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The methodology developed by the Federal Planning Bureau to produce long-term scenarios

February 2012

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Abstract - The Federal Planning Bureau has a long tradition in providing long-term projections focused on the evolution of social expenditure within an overall framework of public finance, using the MALTESE system of models. This outlook is based on different scenarios: demographic, socio-economic, macroeconomic and welfare adjustment. The purpose of this publication is to describe the methodology for the construction of the socio-economic and macroeconomic scenarios and to illustrate it by presenting the main results from the 2011 projection for the Annual Report of the Study Group on Ageing.

Jel Classification – E6, H53, H55, J1, J2

Keywords – Long-term scenario, social expenditure, population ageing

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Executive summary

Since 1987, the Federal Planning Bureau (FPB) has been providing long-term projections focused on the evolution of social expenditure within an overall framework of public finance, using the MALTESE system of models (Model for Analysis of Long-Term Evolution of Social Expenditure). This outlook is based on different scenarios: demographic, socio-economic, macroeconomic and welfare adjustment. After a short presentation of the scenario and demographic outlook, this publication describes the methodology to construct the socio-economic and macroeconomic scenarios and illustrates it by presenting the main results from the 2011 projection made for the Annual Report of the Study Group on Ageing.

The population projection is first split into four socio-economic categories by gender and age (or age group): the school population, the potential labour force (employment and unemployment but also 'prepension' and full-time career breaks), the disabled persons and the others (as a residual). The projection of the potential labour force and the disabled relies on a cohort approach and results from probabilities of maintaining in a status or transition probabilities from one status to another between two periods. The school population aged 15 to 34 is assumed to evolve inversely to the potential labour force for this age category.

The long-term macroeconomic scenario is based on the supply-side model S3BE (Small Supply-Side model for the Belgian Economy) that assumes a CES production function with two factor inputs (labour and capital), labour-augmenting technical progress and constant returns to scale. Using the observed past trend in labour market efficiency gains, the evolution of the structural unemployment rate can be computed. Given the unemployment rate trajectory, the development in the labour force and an assumption regarding total factor productivity growth, employment and GDP are determined simultaneously. Relying on the concept of potential output, a specific simulation procedure ensures full consistency between the medium and the long-run macroeconomic scenario produced by the FPB.

Once the overall evolution of the employment and unemployment is known, the second phase of the socio-economic projection disaggregates employment and unemployment further and estimates the number of pensioners. Employment is divided by scheme (wage earners, self-employed and civil servants), gender and age group, on the basis of assumptions. The projection of the number of pensioners is carried out at a highly disaggregated level per scheme, gender and age by letting the existing number of pensioners grow old and adding new pensioners based on recent "retirement behaviour" and historical participation rates.

The computation of the number of beneficiaries in the various schemes allows determining, in combination with a projection of the corresponding benefits and of the healthcare expenditure, the so-called budgetary cost of ageing or the change in total social allowances compared to a base year. Finally, those social expenditures are included in a projection of the general government account. Those final steps are beyond the scope of this working paper and consequently not described here.

1. Introduction

Since 1987, the FPB disposes of a long-term system of models, called MALTESE as Model for Analysis of Long-Term Evolution of Social Expenditure, focused on long-term social expenditure projection within an overall framework of public finance, in the context of an ageing population. Between 1987 and 2001, it was used several times, either on the initiative of the FPB or to support economic policy-making (especially for measuring the impact of some statutory public pension reforms in Belgium).

In 2001, the Law "guaranteeing a continuous reduction in public debt and the setting up of the Ageing Fund" created in particular the Study Group on Ageing, which publishes a yearly report on the budgetary and social implications of ageing. The Federal Planning Bureau has been entrusted with the technical and administrative secretariat of the Study Group on Ageing. So every year, the MALTESE system of models is applied to produce a long-term projection of all social expenditure for the yearly report of the Study Group on Ageing.

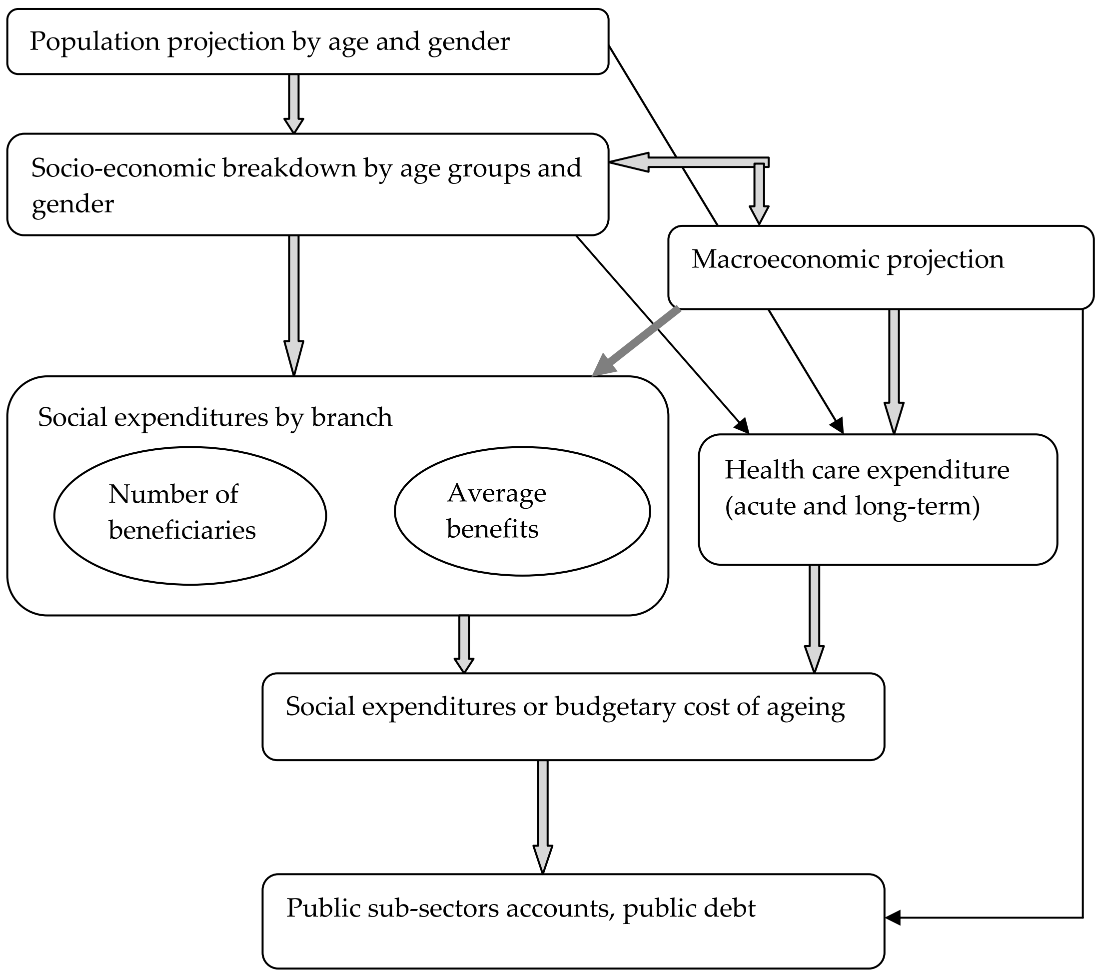
Since 2001, the MALTESE system of models is also used, every three years, to produce the projections of public pension expenditure for Belgium, as part of the Working Group on Ageing Populations and Sustainability. This group was established in December 1999 within the Economic Policy Committee of the European Council ECOFIN to realise international exercises of long-term social expenditure projection for which every country delivers its estimations for pension expenditures, sticking to common assumptions.

MALTESE is mainly a system of meso-economic models with one central model and several specific peripheral models (computing number of pensioners, average pensions, health care...). With the exception of the econometrical macroeconomic model, the central model and the peripheral models are mechanical models adequate for translating demographic and socio-economic projections into budgetary developments like the social security account and the overall public finance account. Special attention is paid to modelling social expenses according to the legislated calculation rules, by scheme, gender, age and categories for the number of beneficiaries and the corresponding average benefits. A very detailed database is used for this purpose but the global accounting frame of the system relies on the national accounts. The baseline assumes no change in legislation, rules or policy and has a fifty years' horizon. In the short- and medium-term, for the annual national exercise of the Study Group on Ageing, the projection relies on the short-term forecast and the medium-term projection of the FPB.

The following box illustrates the global structure of the Maltese system of models. The first step is the projection of the population by age and gender given the hypotheses about fertility rates, life expectancy and migration flows. In a second step, the population is split into different socio-economic groups: school population, labour force, disabled persons and others. This socio-economic projection results from transition probabilities from one status to another. The macroeconomic scenario is then elaborated with a trajectory for the global unemployment rate and an assumption on the evolution of total factor productivity, allowing to determinate total employment and GDP. The population is then further broken down into various categories relevant to calculate the numbers of beneficiaries of a social allocation (unemployment by age and gender; employment by scheme, age and gender; pensioners by scheme, age and gender).

After those steps, the benefits in the various schemes are projected on the basis of the numbers of beneficiaries and the different institutional arrangements (wage ceilings, adjustment to living standards). Average benefits are calculated by branch, gender, age groups and categories, except for healthcare expenditure. The projection of the acute care depends on private consumption of healthcare per capita by age group and gender, on population prospects and on GDP growth per capita, while the long-term care projection is based on a hierarchical model with probabilities. Finally, those social expenditures are included in a projection of the general government account based on internationally common agreed assumptions (constant tax rates and contributions rates, primary expenses - other than social expenses - constant in % of GDP). The evolution of all revenues and primary expenditure leads to the calculation of public debt and interest payments.

Overview of the Maltese system of models



The object of the paper is to describe the methodology behind the long-term socio-economic and macroeconomic scenarios which are closely related. After a short presentation of the parameters on which the population projection is based (section 2), the paper focuses on the methodology regarding the socio-economic breakdown of this population (sections 3 and 6). The short-term and the medium-term macroeconomic scenarios as well as the concept of potential output are presented briefly in section 4, while the approach used to produce the long-term macroeconomic scenario is explained in detail in section 5.

2. The demographic scenario

The purpose of this section is not to provide a full account of the demographic model but to illustrate the evolution of the parameters behind the population projection, putting forward the ageing population and hence the usefulness of the specific characteristics of the long-term model. A detailed description of the demographic model can be found in previous publications[1].

The most recent national "Population projection 2010-2060" has been carried out in May 2011[2]. The projection is elaborated by age and gender, and at a very detailed geographical level (the 43 Belgian administrative districts).

Basically, the population in the year t is calculated as the surviving population of the preceding year, accrued with the number of births and the number of immigrants, and diminished with the number of emigrants. This means that the projection rests on three demographic assumptions: the fertility rate, the life expectancy and the migration (see Table 1).

Table 1 Demographic assumptions of the "Population projection 2010-2060" of Belgium

	1960	2000	2010	2030	2060
Fertility rate	2.54	1.61	1.85	1.86	1.86
Life expectancy at birth : men (in years)	66.8	75.1	77.9	81.9	86.2
Life expectancy at birth : women (in years)	72.8	81.4	83.2	85.8	88.8
Net migration flow (in thousands)	-39.9	14.3	63.8	24.3	32.6

Fertility rate represents the average number of children a woman would have, should she at each bearing age have the fertility rate of the year in question. After a long period of decrease, the fertility rate has increased over the last decade, from 1.6 in 2000 to 1.85 in 2010. The projection shows a very slight rise at the beginning of the period, where after the fertility rate remains stable at the level of 1.86 children by women.

Life expectancy at birth has been largely increasing since the sixties. The projection assumes, between 2010 and 2060, an improvement by more than 8 years for men and 5.5 years for women on half a century, implying a reduction of the gap between males and females.

The net migration flow or the difference between immigration and emigration is characterised by high variability in the past. But since the beginning of the year 2000, the net migration flow has always been positive and is even increasing. In projection, this is probably the most uncertain demographic assumption. The methodology relies on hypotheses regarding the immigration on the one hand and emigration on the other hand. Concerning immigration, four groups of people are distinguished: Belgians returning to their country, people from the EU-15 (mostly French and Dutch), people from the new Member States (EU-12) and people from the rest of the world. Many factors are integrated in our scenario. Immigration from the EU-15 continues but at a slower pace. Immigration from the EU-12 is still increasing until 2015. A comparison between the evolution of the living standards between Bel-

[1] See Bureau fédéral du Plan, Direction Générale Statistique and Information Economique et Comité scientifique d'accompagnement (2008)

[2] See Bureau fédéral du Plan and Direction générale Statistique et Information économique (2011)

gium and the origin country[3] is also made, which implies a fluctuating migration inflow. The emigration scenario rests on emigration rates based on the three last observed years. As a result, the net migration flow first slightly increases till 2012, then decreases up to the years 2030, and finally increases again. The next table presents an overview of the "Population projection 2010-2060" for Belgium.

Table 2 Overview of the "Population projection 2010-2060" of Belgium

	2010	2030	2060
Total population in thousands	10884.1	12309.1	13537.2
By age-groups in thousands			
population aged 0-14	1841.9	2125.7	2275.1
population aged 15-64	7171.0	7456.1	7911.0
population aged 65 and over	1871.1	2727.2	3351.1
Age structure in %			
population aged 0-14	16.9	17.3	16.8
population aged 15-64	65.9	60.6	58.4
population aged 65 and over	17.2	22.2	24.8
Some indicators			
Old-age dependency ratio (65+/15-64)	26.1	36.6	42.4
Ageing intensity (80+/65+)	29.0	28.9	38.9

The total population rises by almost 25% between 2010 and 2060, reaching more than 13.5 million. This population is also ageing. Indeed, the proportion of the population aged 65 and over largely increases from 17% in 2010 to almost 25% in 2060, to the detriment of the proportion of the working-age population (15-64).

The old-age dependency ratio (people aged 65 and over relative to those aged 15-64) increases from 26% in 2010 to 42% in 2060. In other words, in 2010, there are almost 4 people aged 15-64 for one people aged 65 and over, while in 2060, there are only slightly more than two people aged 15-64 left for one people aged 65 and over. Another demographic indicator called the ageing intensity shows that the population aged 80 and over is increasing in comparison with the population aged 65 and over (from 29% in 2010 up to 39% in 2060).

3 This comparison is based on the « Working Group on Ageing Populations and Sustainability » projections, established by the Economic Policy Committee of the European Commission.

3. The (first) socio-economic breakdown

The population projection is first split into four socio-economic categories: the school population, the labour force, the disabled persons and the others (as a residual), by gender and age (or age groups). This socio-economic projection relies mainly on a cohort approach and results from transition probabilities from one status to another between two periods, based on behaviour in recent years (including effects of reforms already decided).

In a cohort approach, people of a socio-economic category by age (or age group) are a function of:
– people of this category the year before and one year younger, as a probability of remaining in the category;
– people from another socio-economic category the year before and one year younger , as a probability of transition from one category to another.

Analytically, if X and Z represent two socio-economic categories, g the gender and i the age (or the age group), we have:

$$X_{g,i,t} = Z_{g,i-1,t-1} \text{ x } PX_{g,i,t}$$

where $PX_{g,i,t}$ represents the probability of transition from the socio-economic category Z at the age i-1 in year t-1 to the socio-economic category X one year later at the age i. If the socio-economic category X is equal to the socio-economic category Z, then it is a probability of remaining in the category.

In most cases, we calculate X and Z as proportions of the corresponding overall population. This allows to automatically correct for projected evolutions in mortality and net migration that would differ from past trends, under the hypothesis that these differences are evenly spread among socio-economic categories.

3.1. The projection of the labour force

The definition of the labour force used in our approach covers a wide concept, the so-called 'potential labour force', which takes into account not only employment and broad administrative unemployment (which includes older unemployed exempt from job search requirements), but also 'prepension' (peculiarity of the Belgian system) and full time career breaks. The latter groups may be considered to have withdrawn permanently (older unemployed, prepensioners) or temporarily (career breaks) from the labour market, but are included in our notion of potential labour force for two reasons. First, economic policy measures have produced important shifts between these groups and the labour force proper over the last decades. As a consequence, the evolution of potential participation rates has been much smoother than the evolution of participation rates exclusive of government-subsidized withdrawals from the labour market. Second, although the people currently present in these schemes (with the exception of career breaks) may be considered as very distant from the labour market and rather unlikely to return into employment, for future generations it is expected that an increase in participation rates may be obtained by reducing the future inflow into these schemes. In our projection methodology, flows into subsidized withdrawals are modelled explicitly (refer to 6.1 below). The labour force proper is then obtained by subtracting the resulting stocks in these withdrawal schemes from the potential labour force.

The projection of the (potential) labour force is constructed bottom-up by gender, age and the three Belgian regions (Brussels-Capital, Flanders and Wallonia). For this socio-economic category, the general principle of the projection is a cohort approach by means of probabilities of remaining in the (potential) labour force.

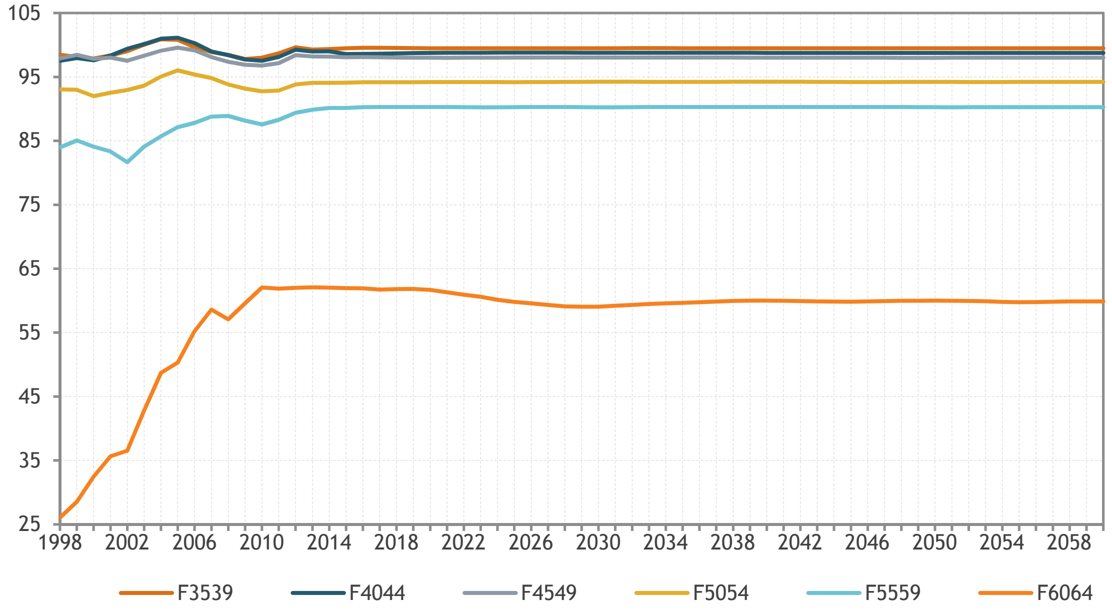
For instance, the female labour force living in Wallonia of 40 years old will be determined for the year 2011 as the female labour force living in Wallonia of 39 years in the year 2010 multiplied by the probability of remaining in the labour force of the 39 years old women of Wallonia one year later when aged 40 years. The probability is calculated as the ratio between the female labour force of 40 years old and the female labour force of 39 years old one year before.

As a general principle, the probabilities in projection follow the trend evolution in the behaviour of successive past generations by region, gender and age but at diminishing pace, to become constant relatively rapidly into the projection period. Moreover, their projected evolution also includes all reforms already decided that may impact on this behaviour. Finally, when for a certain age, gender and region, the projected path for the probability shows an aberration, ad hoc interventions may be implemented.

For the ages between 60 and 65 years, the projection of the probability of remaining in the labour force takes explicit account of the entries in old age pension. However, for the younger age groups (in principle, between 15 and 34 years), the cohort methodology is not used at all. The current state of administrative statistics does not allow for a full-fledged system that follows successive cohorts of students through their schooling career and up to their subsequent entry into the labour market. Instead, for each of these ages, past trends in participation rates are extrapolated independently (again, at diminishing pace), without much attention being given to implicit cohort behaviour.

For the sake of simplicity, observed probabilities of remaining in the labour force will now be presented at aggregate level only: by gender, five-year age group and for all three regions confounded. Because five-year age bands are taken, the probabilities have been calculated with respect to the situation of the previous age band, five years before. The next graph illustrates the evolution of the female probabilities of remaining in the labour force, between 1998 and 2060, by five-year age group (the observation period runs up to 2009).

Graph 1 **Female probabilities of remaining in the potential labour force (five-year age group)**
in %

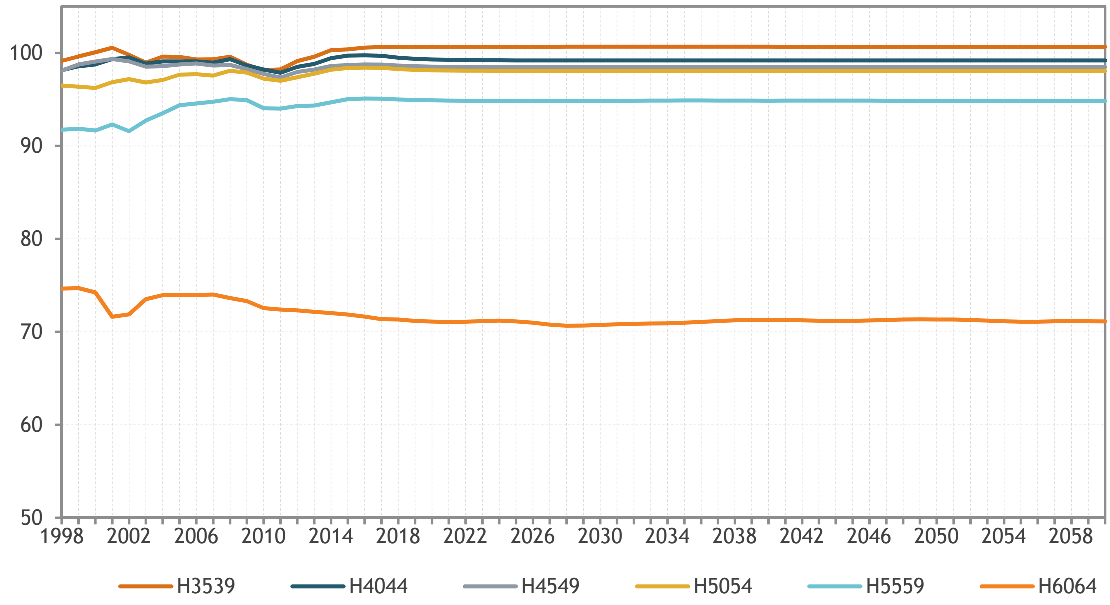


For women between 35 and 54 years, there is clearly an increase since the end of the nineties till 2005 meaning that fewer women leave the labour market at these ages. For the 55-59 years age group, the rise appears a few years later, namely from 2002 onwards. But in the second half of the years 2000, the probabilities show a decreasing trend (from 2007 onwards for women aged 55-59 years). The administrative treatment of the unemployed may provide one explanation for this decrease: more stringent controls on active job search behaviour were put in place, leading to more exclusions from registered unemployment (and, hence, the potential labour force). The economic crisis of 2009 may also have contributed to this reduction but it is very hard to distinguish the various factors, and, overall, our impression is that the adverse economic conditions have slowed down the growth of the labour force much less than originally expected and that their impact has been relatively larger in the younger age classes. The probabilities to maintain in the potential labour force at ages between 35 and 59 are supposed to decline further in 2010, before increasing slightly during a few years and stabilizing in the medium and long-run.

For women aged 60 to 64 years, the probability to remain in the labour force has increased substantially between 1998 and 2009. Indeed, on 1 July of 1997, a pension reform came into force increasing progressively the female legal age of retirement from 60 years to 65 years in 2009. Considering that the reform has come to maturity, the probability of remaining in the labour force stays relatively constant in projection and takes into account the probabilities of entries in retirement which are different according to the various socio-economic categories and to the scheme (see 6.2 below).

Graph 2 shows the male probabilities of remaining in the labour force by five-year age band.

Graph 2 **Male probabilities of remaining in the labour force (five-year age group)**
in %

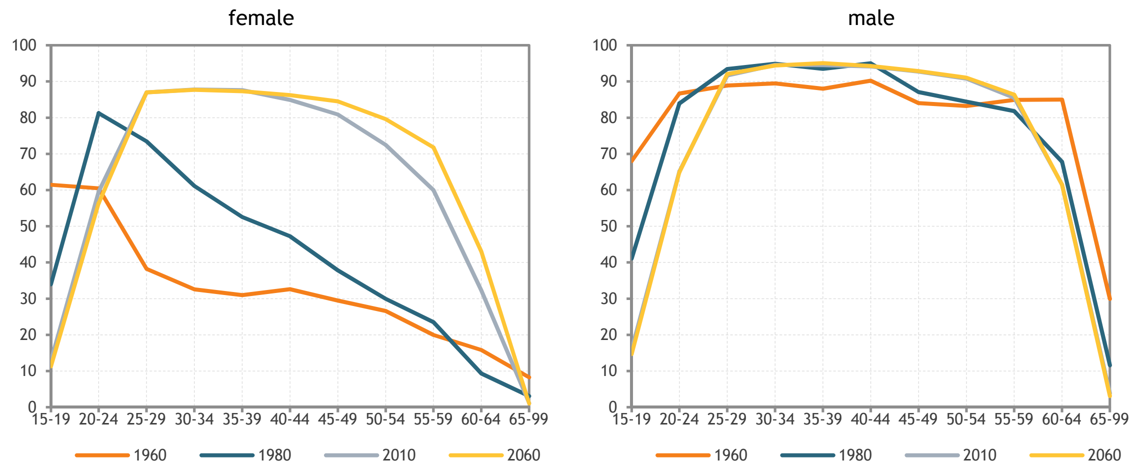


From 1998 till 2008, the male probabilities between 35 and 49 years remain stable at high levels (close to 100%). In those age groups, the participation rates amount to more than 90% and few men leave the labour market. From 50 to 59 years, the male probabilities are significantly below 100%, but were clearly increasing during the years 2000. This is an inversion of the trend observed in the eighties and in the beginning of the nineties, a period during which early retirement was encouraged by public policies. On the other hand, the probability to remain in the potential labour force for men aged 60 to 64 years shows a slight decrease: indeed the macroeconomic scenario supposes employment creation and the probability to enter into retirement is more important for people in employment than for the other socio- economic categories.

After a small decrease in the year 2009 (which may be attributed to the economic crisis) and in the two following years, the probabilities of all those five-year age groups are assumed to return to their pre-crisis trend. They become nearly constant a few years later.

The following graph presents the past evolution of the (potential) participation rates by gender and age groups and also the projection resulting from the cohort approach.

Graph 3 Evolution of the potential participation rates by gender and age groups



The past evolution of the female participation rates reflects an obvious phenomenon: more and more women are present on the labour market and they are staying longer in the labour force. Between 1960 and 1980, the participation rates increased at all ages, except at the youngest age of 15-19 years due to the rise of the school-leaving age and at the older age of 60-64 years due to old age retirement. Until 1980, there is a clear decrease of the female participation rates at the age of 25-29 years: women are leaving the labour market, probably to raise children and they do not come back to the labour force. Thirty years later, in 2010, the female participation rates are inferior at 15-19 and 20-24 years denoting a further increase of school attendance. From the 25-29 age group onwards, the participation rates are much higher and do not show a very marked decrease anymore. They remain stable at nearly 90% from 25 to 44 years and then they begin to decrease. In projection, we have a rise in the participation rates from 45 years to 64 in view of the arrival of female cohorts that are more active on the labour market. This increase will diminish in strength and fade out around 2030.

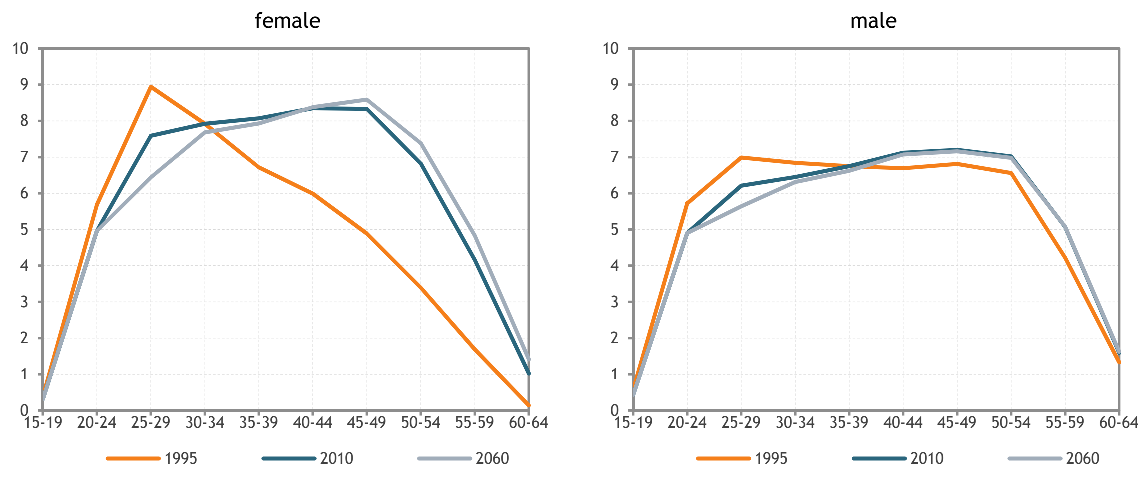
As far as men are concerned, the observed participation rates also show, like for women, a persistent decrease at young ages resulting from higher school attendance. In 1980, the male participation rates decreased from the age of 45-49 years onwards. This phenomenon does not appear anymore in 2010 for this age class, but is postponed to the age of 55-59 years. In projection, the male (potential) participation rates remain very stable.

3.2. The projection of the disabled persons

The disability rates by gender and five-year age groups, as proportions of the corresponding overall population, are projected using the principle of cohorts. Firstly, the entry probabilities in the primary disability benefit system (disabled for less than one year) are calculated from the potential labour force. Then, the entry probabilities in the disability benefit system (disabled for more than one year) are computed from the primary disabled category. Finally, probabilities of remaining in the disability system are calculated for the other disabled. The last observed probabilities are generally kept constant in projection. The distribution of the number of primary disabled and disabled persons over the wage earners' scheme and the self-employed scheme is carried out proportionally to the number of workers in the respective schemes (see section 6).

Graph 4 shows the evolution of the primary disability rates (number of cases of primary disability in relation to the corresponding population) by gender and five-year age group.

Graph 4 Evolution of the primary disability rates by gender and age groups

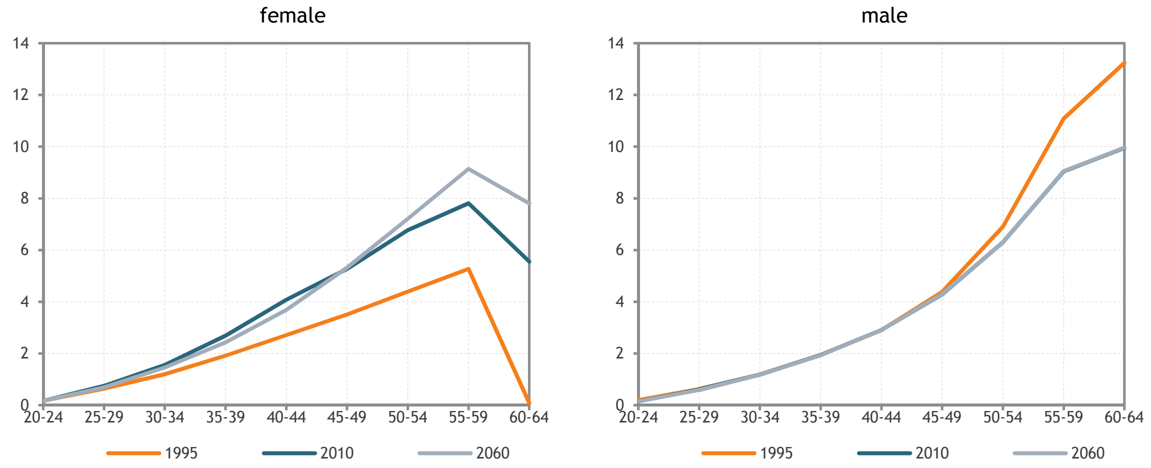


The curves of the primary disability rates (disability for less than one year) logically reflect the shape and the evolution of the potential participation rates since the currently primary disabled persons originate from the labour force. For both women and men, the rate at younger ages decreased between 1995 and 2010, while the rate at older ages increased. This trend continues throughout the whole projected period.

Contrary to the primary disability rates, the disability rates (number of disabled persons after one year of primary disability, in relation to the corresponding population) – cf. Graph 5 – increase steadily with age (except for the women aged 60 to 64[4]). In other words, the older the disabled, the greater the probability they remain in the system.

[4] The disability rate of women aged 60 to 64 years is largely influenced by the pension reform of 1997: it goes up from 0% to 6% in 2010 but does not catch up with the disability rate of women aged 55 to 59.

Graph 5 Evolution of the disability rates by gender and age groups



The curve evolution in time largely reflects the evolution of potential participation rates. The disability rate of women aged 30 and over increased between 1995 and 2010 and continues to grow slightly at older ages until 2060. Conversely, the disability rate of men aged 50 to 64 decreased between 1995 and 2010 as a result of an increase in the corresponding potential participation rates. The male participation rate being close to 100%, the increase in the former rate causes a decrease in the latter rate and vice versa.

3.3. The projection of the school population

As mentioned earlier, the school population is not projected with a cohort approach: the school rates till 2 years of age are zero percent, 100 percent between 3 and 14 years, and between 15 and 34 years, they evolve inversely to the potential participation rates, while the rates of 'other inactive status' are kept constant.

4. Short-to-medium-term macroeconomic scenarios

4.1. Short-term macroeconomic forecasts

The Federal Planning Bureau (FPB) supplies the official macroeconomic assumptions to be used by the Belgian federal government for drawing up its annual budget since 1994. The so-called economic budget is, in principle, released twice a year, once in September of the year t-1 for the preparation of the federal government's budget of the year t and once in February of the year t for the budgetary control of the year t. However, unpredicted changes in business cycle conditions or political instability (as recently experiences by Belgium) may imply a different timetable or entail additional forecasting exercises. The economic budget supplies forecasts for a large range of economic variables but forecasts of the general government account.

The quarterly macro-econometric model MODTRIM serves as a central tool for producing the economic budget.[5] The outcome of the model is 'demand-driven' in the sense that output is essentially determined by the level of aggregate demand. World trade, international prices (including oil prices), interest rates and exchange rates remain the most important exogenous variables but variables like equity prices also play a role. The model distinguishes two sectors (the business and the non-business sector) and contains about 20 true behavioural equations, around 180 technical relationships and about the same number of identities. Most of the behavioural equations are modelled as error correction mechanisms, which allow combining empirically estimated short-term dynamics with theory-based long-term relationships. The model's results, however, are adjusted on the basis of experts' views and adapted to take into account the most recent business cycle information, for instance stemming from leading indicators. This additional information is introduced into the model through add-factors.[6]

4.2. Medium-term macroeconomic projections

The FPB has been producing medium-term macroeconomic projections for the Belgian economy since the beginning of the eighties. This baseline is a no-policy-change scenario, notably with regard to fiscal and social policies, based on an international environment founded on projections prepared by international institutions like the European Commission or the OECD. Scenario analysis is sometimes performed to illustrate potential risks surrounding the baseline or to analyse the effects of changes in economic policy. The economic outlook for the Belgian economy is published each year in May[7] and presented to the representatives of the social partners within the Central Economic Council. This tradition is a heritage from the (failed) indicative planning experiments in the seventies. The medium-term outlook takes as a starting point the forecasts for the current year (as published in the economic budget of February, possibly adapted on the basis of new business cycle information) and covers a five-year period. Since the introduction last year of the European Semester, a preliminary version is prepared for the federal government in March which is used as the macroeconomic framework for the

5 See Hertveldt and Lebrun (2003) for a comprehensive description of the model.
6 For a detailed account of the forecasting process see Dobbelaere et al. (2003).
7 The exact publication date has evolved slightly in the course of time, as well as the frequency, but at least one outlook has been published each year in spring since 1980.

elaboration of Belgian Stability Program and National Reform Program. With the growing emphasis laid by the enhanced fiscal policy surveillance at the EU level on multi-annual budgeting, it is likely that in the future an update of the medium-term outlook - incorporating the latest short-term forecasts (elaborated for the new budget) - will be requested by the federal government in September.

The outlook is a very detailed macroeconomic projection covering developments per industry, in the labour market, public finances and even energy consumption and associated greenhouse gas emissions. The baseline and variants for the Belgian economy are produced using the annual multi-industry model HERMES. It is a medium-term econometric model in which output is determined mainly through the expenditure side, but supply-side effects also play a role, in particular to compute the long-run production capacity. The model contains more than 4 000 equations (of which around 500 behavioural equations) and about 700 exogenous variables. The model's size is mainly a consequence of breaking down the economy into 16 industries, which allows taking into account structural shifts within the economy. The public finance block is also described in detail.[8] A specified sub-model called HERMREG splits the national projection into its regional components, reflecting the more and more decentralized nature of the Belgian institutions. A new version of HERMREG is currently being developed that will adopt a hybrid top-down/bottom-up approach.

4.3. Potential output and the output gap

The concept of potential output can be defined as the level of output consistent with stable inflation. As such it constitutes an aggregate indicator of the supply-side capacity of an economy. Since potential output is not directly observable, it may be computed through a variety of methods.[9] Most international organisations rely on a method based upon a macroeconomic production function that allows potential output to be broken down into contributions from input factors and total factor productivity. In order to identify the underlying trends, this methodology uses statistical filters to smooth some of the input series. Due to the well-known end-point bias (difficulty of disentangling the cycle from the trend at the end of the sample) a widespread approach consists of applying a filter to a historical series that is supplemented by projected values. Following this approach, the FPB uses the methodology developed by the European Commission[10] but applies it to its own historical database extended using its medium-term projection. This approach ensures full compatibility between the potential GDP estimates and the medium-term macroeconomic scenario produced by the Hermes model.

This procedure permits computing the so-called output gap which is defined as the percentage deviation of the actual level of GDP from its potential level. Under "normal" business cycle conditions, we impose that the output gap is closed at the end of the five-year projection horizon.[11] This practise means that no cyclical component remains and that potential and actual GDP coincide. This assumption allows us to use a small supply-side model to extend the projections beyond the medium-term horizon as will be explained in the section 5.

8 See Bossier et al. (2004) for a full description of the model.
9 See ECB (2000) for an overview of the methods available.
10 See D'Auria et. al. (2010).
11 In the year 2009 with the Great Recession, we assumed the output gap to be still negative in 2014.

5. The long-term macroeconomic scenario

5.1. A supply-side model for the Belgian economy

The S3BE model (**S**mall **S**upply-**S**ide **M**odel for the **B**elgian **E**conomy) is used by the FPB to produce its long-term macroeconomic scenarios. The model assumes that firms face a CES production function with two factor inputs (labour and capital), labour-augmenting technical progress and constant returns to scale. Monopolistic competition in the product market implies that the value added price deflator is obtained as a mark-up on top of factor prices. In the labour market, trade unions and employers bargain according to a "right-to-manage" model. Combining the labour share deduced from profit maximization with the one originating from the wage bargaining process provides an expression for the equilibrium rate of unemployment. The tax wedge (including terms of trade effects), the replacement rate, the mark-up and real cost of capital drive this equilibrium. The model is supplemented by a price block including equations for the deflator of private consumption, corporate investment and imports.

By adding a number of bridge-equations, the model can be solved recursively based on assumptions regarding the evolution of import prices, terms of trade, taxation levels, labour efficiency, the labour force and exogenous categories of employment. A specific simulation procedure has also been elaborated to ensure full consistency between the medium and long-run projection, in particular to avoid "jumps" for certain endogenous variables for the first simulation year of S3BE.[12]

Homogeneity conditions imposed on the price and wage equations guarantee that no trade-off exists between inflation and unemployment, i.e. the equilibrium unemployment rate is independent of the inflation rate. Value added growth is determined by the evolution of labour efficiency, the labour force, taxation on labour, terms of trade and the real cost of capital. As will be illustrated in the next sub-sections, in the absence of changes in the relative prices and taxation levels, employment growth will be given by the evolution of the labour force and productivity growth by the increase in labour efficiency.

5.2. Labour productivity

Starting with a linearized version of the CES production function:

$$\ln Y = \lambda \ln L_e + (1-\lambda)\ln K \qquad (1)$$

where Y represents value added at constant prices, L_e employment in efficiency units, K the capital stock, λ the distribution parameter and with:

$$L_e = LHE \qquad (2)$$

[12] See Lebrun (2009) for a complete description of the model and of the simulation procedure.

where L stands for labour inputs per capita, H the average working time et E technical progress improving labour efficiency, we obtain:

$$\ln Y = \lambda \ln(LH) + (1-\lambda)\ln K + \lambda \ln E \tag{3}$$

where E^{λ} stands for total factor productivity (*TFP*).

Considering no further changes in hours worked, labour productivity growth comes down to the following expression:

$$\Delta \ln\left(\frac{Y}{L}\right) = (1-\lambda)\Delta \ln\left(\frac{K}{L}\right) + \Delta \ln TFP \tag{4}$$

This equation implies that labour productivity growth is determined by the growth in capital per worker, the so-called capital deepening, and in TFP.

At the steady-state and without further changes in relative prices of factor costs, the capital-output ratio and the efficient labour-output ratio remain constant over time. This implies that the ratio between the capital stock and labour expressed in efficient units also remains unchanged. Expression (4) can therefore be rewritten as:

$$\Delta \ln\left(\frac{Y}{L}\right) = \Delta \ln\left(\frac{K}{L}\right) = \left(\frac{1}{\lambda}\right)\Delta \ln TFP \tag{5}$$

It also entails that the contribution of capital deepening to labour productivity growth can be expressed as a function of total factor productivity, leaving it as the single determinant of productivity growth:

$$(1-\lambda)\Delta \ln\left(\frac{K}{L}\right) = \left(\frac{1-\lambda}{\lambda}\right)\Delta \ln TFP \tag{6}$$

This means that in the long-term scenarios labour productivity growth will be determined solely by the assumption made on the evolution of total factor productivity.

To disentangle the TFP trend from its cycle in the short-to-medium run we apply the method proposed by Planas et. al. (2010) using a bivariate Kalman filter exploiting the link between the cyclical component of TFP and an indicator of capacity utilisation. This methodology is part of the procedure developed by the European Commission to compute potential output and introduced in the section 4.3.

Formally, the bivariate model can be written as follows:

$$TFP = T + C$$

$$CU = \mu_{CU} + \beta C + e_{CU}$$

where T stands for the TFP trend, C for its cycle, CU an indicator of capacity utilization and e_{cu} a random shock.

The unobserved components dynamics is given by:

$$\Delta T = \mu_{-1}$$

$$\mu = \omega(1-\rho) + \rho\mu_{-1} + \alpha_{\mu}$$

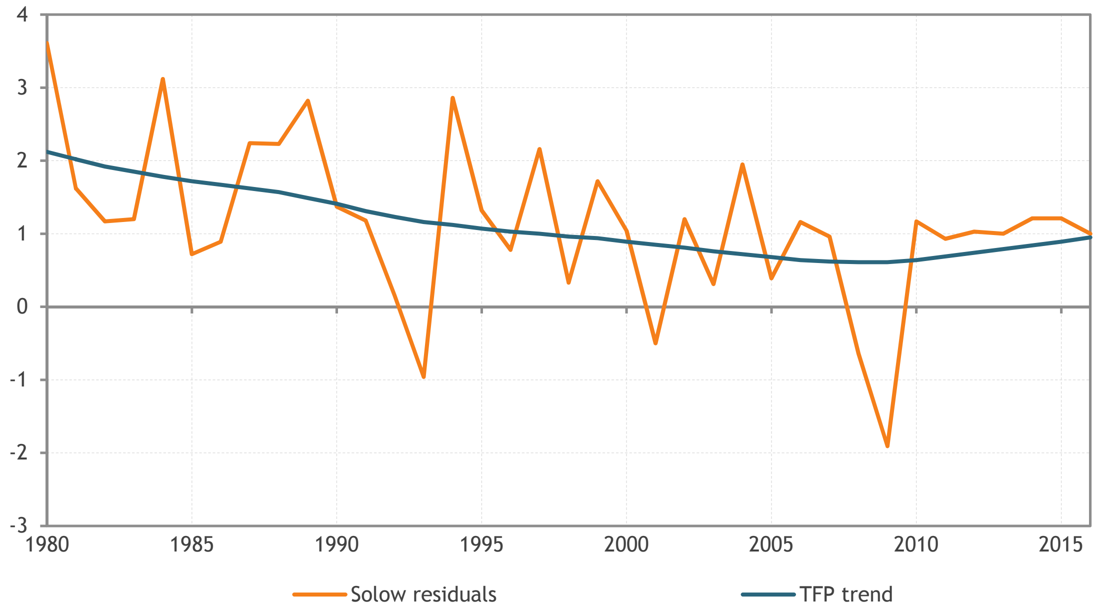
$$C = 2A\cos(2\Pi/\tau)C_{-1} - A^2 C_{-2} + \alpha_C$$

The second equation describes the TFP long-term path through a damped trend model with a coefficient ω that catches the series average growth rate and ρ the inertia of the process. The third equation reproduces the cyclical movements using an AR(2) model with complex roots that are parameterized in terms of amplitude A and periodicity τ.

The graph below represents the Solow residuals as estimated for the past and those implicitly contained in the medium-term projection till 2016 and the trend using the method described above. This trend represents according to equation (4) the contribution of TFP to potential productivity growth. The parameter of inertia is estimated for Belgium at 0.97 and the long-term historical growth rate at 1.1%.

Graph 6 Total factor productivity

Growth rates in %



At the end of the medium-term projection period a rate of 1% is nearly reached. To be on the cautious side, from 2017 onwards we suppose the long-term growth rate to remain at 1% as can be seen in Table 3 below. This growth rate of TFP also corresponds to the assumption in the long run made by the European Commission (2011) in its latest Ageing Report for Belgium and the EU as a whole.

Table 3 Potential labour productivity
Growth rates in %

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Potential labour productivity	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.5
Contributions:										
Capital deepening	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.5	0.5
Total factor productivity	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.0	1.0	1.0

Note: as the output gap is supposed to be closed in 2016, from 2017 onwards potential and actual labour productivity coincide.

Due to the financial crisis and its estimated impact on the cost of capital[13], the capital-output-ratio is expected to decline further during the 2011-2016 period. Consequently, the contribution of capital deepening to potential productivity[14] is smaller than the one predicted at the steady-state where the capital-output ratio is supposed to be constant.[15] To smooth the implicit profile of the investment rate we suppose that a stable capital-output is attained progressively by 2020.

5.3. The equilibrium unemployment rate

5.3.1. The NAIRU

In the methodology used to compute potential output in the medium-term, the structural unemployment rate is defined as the rate consistent with stable, non-accelerating (wage) inflation, commonly called the NAIRU. It is computed by removing the cyclical component (the "unemployment gap") from the actual unemployment rate. The system is identified by adding a reduced-form Philips curve linking the change in wage inflation to the unemployment gap and other explanatory variables. By imposing a functional form to the equations representing the trend and cyclical components, the whole system can be estimated using the Kalman filter technique.

Formally the system can be written as follows. First, the observed unemployment rate (U) can be decomposed in a trend (U^T) and cyclical component (U^C):

$$U = U^T + U^C \qquad (7)$$

The cyclical component, which representing the unemployment gap, is supposed to follow a stationary autoregressive process ($\phi_1 + \phi_2 < 1$):

$$(1 - \phi_1 L - \phi_2 L)U^C = \varepsilon^C \qquad (8)$$

while the trend component is modelled as a random walk with drift:

$$(1 - L)U^T = \mu + \varepsilon^T \qquad (9)$$

where the drift term μ is itself allowed to follow a random walk.

13 See for instance OECD (2010).
14 For capital, the full utilisation of the existing stock represents the maximum contribution to potential productivity and therefore no smoothing is required.
15 According to equation (6), an increase in TFP by 1% should imply a contribution of capital deepening of about 0.5%.

Moreover, a reduced-form Phillips curve relationship is postulated which links the change in wage (W) inflation to the unemployment gap and other exogenous variables (Z). In the case of Belgium, the selected additional variables are: changes in productivity and in the terms of trade growth and the lagged unemployment gap. Other unobserved shocks are captured by the error term.

$$\Delta^2 \ln W = cte + \varphi U^C + \delta Z + \nu \tag{10}$$

The system of equations (7) to (10) can be estimated with the maximum likelihood method. Note that this concept of a time-varying NAIRU can also be interpreted as a reduced-form relationship derived from the interaction of wage and price setting (Giannelli et. al., 2008) as presented in the next sub-section.

5.3.2. The long-term structural unemployment rate

In the S3BE model, the confrontation of the labour share implied by profit maximization under monopolistic competition with the share originating from the wage bargaining process allows deriving an expression for the equilibrium rate of unemployment.

Formally, the price and wage equation are given by the following expressions forming a so-called wage-price setting framework:

$$\ln P = \ln M + \ln \beta C + \varepsilon^P \tag{PS}$$

$$\ln W = \chi_0 + \ln \frac{Y}{L} + \ln P + \chi_1 \ln wedge + \chi_2 \ln rp - \chi_3 U + \varepsilon^W \tag{WS}$$

where P denotes the price of value added, βC marginal costs, M the mark-up, W the nominal wage cost per worker, *wedge* the tax wedge, *rp* the replacement rate, i.e. the ratio between unemployment benefit and take-home wage, and U the unemployment rate.

These two equations allow deducing respectively the wage share that guarantees the expected mark-up (given the capital cost p_k and σ the elasticity of substitution) and the share stemming from the wage bargaining process:

$$\frac{WL}{PY} = \left(1 - (1-\theta)\left(\frac{p_k}{C}\right)^{1-\sigma} \right) M^{-1} \tag{LS1}$$

$$\ln \frac{WL}{PY} = \chi_0 + \chi_1 \ln wedge + \chi_2 \ln rp - \chi_3 U \tag{LS2}$$

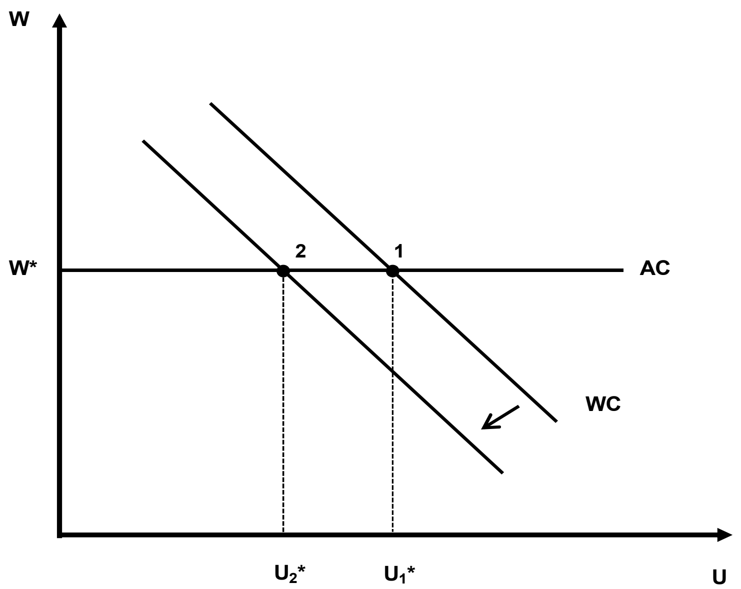
The equilibrium unemployment rate corresponds to the value satisfying both equations (LS1) and (LS2):

$$U^* = \frac{1}{\chi_3}\left[\chi_0 + \chi_1 \ln wedge + \chi_2 \ln rp + \ln M - \ln\left(1-(1-\theta)\left(\frac{p_k}{C}\right)^{1-\sigma}\right)\right] \tag{11}$$

Previous equation shows that the equilibrium unemployment rate will be driven up (down) following an increase (decrease) in the tax wedge, the replacement rate, the mark-up or the real cost of capital. Following Richardson et. al. (2000), this concept corresponds to the steady state of the NAIRU as measured by the Kalman filter method, once there has been full adjustment to all long-lasting shocks.[16]

The econometric estimation of equation (WS) indicates that a stable relationship between real wages, productivity, the wedge and the unemployment rate since the beginning of the nineties only exists with a decreasing constant term. This constant summarises all the information that is not captured by the other explanatory variables and may be interpreted, in our view, as a rough measure of the labour market efficiency. The implications for the equilibrium on the labour market can be illustrated using the graph below. The « wage curve » WC derived from the wage equation describes a negative relationship between the unemployment rate and real wages, showing the erosion of the bargaining power of the trade unions when the unemployment rises. The « ability-to-pay curve » AC defines the level of real wages firms are willing to pay to obtain the desired mark-up. This curve is independent of the unemployment rate. The equilibrium is given by the intersection between the two curves (point 1). A decrease of the constant term in the wage equation will shift de WC curve to the left, implying a lower equilibrium unemployment rate (point 2).

Graph 7 Effect of a decrease of the constant term in the wage equation



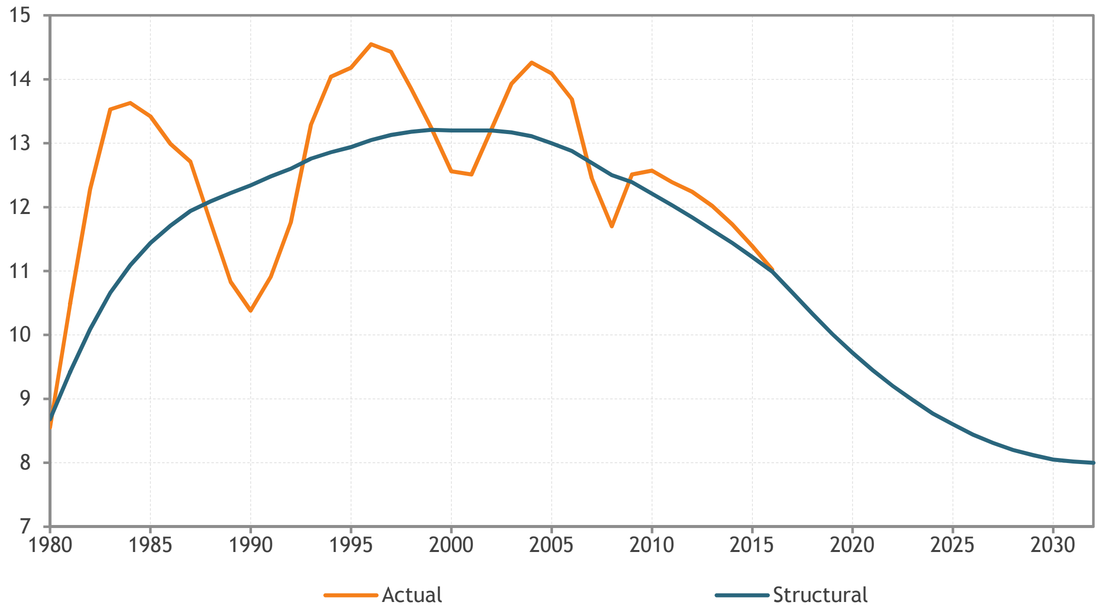
The Study Group on Ageing supposes that the unemployment rate converges to a long term rate of 8%. This rate corresponds to the historical average over the last fifty years. Based on the downward trend of

16 A recent study by the European Commission (2011b) confirms that the NAIRU, as measured by the Kalman filter method, contains the impact of persistent shocks and should therefore be interpreted as a medium-term estimate.

the constant term in the wage equation, and all other explanatory variables remaining unchanged, a trajectory leading to this long-term structural unemployment rate can be determined by simulating equation (11). This path implies implicitly that the active labour market policies put in place during the nineties and the last decade are at least maintained in the following decennia.

The graph below shows the evolution of the actual[17] and structural unemployment rate till it reaches its long-term value in 2032. The actual unemployment rate between 2011 and 2016 is determined by the Hermes model within the medium-term projection while the structural unemployment rate corresponds to the concept of the NAIRU as defined in the previous sub-section. The continuation of the decline of the NAIRU during this period is the consequence of the medium-term scenario which assumes a decrease of the actual unemployment associated with no significant surge in wage inflation. Because the unemployment gap is closed in 2016, from then on both variables coincide and equation (11) defining the equilibrium unemployment rate takes over as explained above. After 2032 the unemployment rate is supposed to have reached its long-term rate and remains unchanged.

Graph 8 **Actual and structural unemployment rates**
In % of the labour force



5.4. Employment and GDP

Given the evolution of the labour force (see section 3), the trajectory of the equilibrium unemployment rate and the assumption on labour efficiency, employment and GDP may be determined simultaneously by simulating the S3BE model. In the absence of changes in relative prices, factor costs and taxation levels, the model results are straightforward as employment growth will be determined by the evolution of the labour force and the unemployment rate while productivity growth will be fixed by the increase in labour efficiency. These simulation results, supplemented by the estimates of potential GDP growth and its contributions for the period 2011-2016, are provided in Table 4. During the period 2017-2020, the higher GDP growth is entirely attributable to the assumption of a progressive im-

17 Broad administrative concept, including older unemployed exempt from job search.

provement in the investment-to-GDP ratio as explained previously. The contribution of employment remains unchanged as the slowdown in the labour force growth is compensated by a higher contribution of the unemployment rate. Note that the historical downward trend in average hours worked is assumed to come to a halt in 2017. From 2020 onwards, labour productivity growth is stable at 1.5% per year. The slightly positive contribution of labour till 2032 is exclusively explained by the further decrease in the unemployment rate, while afterwards the renewed expansion of the labour force, albeit modest, takes the relay.

Table 4 Potential GDP and contributions

Average annual growth rates in %

	2011-2016	2017-2020	2021-2032	2033-2060
Potential GDP	1.7	2.1	1.6	1.7
Contributions:				
Labour productivity	1.0	1.4	1.5	1.5
Employment	0.7	0.7	0.1	0.2
Of which:				
Labour force	0.6	0.3	0.0	0.2
Unemployment rate	0.2	0.4	0.2	0.0
Average hours worked	-0.1	0.0	0.0	0.0

Note: as the output gap is supposed to be closed in 2016, from 2017 onwards potential and actual GDP coincide.

6. The further socio-economic breakdown

6.1. The components of the potential labour force

As already mentioned, the potential labour force is composed of employment and unemployment (including the older unemployed exempt from job search requirements) but also of 'prepensioners' and beneficiaries of a full-time career break.

Employment and unemployment have to be divided by gender and age group, and also by scheme in the case of employment. The cohort methodology is not used for this breakdown for different reasons. First of all, those categories are more influenced by other explanatory variables (macroeconomic environment, economic policy...) than the generational variables. Secondly, there are too many flows between employment and unemployment, and between the schemes of employment, for which we do not dispose of data. The cohort approach is used however for the breaking up of the prepensioners by gender and age.

6.1.1. Employment by scheme

Once the evolution of the total employment is known (see the preceding section), it is divided by scheme: wage earners, self-employed and civil servants (inclusive contractual employment). In the long-run, the evolution of public sector employment is the result of two drivers: the development of the labour force (which determines employment in administration) and of the school population (which determines employment in education). Self-employment is also supposed to follow the evolution in the labour force. The number of wage earners is therefore obtained as a residual.

6.1.2. Employment and unemployment by gender and age group

By assumption, the unemployment rates by gender converge. The female unemployment rate being higher than the male rate at the starting point, female unemployment decreases faster than male unemployment and as a consequence female employment grows. Female employment by scheme is then obtained by allocating the change in total female employment in each scheme proportionally. Male employment is calculated as a balance.

The breakdown of the unemployment by gender and five years age group is made according to the following assumption: the evolution of each age group is proportional to the level of the preceding period. This means that the unemployment diminishes more in absolute terms in the age groups with a high starting level. Self-employment and the civil servants by gender of a specific age group depend on the evolution of the labour force by gender of this age group and on the employment of the scheme by gender. Wage earners employment by age group is obtained as a balance.

The latest shares observed by gender and age group of the contractual employment in the civil servants' employment are supposed to remain constant in projection.

6.1.3. The full-time career breaks

The number of beneficiaries of a full-time career break evolves by gender and age group like the employment growth of the wage earners' and the civil servants' schemes by gender and age group.

6.1.4. The prepension

The beneficiaries of a prepension (a kind of early retirement embedded in the unemployment scheme, only applied in the wage earners' scheme) are projected using the cohort method by gender and age. With the hypothesis that there is no exit from this socio-economic category before the legal retirement age, the number of beneficiaries are calculated as the surviving population added with the new entries in this system. These are obtained on the basis of entry probabilities from the wage earner employment which take into account the restrictive impact of the Generation Pact on the prepension.

6.2. The number of pensioners

The projection of the number of pensioners[18] is carried out at a disaggregated level per scheme, gender and age or age group. The fundamental principle used to model the number of pensioners is to let the existing number of pensioners grow old and to add new pensioners based on recent "retirement behaviour" and historical participation rates.

6.2.1. Methodology

In Belgium, the statutory retirement age is 65, but it is possible, provided a sufficient career, to benefit from such a pension from the age of 60[19]. The number of beneficiaries of a retirement pension is determined in three phases.

In the first phase, the global number of 65-year-old pensioners is determined, whatever the scheme. This number is expected to meet a constraint. As far as men are concerned, the constraint is a constant overall pension rate at 65 years (calculated as an average over the last decade) because of the practically universal character of the statutory pension.

$$\frac{\mathrm{PM65}_t}{\mathrm{POPM65}_t}:\ \text{constant} \tag{1}$$

where $\mathrm{PM65}_t$ is the number of male pensioners aged 65 in year t (all schemes considered) ;

$\mathrm{POPM65}_t$ is the overall male population aged 65 in year t.

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[18] The number of pension beneficiaries is a hybrid concept combining the number of pensions and the number of pensioners. Double counting of pensioners receiving benefits from both the wage earners' and the self-employed scheme is avoided (when pensioners receive a pension from both schemes, it is classified either in the wage earners' scheme or in the self-employed scheme, taking into account the total spending in both schemes for "mixed" pensions). However, double counting between pensioners of the civil servants' scheme and pensioners of the general scheme for wage earners and the self-employed could not be avoided.

[19] The government budget 2012 foresees a gradual increase of this early retirement age from 60 to 62 years in 2016 and progressively modifies the career condition to benefit from an old age pension before the statutory retirement age. The projection presented in this paper does not yet take this pension reform into account.

Regarding to women, a "total coverage rate" at 65 years is defined and also supposed to be constant. This "total coverage rate" is the ratio of the number of women benefiting from their own pension (old age or survivor's pension) or from their husband's (at household rate, which is higher if the spouse has no income) to the overall number of women aged 65.

In the second stage, the distribution by scheme (wage earners, self-employed and civil servants) of the beneficiaries at 65 years by gender is determined according to the historical evolution of employment by scheme of the corresponding generation.

$$\mathrm{PM65}_{s,t} = \frac{\mathrm{EMAX_{s,t}}}{\mathrm{EMAX_{CS,t}} + \mathrm{EMAX_{SE,t}} + \mathrm{EMAX_{WE,t}}} . \mathrm{PM65}_t \tag{2}$$

where $\mathrm{PM65}_{s,t}$ is the number of pensioners aged 65 in scheme s – civil servants (CS) self-employed (SE) or wage earners (WE) – in year t;

$\mathrm{PM65}_t$ is the number of male pensioners aged 65 in year t (all schemes considered) as defined in equation 1;

$\mathrm{EMAX_{s,t}}$ is the maximum historic level (between 15-19 and 60-64) reached by the employment rate in the generation aged 65 in year t.

As for women, the distribution of the female old age pensioners aged 65 among the schemes happens in a similar way: the number of female old age pensioners aged 65 is equal to the number of women benefiting from a pension at the age of 65 minus the number of women with a survivor's pension or whose husband benefits from a 'household rate' pension (see below).

In the third phase, the profile of the entries in old age pension between 60 and 65 is defined by scheme and gender. These profiles result from entry probabilities in old age pension from the various socio-economic categories between 59 and 64 years by scheme, adjusted to respect the global constraint at 65 years by gender and scheme (equation 2). An initial number of entries in old age pension are first calculated by age and scheme as follows:

$$\mathrm{INP_{g,i,s,t}} = \mathrm{C_{g,i-1,s,c,t-1}} \times \mathrm{PE_{g,i,s,c,t}} \tag{3}$$

where $\mathrm{INP}_{g,i,s,t}$ is the initial number of new pensioners of gender g, age i (i= 60 to 65) in scheme s (s=civil servants, self-employed or wage earners) in year t;

$\mathrm{C_{g,i-1,s,c,t-1}}$ is the number of persons of a socio-economic category c other than category « pensioners » aged i-1, in scheme s, in year t-1. For the wage earners scheme, these categories are employment, disability, prepension and unemployment; for the self-employed scheme, it is employment and disability and for the civil servants scheme, it is employment. Moreover, some women from category "inactive" retire (at 65 years);

$\mathrm{PE_{g,i,c,s,t}}$ is the retirement probability for a person from socio-economic category c of scheme s in year t.

Depending on the socioeconomic category (employment, unemployment, “prepension” or disability) and on the scheme, retirements occur at varying ages: for example, people at work retire at a younger age than beneficiaries of a disability allowance. The entry probabilities are generally kept constant in projection. Subsequently, the initial numbers of new pensioners aged between 60 to 65 are (proportionally) adjusted to respect the constraint relating to the total number of pensioners aged 65 by scheme (equation 2).Moreover, the pensioners are distributed among the pension categories (especially for men, “pension at household rate”) depending inter alia on the evolution of the female participation rates and on the evolution of the population distribution by civil status (married, divorced, widowed and single).

Before the age of 60, (female) entries in the survivors’ pension scheme are determined by scheme and five-year age group, taking into account the evolution of the female participation rates, the widowed population and the distribution by scheme of the male labour force of the same age group. From the age of 60 onwards, the number of new female pensioners in the survivors’ pension scheme is determined by the number of deceased (married) male pensioners in the scheme in question.

6.2.2. Evolution of the number of pensioners by 2060

The next table presents the total number of pensioners in projection and also some of its characteristics. This projection does not include the impact of the 2012 pension reform.

Table 5 Characteristics of the number of pensioners projected

	2010	2030	2060
Total number of pensioners in thousands	2191	3263	4005
Population aged 65 and over	1871	2727	3351
Pension rate at 65 years and over			
Male	114	115	116
of which with a dependent spouse	39	24	18
Female	90	100	107
of which survivor	21	11	5

The number of pensioners rises by almost 50% between 2010 and 2030, notably due to the baby-boom generation becoming a grey boom generation. Between 2030 and 2060, the number of pensioners increases by 23% as a result of the increasing life expectancy and also of the increasing female participation rate. This last factor allows women to benefit more and more from their own old age pension. For instance, the male with a dependent spouse pension rate is decreasing to the benefit of the share of male and female old age pension at the single rate. In other words, one pension with dependent spouse (at a higher replacement rate) becomes two pensions at the single (lower) rate.

The female survivors’ pension rate concerns "pure" survivor pensions: women who cumulate an old age pension and a survivor pension are included in the overall pension rate. Three reasons explain the decreasing evolution of the survivors’ pension rate. Firstly, the increasing male life expectancy, more important than the increasing female life expectancy, reduces the number of beneficiaries of a survivors’ pension. Secondly, increasing participation rates of women implies that women benefit more and more from an old age pension. Finally, having been married is necessary to receive a survivor pension and the number of married pensioners decreases in the projection.

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