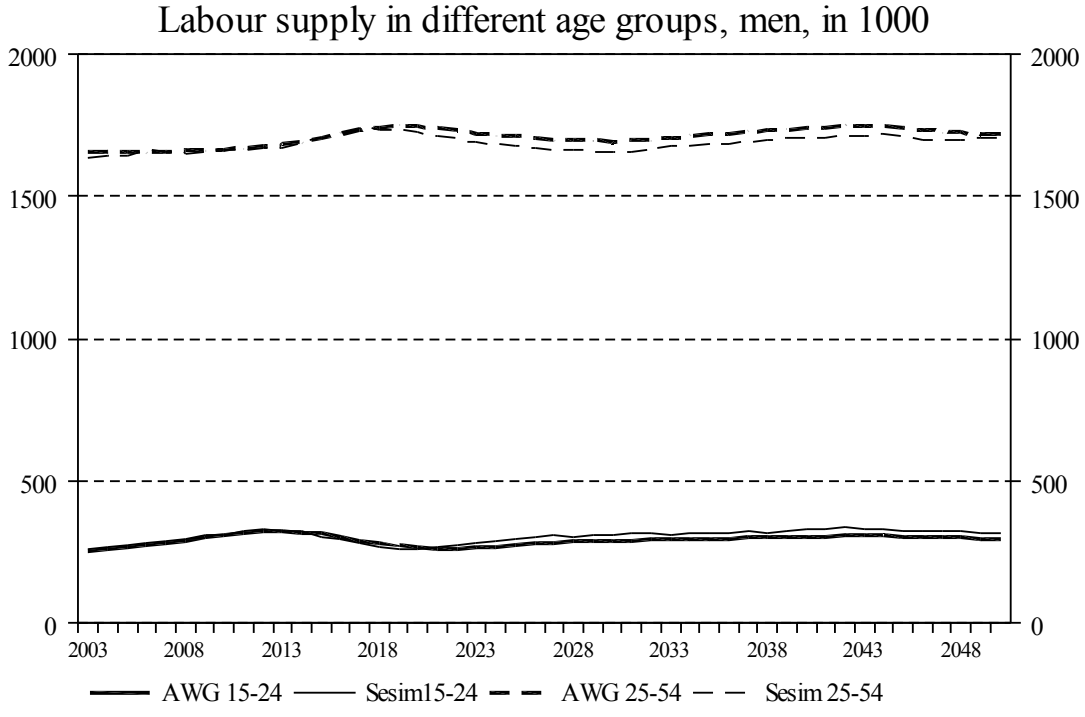
Labour supply

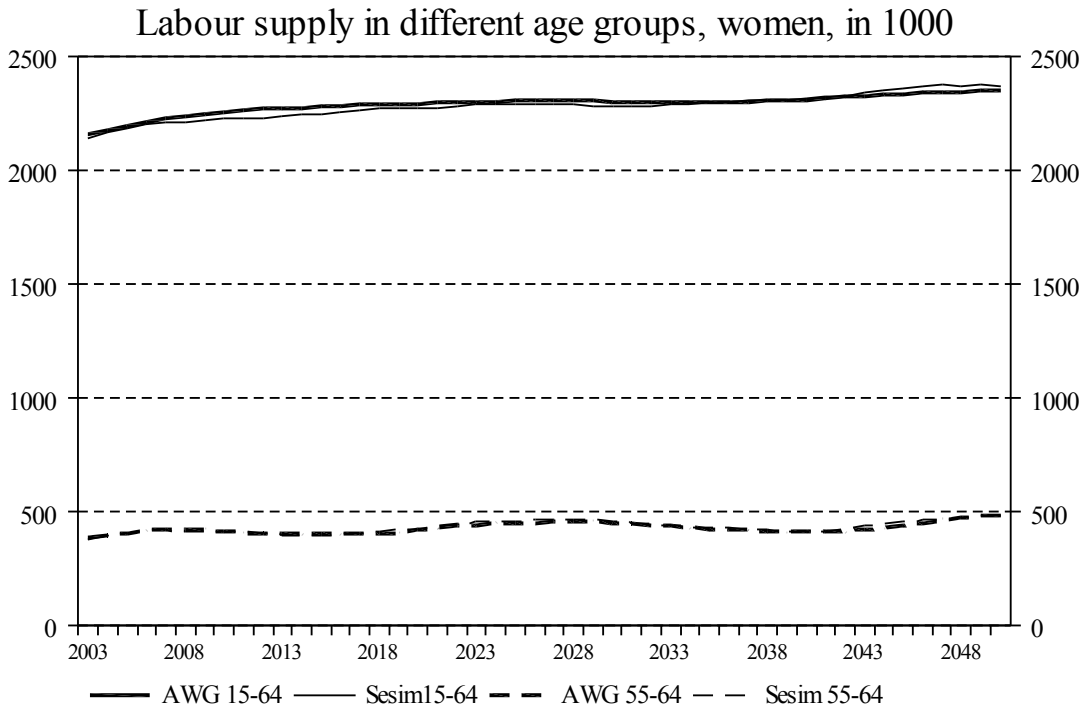
In the diagrams below the differences between the Sesim numbers and the AWG assumptions are amazingly small. If one looks on smaller age groups the differences are greater in relative terms, but of less importance for the results of the calculations.

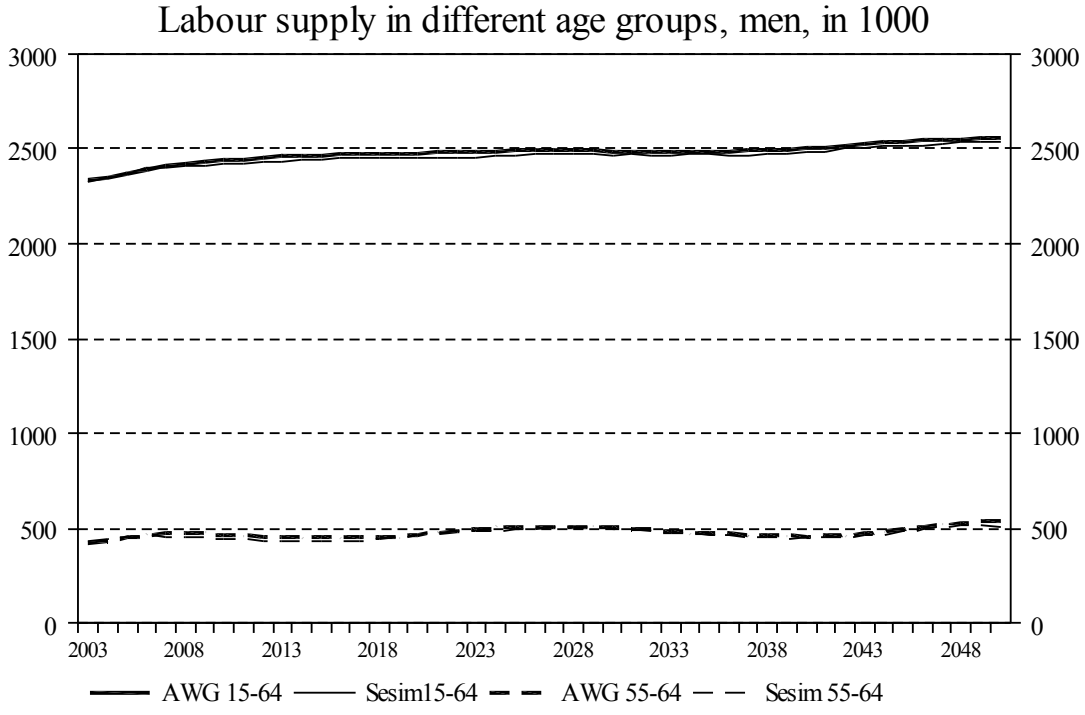

Labour supply in different age groups, in 1000
3500
3000
2500
2000
1500
1000
500
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG 15-24
Sesim15-24
AWG 25-54
Sesim 25-54


Labour supply in different age groups, in 1000
5000
4000
3000
2000
1000
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG 15-64
Sesim15-64
AWG 55-64
Sesim 55-64


Labour supply in different age groups, women, in 1000
2000
1500
1000
500
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG 15-24
Sesim15-24
AWG 25-54
Sesim 25-54


Labour supply in different age groups, men, in 1000
2000
1500
1000
500
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG 15-24
Sesim15-24
AWG 25-54
Sesim 25-54





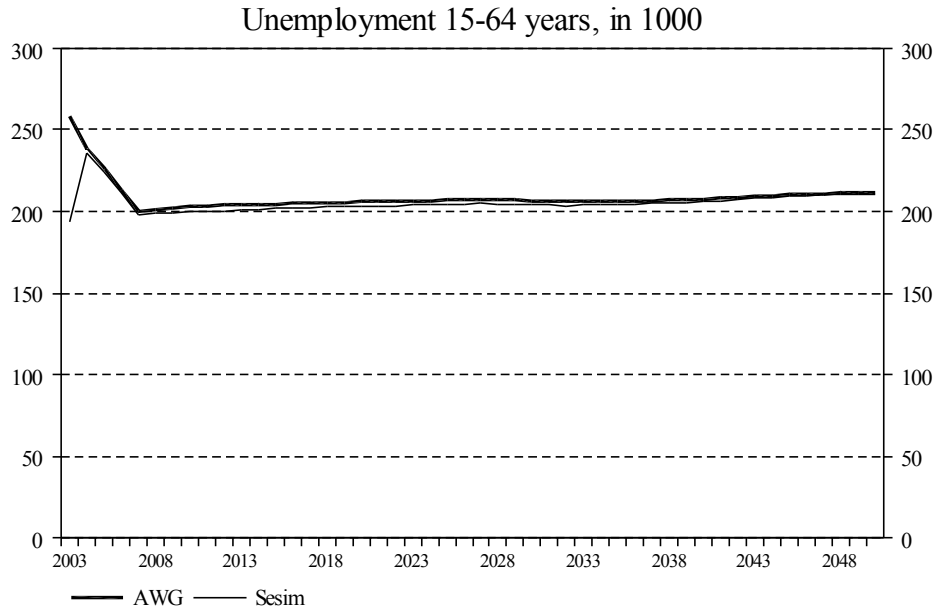
Unemployment

Concerning the unemployment there are some additional difficulties to compare the model results with the AWG assumptions:

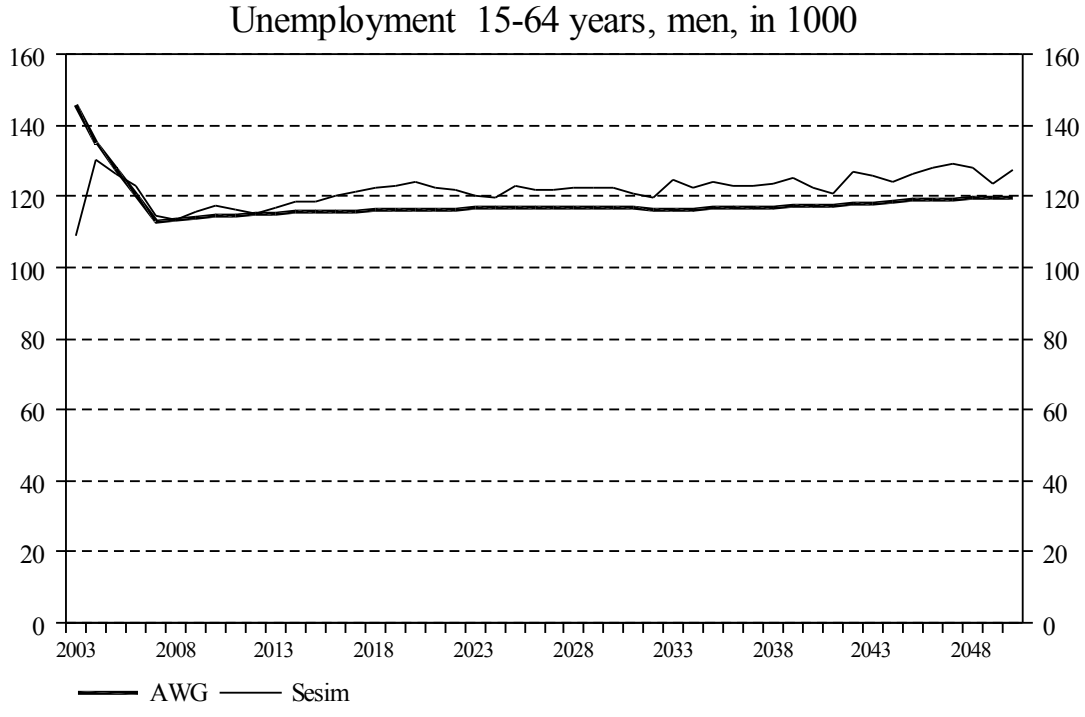
- As for the labour supply only the aggregate unemployment is aligned, and the age profile endogenous.

- The unemployment in the Sesim model is calculated including labour market programs, and therefore the numbers are not directly comparable, *but still consistent*, with the AWG assumptions.
- The labour market programs are calculated as an adjustment of the AWG unemployment assumptions (the percentage share is derived from the Ministry of Finance forecast until 2008, and then kept constant for the rest of the period).
- For the projection period we don't have any age profile for the labour market programs, but only an aggregate number. The implicit assumption is therefore that the age profile for the labour market programs is the same as for the open unemployment.
- The Swedish labour market survey (AKU) has been revised. Therefore there are small differences between the AWG and Sesim numbers for the outcome years. By applying a constant multiplicative adjustment for the whole period this is solved.
- Note that unemployment benefits not are paid to persons older than 64 in Sweden. Therefore it is assumed that no individuals above 65 are unemployed.

The results in the diagrams below shows that the aligning works well on the aggregate level. The data in the diagrams are adjusted with respect for the point mentioned above. The diagrams show that the unemployment for women is somewhat lower than in the AWG assumptions, and consequently somewhat higher for men. When labour market programs by age group is missing no diagrams for different age groups are presented.




Unemployment 15-64 years, women, in 1000
120
100
80
60
40
20
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG
Sesim


Unemployment 15-64 years, men, in 1000
160
140
120
100
80
60
40
20
0
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
AWG
Sesim