Projections of Economically Active Population

A Review of National and International Methodologies

Geneviève Houriet-Segard, Jean-Michel Pasteels

December 2011
ILO Cataloguing in Publication Data

Houriet-Segard, Geneviève; Pasteels, Jean Michel

1 v.

ISBN: 97892221257806 (print) ; 97892221257813 (web pdf)

International Labour Office

labour force participation / projection / trend / statistical method / national level / international

13.01.2

The designations employed in ILO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the International Labour Office concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers.

The responsibility for opinions expressed in signed articles, studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them.

Reference to names of firms and commercial products and processes does not imply their endorsement by the International Labour Office, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.

ILO publications and electronic products can be obtained through major booksellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address, or by email: pubvente@ilo.org
Visit our web site: www.ilo.org/publns

Printed in Switzerland
Preface................................................................................................................................. 4
Introduction............................................................................................................................ 5
1. Determinants of labour force participation ........................................................................ 6
2. Summary of methodologies used and recommendations .................................................. 9
3. Inventory by country/organisation .................................................................................. 15
   Algeria ................................................................................................................................. 15
   Asian Development Bank ................................................................................................. 17
   Australia Bureau of Statistics .......................................................................................... 20
   Australia Government Productivity Group ..................................................................... 22
   Bolivia ............................................................................................................................... 24
   Canada .............................................................................................................................. 26
   CELADE ........................................................................................................................... 28
   European Central Bank ................................................................................................. 30
   European Commission ................................................................................................... 33
   Eurostat ........................................................................................................................... 36
   France ............................................................................................................................... 38
   Haiti ................................................................................................................................. 40
   Honk Kong ....................................................................................................................... 41
   International Labour Office ............................................................................................ 43
   Ireland .............................................................................................................................. 45
   Mexico ............................................................................................................................. 47
   New Zealand ................................................................................................................... 50
   OECD ............................................................................................................................... 52
   Singapore ......................................................................................................................... 55
   Spain ................................................................................................................................. 57
   Sri Lanka ........................................................................................................................ 60
   Switzerland ...................................................................................................................... 62
   United Kingdom ............................................................................................................. 64
   USA ................................................................................................................................. 66
Preface

The ILO programme on estimates and projections of the economically active population (EAP) is part of a larger international effort on demographic estimates and projections to which several UN agencies contribute. Estimates and projections of the total population and its components by sex and age group are produced by the UN Population Division, economically active populations by the ILO, the agricultural population by FAO and the school attending population by UNESCO.

The main objective of the ILO programme is to provide member states, international agencies and the public at large with the most comprehensive, detailed and comparable estimates and projections of the economically active population (EAP) in the world and its main geographical regions. The first edition was published by the ILO Bureau of Statistics in 1971. The sixth edition was released in October 2011. It covers 191 countries and territories. The reference period for the estimates is 1990-2010 and the projections cover 2011-2020.

In this context, the Department of Statistics has decided to undertake a literature review on all the EAP projection models used and developed by national statistical offices and international organisations. Firstly, it has contributed and will continue to contribute to the improvement of the ILO methodology of EAP projections. Secondly, this document will provide guidance to national statistical institutions which are planning to publish EAP projections for their own country for the first time or to revise their present methodology.

The paper was prepared by Geneviève Houriet-Segard and Jean-Michel Pasteels (ILO Department of Statistics) under the supervision of Rafael Diez de Medina, Director of the Department of Statistics. This work has benefited from the precious comments and inputs of Kayla Bolton, Evangelia Bourboula, Monica Castillo, Pablo Fleiss, Messaoud Hammouya and Dagmar Walter.

Michelle de Chaumont provided editorial work and Virginie Woest provided the secretarial support for the publication of the paper.

Working papers of the Department of Statistics are meant to stimulate discussion. The ILO will therefore welcome comments and suggestions concerning the contents of this paper. They should be addressed to the Department of Statistics, International Labour Office, CH-1211 Geneva 22, Switzerland, fax no. + 41 22 799 6957, e-mail: statistics@ilo.org

Rafael Diez de Medina
Chief Statistician
Director
Department of Statistics
International Labour Office

December 2011
Introduction

Since 1971, the ILO has a programme on estimates and projections of the economically active population (EAP). The main objective of this programme is to provide constituents, international agencies and the public at large with the most comprehensive, detailed and comparable estimates and projections of the EAP in the world. In this context, regular estimates and projection are produced and published by the ILO.

The ILO is not the sole institution publishing projections of EAP around the world. Around twenty countries regularly publish projections of national EAP and a few international organisations publish projections on a punctual or regular manner.

The objective of undertaking a literature review on all the EAP projection models used and developed by national statistical offices and international organisations is twofold. Firstly, it will contribute to the update and improvement of the ILO methodology of EAP projections. Secondly, this document will provide guidance to national statistical institutions which are planning to publish EAP projections for their own country for the first time or to revise their present methodology.

This document is organised as follows. The first section includes a reminder on the various factors that determine the participation (or not) to the labour market.

The second section presents the different families of methodologies that are used worldwide to derive projections of labour force as well as a summary table listing the type(s) of methodology used by each national or international institution. Therefore, it gives an idea of the frequency of use of each type of approach. This section also includes a description of the strengths and weaknesses of the different approaches as well as some recommendations for those who will start to implement projections for their country.

The third section, the longest, contains the description of the approach adopted by each national or international institution, presented by alphabetical order. A two page long template has been used describing the following aspects: name of the institution, frequency of updates and projection horizon, brief description of the current methodology, the determinants that are captured explicitly, use (or no) of scenarios, assessment (or no) of current methodology, existence of any previous methodology, reference papers and additional comments. When displaying equations and other mathematic expressions, the terminology of each original document has been respected.

This review does not pretend to be fully exhaustive. A number of economic publications refer to national projection of the labour force without providing detailed results or methodological references. In some other cases, literature is only published in the national language. Therefore, this review of projections is limited to publications and documents published in French, English or Spanish as of February 2011.

In addition, this review is limited to projections of labour force participation rates undertaken at the macroeconomic level. Micro-simulation models using probabilistic methods to model individual labour behaviours are not analysed here. A few research institutions use micro-simulation models to project labour force participation at a national level but also to analyse the participation to education system, probabilities of graduation, probabilities of retirement and so forth. These techniques often request several micro-data and assumptions, without necessarily guaranteeing better results for specific variables such as the labour force participation.
1. **Determinants of labour force participation**

**Microeconomic perspective**

According to the neoclassical theory of labour supply, the individual labour supply is a trade-off between consumption of goods and leisure. The number of hours that an individual is ready to work is a function of labour and non-labour income as well as other individual characteristics (preferences, level of studies achieved, maternity and parental duties, etc.). In the empirical literature on labour supply the following equation is frequently presented:\(^1\):

\[
\ln h = a_w \ln w + a_R \ln R + x\theta + \varepsilon
\]

The variable \(h\) is the hours worked by a given individual at hourly wage \(w\), \(R\) is a measure of non-labour income, \(x\) is a vector \((1, n)\) describing the \(n\) characteristics of the individual (control variables), and \(\varepsilon\) is random term reflecting the individual heterogeneity.

The above equation is only valid for hourly wages that are above the "reservation wage". The later is a theoretical wage defined as the minimum wage you need in order to participate in the market. In other words, an individual participates in the labour market if the market wage exceeds its reservation wage.

An individual's reservation wage may change over time depending on a number of factors, like changes in the individual's overall wealth, changes in marital status or living arrangements, length of unemployment, and health and disability issues. An individual might also set a higher reservation wage when considering an offer of an unpleasant or undesirable job than when considering a type of job the individual likes.

The neoclassical theory can be extended at the community or household level. In other words, this individual decision can be extended to the household or at the community level (eg. agrarian structures where land is in common).

**Macroeconomic perspective**

At the macroeconomic level, what is observed are average aggregated participation rates for the whole population or subgroups of it (male, female, prime age, youth, etc.). These data are derived from labour force or household surveys or from population censuses. The variable "participation rate" is of dichotomous nature: you participate or not. The average number of hours the population is ready to work is not captured by macro-economic data.

The determinants of the participation rate can be decomposed into structural or long-term factors, cyclical factors and accidental factors.

The **structural factors** include policy and legal determinants (e.g. flexibility of working-time arrangements, taxation, family support, retirement schemes, apprenticeships, work permits, unemployment benefits, minimum wage) as well as other determinants (e.g. demographic and cultural factors, level of education, technological progress, availability of transportation).

---

\(^1\) For a comprehensive survey, see Blundell and MaCurdy (1999).
Regarding female labour force participation rates (LFPR), here are some key findings:\(^2\):

- In countries where working-time arrangements are more flexible, there is a higher LFPR of female workers than in other countries.
- Taxation of second earners (relative to single earners) has usually a negative impact on female LFPR.
- Childcare subsidies and paid parental leave usually have a positive impact on female LFPR.
- In countries where the proportion of unmarried women is higher, there is usually a higher female LFPR participation to the labour market than in other countries.
- Cultural factors such as strong family ties or religion. Usually female LFPR is lower in Muslim countries (see illustration in Figure 1).

These structural factors are the main drivers of the long term pattern of the data. Changes in policy and legal determinants (eg. change in retirement and pre-retirements schemes) can result in important shifts in participation rates from one year to another.

The *cyclical factors* refer to the overall economic and labour market conditions that influence the LFPR. In other words, labour demand has an impact on labour supply. In times of strong slowdown or recession, two effects on the participation rates with opposite signs are referred to in the literature: the "discouraged worker effect" and the "additional worker effect".

The "discouraged worker effect" is very important for younger people. In times of discouraging labour market conditions, the length of studies usually increases. The LFPR of younger age groups is more sensitive to severe downturns where there is easier access to post-secondary education.

The "additional worker effect" concern more female or older workers who will enter (or re-enter) the labour market in order to compensate the job loss and decreasing earnings of some members of the family or the community.

Also according to a recent OECD study\(^3\), in times of severe downturns, the changes in the LFPR of older persons depend on financial incentives to continue working as compared to taking retirement.

Lastly, there are *accidental factors* such as wars, strikes and natural disasters that also affect LFPR, usually in a temporary manner.

**Overall regional patterns**

Figures 1 and 2 illustrate regional differences. Figure 1 shows how different female LFPR can be across the world. In developed countries, it often displays a “M” shape, with low LFPR for young and elder people and higher participation for the prime age (25-55) but with a slightly lower LFPR during maternity ages (mostly from 25 to 34). For the Middle East, the pattern is totally different than from the other three sub-regions highlighted in the Chart.

The picture is much different for male LFPR. As highlighted in Figure 2, all sub-regions are characterised by “bell” shapes with a very high LFPR for the prime age. The differences across regions concern primarily the LFPR of youth and older people.

---


Figure 1: Female LFPR by age-group for selected sub-regions

Source: ILO calculations (non-weighted medians) based on national data (labour force or households surveys) reported between 1990 and 1999

Figure 2: Male LFPR by age-group for selected sub-regions

Source: ILO calculations (non-weighted medians) based on national data (labour force or households surveys) reported between 1990 and 1999
2. Summary of methodologies used and recommendations

2.1 Summary of methodologies

Most of the reviewed projection methodologies are elaborated at the national level but a few international organisations publish projections on a regular basis (eg. CELADE or ILO) or not (OECD, EUROSTAT). Projection horizons range from ten to fifty-five years with an average of a projection period of thirty-two years. The projection models are usually composed of two steps: the projections of the labour force participation rates (LFPR) which need a statistical process and the labour force or economically active population projections which result from the product of participation rates and population projections. To project LFPRs, four types of approaches have been identified in the present document:

1. Judgmental (or qualitative) methods based on scenarios or on the targets to be reached. In this case, either scenarios or targets are determined by experts.
2. Time extrapolation models or growth curves. A growth curve is an empirical model of the evolution of a variable over time. Values for the measured variable can be expressed as a function of time and extrapolated over the projection period. There are many growth curves routinely used in the analysis of growth processes that ultimately reach a steady state. These generally form a class of s-shaped or sigmoid curves, of which the most commonly used is the logistic curve. These sigmoid curves are very useful for modelling populations, labour participation rates, inflation, productivity growth (not levels) or other processes where, in the long run, it is expected that the variable will not grow any further. Figures 3 and 4 illustrate two examples of logistic curves fitted to French data as well as projected values.
3. Regression models based on correlation between participation rates and economic, demographic or cultural factors. A regression model with a set of explanatory variables is fitted on observed LFPRs. Future scenarios for the explanatory variables are determined and used in the regression model to project LFPRs.
4. Models based on a cohort approach. In this case, LFPRs are not projected by age and sex, year after year, but they are projected from the estimated probability of entry or exit of the labour force for each age, sex and cohort (people born a specific year). More specifically, the probability of entry and exit of the labour force are kept stable at the last observed value or extrapolated over the projection period for each population cohort.

Most of the time, projections models combine two or more approaches to fit participation rates trends at best. Table 1 lists the type(s) of methodology used by each national or international institution. Therefore, it gives an idea of the frequency of use of each approach.
Figure 3: Linear and logistic curves. LFPR in France for the 15-19 age group (male and female). 1990-2009

Source: ILO calculations, based on national data

Figure 3: Logistic curve. LFPR in France for the 60-64 age group (male). 1990-2009

Source: ILO calculations, based on national data
Table 1. Summary of projection methods

<table>
<thead>
<tr>
<th>Type of projections /Projections model</th>
<th>Judgmental approach (target or scenarios)</th>
<th>Time extrapolation approach</th>
<th>Regression approach</th>
<th>Cohort based approach</th>
<th>Additional modules*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian Development Bank</td>
<td>X**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia Bureau of Statistics</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia GPG</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELADE</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European Central Bank</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>***</td>
</tr>
<tr>
<td>European Commission</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>EUROSTAT</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ILO</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OECD</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>***</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunisia</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In some models, older age groups undergo a specific statistical process to capture the impact of newly implemented pension system’s reforms.

** In this case, a panel data model with country fixed effects is used.

*** In this case, the cohort is one of the explanatory variables of the regression model.
2.2 Pros and Cons of the different methodologies and recommendations

This section assesses strengths and weaknesses of the different approaches and provides some recommendations for their use.

a. Judgmental determination of scenarios or targets to reach

**Strengths:**
- These methods are easy to implement in countries where there are not enough or no comparable historical data to model labour force participation rates, in countries with complex labour force rates' evolution that can't be easily modelled or in countries with few statistical resources (Algeria, Sri Lanka).
- Future values of LFPR for one country can judgmentally be derived on the basis of historical values observed for other countries, that are close culturally and structurally but more advanced in terms of economic development (approach adopted by CELADE).
- Scenarios provide a tool to measure sensitivity of labour force to demographic or activity changes (Sri Lanka, Eurostat).

**Weaknesses:**
- Projections depend on experts' views and cannot be systematised.
- The scenarios are only based on varying population projections or participation rate projections.

These types of projections are more recommended to project labour force in areas where there are few observed or non-comparable data or where statistical resources are limited.

b. Time extrapolation models

**Strengths:**
- These models are statistically easy to develop.
- The use of logistic and other sigmoid curves is a solution to avoid aberrant projections (e.g. negative values or explosive pattern).
- Time trends can be calculated specifically on the LFPRs or on the female to male participation rates ratio (Asian Development Bank model).

**Weaknesses:**
- Like all extrapolative methods, time trend methods only extrapolate past patterns without being able to project changing trends in the future. In other words, it is a continuation of past trends.
- This time trend calculated on the LFPR is meant to capture as a whole demographical, economical and cultural effects. In other words, it is a reduced model of a more complex one.
- Possible inconsistencies between subgroups' projections if the method is applied without looking at consistency across gender and age groups.

This methodology is appropriate for modelling the female to male LFPR ratio in countries where we assume that female labour force behaviours are becoming similar to those of men. It is also recommended when it is not easy to measure and project the determinants of the labour force and when historical time series are available.
c. Regression models using economic, demographic or structural explanatory variables

**Strengths:**
- These models are based on the correlation between LFPRs and a set of determinants which can be economical, demographical or structural. It gives more flexibility to adapt the model to a country or area's specifications (Spain, UK, France).
- Comparing to the other methods, it provides detailed information on the relation between labour force participation rates and each chosen determinant, helping to put into light effects that cancel each other.
- The creation of scenarios for the projection is easy by playing on the assumptions chosen for the projection of the determinants (Switzerland).

**Weaknesses:**
- These models are often statistically complex (European Central Bank).
- They can be "heavy users" of historical and projected data (Switzerland).
- The choice of determinants can be a difficult and strategic process; for example when they are changing over time.

This methodology is generally used in areas with statistical resources. It is an appropriate method when the purpose of the projection is to compare future LFPRs under different assumptions of their determinants.

d. Models based on a cohort approach

**Strengths:**
- This approach takes into account an additional demographic effect: the effect peculiar to a cohort (here, people born the same year). It synthesises the economical, cultural and institutional effects to which a cohort is subject.
- In labour force projections, the cohort effect, applied to cohorts to come, is either maintained stable or is extrapolated on the basis of its past evolution (Australia GPG). This allows to project a varying cohort's trend.
- Mainly based on demographical data, the method can be applied on a regional or international basis with less problem of comparability than when using economical or structural data.

**Weaknesses:**
- These models need historical data over a long period to be implemented. Ideally, it should be pure longitudinal data (same surveyed people over the years) but in fact, most of the projections are based on annual surveys with the assumption that the cohort aged \( a \) in the survey dated \( t \) behaves similarly to the cohort aged \( a+1 \) in the survey dated \( t+1 \) (OECD).
- Statistical procedures for projecting the cohorts' rates of entry or exit of the workforce become quickly complicated (Mexico).
- Different scenarios for the projections are not easy to implement.
This methodology is particularly well suited for projections made by international organisations because it only takes into account demographical determinants which are often more standardized from one country to the other.

e. Combining different methods

In practice, most recent studies include two or more types of methodology in their projections to capture at best the changes in participation rates. Often, population projected are considered separately depending on their age, sex, level of education or nationality, and specific methodology and determinants are chosen to project the subgroups' participation rates. In some cases, a time trend is used but completed with other determinants. In other cases, models use additional modules (for example based on microsimulation techniques or mathematical estimation) to modify the projection made by the main model (France with the Destinie microsimulation model, OECD with the estimation of the pension reforms effects).

To conclude, the choice of a methodology to project labour force participation rates has to take into account the objective of the project, the available data and, last but not the least, the level of "maturity" of the labour force:

In countries or areas where women LFPRs are still far below those of men or where participation rates after 50 are still low, their participation rate will most likely undergo the same kind of transition period that was observed in countries more advanced in that process. In this case, time extrapolation or judgmental approaches are easy and efficient ways to project future trends.

In countries or areas where both male and female LFPRs are at a similar level, demographic changes will most likely have an impact on the labour force level but less on the LFPRs. Therefore, a regression approach is more appropriate to capture the economical and institutional effects in the future. This approach is also well suited to build scenarios capturing different future paths for the explanatory variables and can be used as a tool to measure the LFPRs' sensitivity to their determinants.

In other words, labour force participation rates undergo a transition period from a state where male and female have two very distinctive LFPRs profile by age to a state where these profiles have a similar shape (not necessarily at the same level).
3. Inventory by country/organisation

ALGERIA

Institutions: Robert Schuman Centre for Advanced Studies

Link: http://www.eui.eu/DepartmentsAndCentres/RobertSchumanCentre/Index.aspx

Data: Historical data have been taken from the UNPD for 1987 and 1996 and from the National Office of Statistics (ONS) for 2001 and onwards.

Objective of the projections: These projections are made in the context of a broader study "Labour Markets Performance and Migration Flows in Arab Countries: Determinants and Effects" commissioned by the European Commission.

Current methodology:
In this case, labour force projections for men are the product of projected population and future participation rates derived from the assumption that overall participation rates will stabilize from 73.5% in 2008 to 75% in the long term. Female participation rates, which are currently very low, are assumed to converge towards male rates with a predetermined speed of adjustment.
In other words, male participation rate $tpm_i$ is assumed to be constant in the long run at $tpm'$ level (75% in this projection) and female participation rate $tpf_i$ is assumed to converge towards male participation rate with the following dynamic relation:

$$tpm_{i+1} - tpm_i = \mu \cdot (tpm' - tpm_i)$$
$$tpf_{i+1} - tpf_i = \lambda \cdot (\alpha \cdot tpm_i - tpf_i)$$

where $1-\alpha$ is the natural gap between male and female participation rate and $\lambda$ gives the speed of adjustment.

Projection horizon and frequency of updates:
Labour force projections target 2025 horizon and overall participation rates have been published for 2009, 2010 and on a five-year basis onwards.

Use of scenarios:
Female participation rates are projected taking into account two different speeds of adjustment: 0.01 and 0.015 (called medium and high variant respectively). These speeds of adjustment are fixed on the assumption that the observed rate (0.0085 on average) will increase.

Main results of the projection:
Over the projection period, female participation rates grow nearly by 10 percentage points when using the medium speed of adjustment (from 15.08% in 2008 to 24.49% in 2025) and more than 13 percentage points using the high variant (participation rate of 28.65% in 2025). In terms of labour force, it will result in a yearly increase of active population ranging from 225 000 to 260 000, depending on the scenario. Total labour force will rise from 10.34 million in 2008 to 14.67 million (medium scenario) or to 15.27 million (high scenario) in 2025.
**Assessment of current methodology:** No assessment found.

**Older methodology:** Not found.

**Comments**
These projections do not publish data broken by age. Nevertheless, they have an interesting approach to project female participation rates.

**Reference papers:**
ASIAN DEVELOPMENT BANK

Institutions: Asian Development Bank

Link: http://www.adb.org/

Data: For most of the countries, historical employment, unemployment and average working hours' data are taken from the ILO database. Population data and projections are provided by the UN Population Division.

Objective of the projections: These projections were part of a broader project to determine if emerging Asian economies have a growth potential over the period 2010-2030. The countries or territories included in this project are China, Hong Kong, India, Indonesia, Viet Nam, Malaysia, Pakistan, Philippines, Singapore, Republic of Korea, Taiwan (province of China) and Thailand.

Current methodology:
Type of model: Firstly, a fixed-effect regression model is fitted on each Asian country's data as followed:

\[ \ln L_{igat} = \gamma_0 + \gamma_1 \ln POP_{igat} + \gamma_2 \ln PGDPI_{it} + \sum_{j=2}^{11} \gamma_j D_j^a + \sum_{j=2}^{11} \gamma_j D_j^g \cdot \ln PGDPI_{it} + \gamma_6 \ln (K / L)_{it} + \gamma_7 T \cdot \ln PGDPI_{it} + \gamma_8 RD_{it} + \mu_{ig} + \varepsilon_i \]

where \( L_{igat} \) is the size of the labour force country \( i \) for gender \( g \) and age group \( a \) in year \( t \). \( POP_{igat} \) is the total population size, \( PGDPI_{it} \) is the per capita real gross domestic product, \( D^a \) and \( D^g \) are dummy variables for age groups and gender indicator (male=1), respectively. \( (K/L)_{it} \) is per capita capital stock, \( T \) is a time trend variable and \( RD_{it} \) is the GDP share of research and development expenditure. Finally, \( \varepsilon_i \) is a fixed effect for country \( i \) and \( \mu_{ig} \) is the residual.

Determinants: The total population size is used in the regression as a measure of the size of the economy and the per capita real GDP as an indicator of the stage of economic development. The interaction terms of the latter with age group dummy variables allows an age varying effect of economic development on labour supply. Then, the per capita capital stock is included in the regression to account for possible labour-capital substitutability and time trend variable is combined with the gender dummy to reflect gender difference in time trends.

Lastly, GDP share of R&D expenditure may pick up variations in the speed of technology progress across countries.

Results of this estimation model are given table 1 of the study.

Projections: a similar method to ILO's projections is used. In this case, for each age-sex group, LFPR time series is analysed and classified in four categories:

- Category A: Both male and female LFPRs simultaneously rise, decline or stay fairly constant over time with a constant gap between the two times series.
  The projection includes three steps:
  1) To determine the convergence points, the average \( m \) of the male and female series and the difference \( d \) between them are calculated over the sample period (1980-2008). Using the two growth rates of \( m \) and \( d \), their extrapolated values in 2030 is calculated. From there, the convergence points are fixed at \( m+d/2 \) for the higher time series (male or female, observed over the sample period) and at \( m-d/2 \) for the other one.
2) The observed time series are modelled to fit the LFPR for males or females using the following logistic function:

\[ y_t = y_{\min} + \frac{y_{\max} - y_{\min}}{1 + e^{a + \beta t}} \]

where \( y_t \) is the LFPR in year \( t \) for males or females aged \( a \) and \( y_{\min} \) and \( y_{\max} \) are taken from the larger and smaller of the two values, respectively: the observed LFPR in 1980 and the convergence point.

3) Projected LFPRs are then extrapolated using the logistic function and the estimated parameters \( a \) and \( \beta \).

- Category B: one LFPR stays constant or steadily declines over time while the other LFPR converges to the first time series.

  The same model of projection is used as for category A but skipping the first step. \( y_{\min} \) and \( y_{\max} \) are determined the following way: if female LFPR catches up the male LFPR, the value of \( y_{\min} \) and \( y_{\max} \) for males are taken from the larger and the smaller of the two values, respectively: the observed LFPR in 1980 and the observed LFPR in 2008. The value of \( y_{\min} \) and \( y_{\max} \) for females are taken from the observed female LFPR in 1980 and the male LFPR in 2008. Vice-versa if the male LFPR catches up with the female LFPR.

- Category C: The two time series diverge over time. In one case, male LFPR declines over time but female LFPR declines even faster. In the other case, the male LFPR rises faster than the female LFPR. To project participation rates, the same pattern as in category A is followed. The convergence values for males and females are retrieved from the predicted value of \( m \) and \( d \) for 2030. In step 2), the \( y_{\min} \) and \( y_{\max} \) are selected from the observed data and the convergence values. I.e., if both male and female LFPRs decline but the latter declines faster, the values of \( y_{\min} \) and \( y_{\max} \) for males are the observed LFPRs in 1980 and 2008, respectively. For women the values of \( y_{\min} \) and \( y_{\max} \) are the observed LFPR in 1980 and the convergence point calculated in step 1, respectively.

- Category D: Either one or both of the two time series for men and women take a non-monotonic pattern (i.e. U-shaped or inverted U-shaped time trend). For the LFPR projections, the longer section of the times series between the monotonically rising section and the monotonically declining section is taken to estimate the logistic function as in other categories.

**Projection horizon and frequency of updates:**

The projections, dated 2010, are targeting the 2030 horizon and provide every five-year figures for 22 age-sex groups. Not all results are published; only overall labour supply graphs for each country are included in the study. No previous projections were found.

**Use of scenarios:**

It looks like the projections were made using the four fertility variants of the UN population projections.

**Main results of the projection:**

Labour force supply will continue to grow at a steadily pace for Pakistan, Philippines, India, Malaysia and Indonesia over the period 2010-2030. Viet Nam will have a slowing down of its labour force growth. In the case of Thailand, the projections show a flat labour force supply over time. For China, Honk Kong, Singapore, Republic of Korea and Taiwan (province of China), their labour force reach a
peak during the projection's period (between 2010 and 2025 depending of the country) and begin to shrink (with a more or less steep decreasing rate) afterwards.

**Assessment of current methodology:** No assessment found.

**Older methodology:** Not found.

**Comments:** Unfortunately, there were no projections results by age-sex groups.

**Reference papers:**
Data: employment, unemployment and population data given by the Australian Labour Force Survey from 1978 to December 1998 are the base of the projections. More precisely, monthly employment and unemployment data were seasonally adjusted for 16 age-sex groups, then added together and then divided by the corresponding civilian population age-sex groups to produce monthly seasonally adjusted participation rates, base of the time trends equations. The ABS population projections for the period 1997-2051 were used to produce labour force projections.

Objective of the projections: extrapolation of historic trends in LFPR into future.

Current methodology:
Type of model: use of time-trend regressions. Three basic methods were considered to project rates for each age-sex groups:

- Application of constant participation rates for future periods. The constant rate is set to the average PR calculated over the last 5-10 years.

- Extrapolation of a linear trend based on historical data:
  \[ P_i = \alpha + \beta T_i + \varepsilon_i \]
  where \( T \) is a linear time-trend, \( P_i \) is the participation rate in time period \( t \), \( \varepsilon \) is the residual in time \( t \) and \( \alpha \) and \( \beta \) are the parameters to be estimated (using ordinary least squares, OLS). The parameters estimated are used to extrapolate into future.

- Extrapolation of a logistic curve based on historical data:
  \[ P_i = \frac{1}{(K + \alpha \cdot \beta^T)} + \varepsilon_i \]
  where \( T \) is a linear time-trend, \( P_i \) is the participation rate in time period \( t \), \( \varepsilon \) is the residual in time \( t \) and \( K \), \( \alpha \) and \( \beta \) are the three parameters to be estimated (using non linear least squares method). \( K \) is the inverse of the asymptote, \( \alpha \) is the intercept on the vertical axis (when \( T \) equal 0) and \( \beta \) (with \( \beta < 1 \)) is the rate at which the modelled participation rate changes (diffusion rate) from its initial value to its asymptotic value, \( 1/K \). The estimated parameters are used to derive future values.

For each age-sex groups, OLS regression was first used to fit the linear time-trend to the data. If the extrapolated linear trend was found to be implausible, an alternative method was chosen (constant assumption or logistic time-trend). Indicators of implausible trends include female participation rates exceeding male participation rates for any given age group and the ratio between the participation rates of consecutive age-sex groups changing dramatically over time.

For most of the age groups, logistic trends were used for male (decreasing trend) and female (increasing trend) data simultaneously with a common asymptote. For the 15-19 male group, the future participation rates were calculated using a logistic trend regression to fit the ratio of the male and female participation rates asymptotically approaching one.
Determinants:
Not used.

Projection horizon and frequency of updates:
The latest projections, dated 1999, target 2016 and provide yearly figures (participation rates and labour force supply) for 16 age-sex groups (male/female and 15-19/20-24/25-34/35-44/45-54/55-59/60-64/65+). All data are published.
Previous projections, dated 1991 and 1994, were targeting 2005 and 2011 horizon respectively.

Use of scenarios:
Future labour force is also projected using the 1998 participation rates (they remain constant until 2016) to bring to light variation in labour force due to changes in participation rates.

Main results of the projection:
Labour force supply is projected to continually grow from 1999 to 2016 but at a slower pace than the rate calculated for the period 1979-1998 (0.8% against 1.9%). The overall participation rate is projected to decline slightly to 60.6% at the end of the projection period (peak observed at 63.7% in 1990).

Assessment of current methodology:
In the last projection exercise, the authors compare their results with the projections made in 1991 and 1994. The differences of labour supply projected with the previous extrapolations can be explained by three main factors: regressions based on different periods of observed data, use of more complex methodologies to extrapolate data and use of new population projections with updated assumptions.

Older methodology: The first projection, in 1991, relied almost exclusively upon simple time-trend regression techniques to project participation rates. The second projection, in 1994, made use of more “detailed” time-trend regression techniques, combining linear and logistic regressions for some age groups and assuming constant participation rates in other groups.

Comments:
No further projections were produced after 1999. A reason could be due to the development of a new research project conducted by the Australian Government Productivity Commission about the economic implications of ageing in Australia, which includes a long-term projection of the labour force supply.

Reference papers:
Projections of Economically Active Population – A Review of National and International Methodologies

Institutions: Australian Government Productivity Group


Data: employment, unemployment and population data given by the Labour Force Survey (Australian Bureau of Statistics) from fiscal year 1978-79 to 2003-04 are the base of the projections. The ABS population projections for the period 2003-04 to 2044-45 were used to produce labour force projections.

Objective of the projections: to measure the implications of an ageing Australia on the labour force supply and more broadly on the economy.

Current methodology:
Type of model: use of a cohort based approach. As in the OECD’s model, a synthetic panel of data is constructed from year based surveys and rates of exit from and entry to the labour market, as cohorts age, are calculated from age 15 to age 70 and over by quinquennial age-sex groups.

Exit rates:
\[
 Exit_{x,x+4}^{t} = \frac{PR_{x+5,x+9}^{t} - PR_{x,x+4}^{t}}{PR_{x,x+4}^{t-5}}
\]

with \( PR \) being the rate of participation age groups \( x, x+4 \) and \( x+5, x+9 \).

Entry rates:
\[
 Entry_{x,x+4}^{t} = 1 - \frac{(PR_{x+5,x+9}^{t} - PR_{x,x+4}^{t-5})}{(PR^{t} - PR_{x,x+4}^{t-5})}
\]

where \( PR' \) is the maximum potential participation rates (fixed at 99% for men and 95% for women).

Projections:
Unlike OECD’s model where fixed exit and entry rates (based on the last observed values of these ratios) are used to project labour force, this methodology applies time varying entry and exit rates: Historical patterns of smoothed\(^5\) exit and entry rates for each quinquennial age group are analysed and trend observed. When it appears that an entry (exit) rate is likely to be positive in the long run, then the series is modelled as an entry (exit) rate fitting a Richards curve and using non-linear least squares subject to maximum (or minimum) limits on the long run participation rates.

The projected entry and exit rates are then used to estimate participation rates by using the following formulae:
\[
 PR_{x+5,x+9}^{t} = (1 - Exit_{x,x+4}^{t}) \cdot PR_{x,x+4}^{t-5} \quad \text{where the exit path is modelled.}
\]
\[
 PR_{x+5,x+9}^{t} = Entry_{x,x+4}^{t} \cdot (PR^{t} - PR_{x,x+4}^{t-5}) + PR_{x,x+4}^{t-5} \quad \text{where the entry path is modelled.}
\]

\(^5\) Participation rates were smoothed using a Hodrick Prescott filter.
Determinants:
Age, gender and cohort effects are the only determinants.

Projection horizon and frequency of updates:
To my knowledge, this is a one-shot exercise and the projections horizon is fiscal year 2044-45. Published data include yearly labour force participation rates for each age-sex groups.

Use of scenarios:
To analyse the sensitivity of the aggregate participation rates to different assumptions about trends in age-specific participation rates, nine scenarios are proposed with the aggregate participation rate in 2044-2045:

A/ Base case 56.3%
B/ No change in age-specific participation rates after 2003-04 53.4%
C/ Age-specific female rates rise by half the base case increment 54.5%
D/ Age-specific rates for males aged 20-59 do not fall after 2003-04 57.5%
E/ Age-specific rates for females aged 60+ converge on males 57.4%
F/ Age-specific rates for males 55+ years 10 points above 2044-45 base 58.3%
G/ Age-specific rates for both genders 55+ years 10 points above 2044-45 base 60.6%
H/ Age-specific rates increase to OECD 80% percentile by 2044-45 60.9%
I/ Age-specific rates reach the maximum level between 1978-79 to 2044-45 59.5%

Main results of the projection:
Labour force participation rates are projected to fall by around 7 percentage points from their current level of 63.5% to 56.3% by 2044-45. Falling aggregate participation rates still occur even in scenarios in which labour participation rates for specific age/sex groups increase substantially. Because of this, there are few prospects that the demographic effects on participation can be offset through government interventions that raise participation rates broadly.

Assessment of current methodology:
The authors discuss about the uncertainty in the projections and use the scenarios to test the sensitivity of overall participation rates to changes in age-specific LFPRs. They also call attention to the discrepancy between previous projections made in Australia and actual data.

Older methodology:
They refer to previous projections made by the Australian Bureau of Statistics (1999, 1994, 1991) and model developed by Sam and Williams (1982).

Comments:
This model based on a cohort based approach allows entry and exit rates to have time varying trends and therefore, a new element to the projections.

Reference papers:
**BOLIVIA**

**Institutions:** Instituto Nacional de Estadística de Bolivia

**Link:** [http://www.ine.gob.bo/](http://www.ine.gob.bo/)

**Data:** Historical data are taken from the population census (Censos de Poblacion y Vivienda de 1976 y 1992) and from a survey called "Encuesta Nacional de Poblacion y Vivienda de 1988". The labour force is calculated for population aged 10 and over and participation rates are broken down by sex, quinquennial age group and urban or rural status. Labour force participation rates for 1990, the base year of the projection, are estimated by linear interpolation between 1988 and 1992 observed rates.

**Objective of the projections:** Provide official labour force projections.

**Current methodology:**
At Latin America level, three models of participation rate limits (for each age, sex and urban or rural area) were fixed by the CELADE: Model 1 gives participation rates limits for industrialised countries with less active populations at extreme age groups, Model 2 for semi-industrialised countries with less differentiated distribution of participation rates by age group and Model 3 which is an average of the two preceding models. In the three models, participation rate limits are identical for groups aged 20-24 to 50-54.

For each age-sex group in urban area, Bolivian LFPRs projections are made by linear interpolation between the base year (1990) and a set of participation rate limits targeted for 2030. Model 1 rates are used for populations aged 10 to 54 and Model 3 rates for population aged 55 and over.

In the case of rural population, male LFPRs projections are kept constant for groups aged 25-29 to 50-54, Model 3 rates were used for younger groups and Model 2 rates for older groups. For the projections of female labour force participation rates, the same procedure is used for urban and rural population (only the base year participation rate is different). Model 1 rates are fixed as 2030 targets for women aged less than 45 years old and Model 3 rates for women aged 45 and over.

Labour force projections are the product of projected participation rates and projected population.

**Projection horizon and frequency of updates:**
The labour force projections range from 1990 to 2010. Five-yearly projected labour force and participation rates are published by age-sex group for urban and rural areas.

**Use of scenarios:** No use of scenarios.

**Main results of the projection:**
Overall labour force is projected to grow at around 3% per year. From 2.29 million in 1990, labour force will nearly double to 4.19 million in 2010. The growth is particularly high in urban areas (between 5-4%) and less than 1% in rural areas. If overall male participation is stable around 68%, female rates increase by nearly 10 percentage points to reach 40.5% in 2010. This trend is particularly strong for women living in urban areas.
Assessment of current methodology: No assessment found.

Older methodology: Not found.

Comments:
There is no explanation on the method used to fix the participation rate limits.

Reference papers:
CANADA

Institutions: Statistique Canada, Division de la démographie

Link: http://www.statcan.gc.ca/start-debut-eng.html

Data:
Observed labour force participation rates are taken from the Labour Force Survey from 1981 to 2005. Population data are demographic data compiled by Statistics Canada. Labour force is calculated for the population aged 15 and over, and participation rates are broken down by sex and quinquennial age group.

Objective of the projections:
The ageing of the labour force is already a fact in Canada but its impact on the economy is partially offset by a simultaneous increasing trend in participation rates. In this context, projections are a tool to analyse possible future scenarios and estimate their impact on the economy.

Current methodology:
The study is based on the analysis of four different scenarios as followed:

<table>
<thead>
<tr>
<th>Table 2 Projection scenario's for Canada's labour force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth</td>
</tr>
<tr>
<td>1- Low growth</td>
</tr>
<tr>
<td>2- Recent trend continues</td>
</tr>
<tr>
<td>3- Rising participation</td>
</tr>
<tr>
<td>4- High growth</td>
</tr>
</tbody>
</table>

Source: Laurent Martel (2006)

Projected labour force participation rates are kept constant at the 2005 level in scenarios 1 and 2. Otherwise, male participation rates by age group and by province are linearly extrapolated until 2011 using trends observed over the past decade (the reference period covers 1996 to 2005), and kept constant for the remainder of the projection period.

For women, it is the ratio of female to male participation rates by age group and province which is extrapolated up to 2021 (the reference period covers in this case 1976 to 2005). Variant extrapolation methods were tested for each age group in order to fit as closely as possible the past trends. After 2021, the ratio is kept constant for the remainder of the projection period. Female participation rates are then calculated by multiplying the corresponding male participation rate by the ratio extrapolated.

Projection horizon and frequency of updates:
The projection range starts in 2006 and targets 2031. Most results are given in graphic form. Only participation rates broken down by age groups and projected in 2031 are published.
Use of scenarios:
Use of different scenarios in terms of population growth and participation rate (see Table 2).

Main results of the projection:
In three of the four scenarios, overall labour force projections show a continuous increase up to 2031, bringing the active population from 17.76 million in 2005 to over 19 million in 2031. On the contrary, overall labour force participation rates are projected to decrease from 66.8% in 2005 to 62% at best (scenario 4). This trend is a consequence of the low fertility level and the ageing population (the baby boomers generation will reach retirement age over the projection period). Future higher participation rates by age group will not change this structural evolution but will only delay the decrease of the overall participation rate for a few years.

Assessment of current methodology:
No assessment found.

Older methodology:
No previous methodology found.

Comments:
No detail is given on extrapolation methods used in projections.

Reference papers:
Institutions: CELADE, demographic division of CEPAL (Comisión Económica para América Latina)

Link: http://www.eclac.org/celade/

Data:
Population data (observed and projected) are provided by or elaborated with each national statistics office (20 countries are involved in the project). On the other hand, observed labour force data are given by national surveys and most of the projections are compiled by the CELADE. For each country, the definition for economically active population is the same as the definition used in population censuses or household surveys.

Objective of the projections:
The objective of these projections is to give Latin America and Caribbean countries inputs to help to develop economic and social policies.

Current methodology:
At the Latin America level, three models of participation rate limits (for each age and urban or rural area) were fixed by the CELADE: model 1 gives participation rates limits for industrialised countries with less active population at extreme age groups, model 2 for semi-industrialised countries with less differentiated distribution of participation rates by age group, and model 3 which is an average of models 1 and 2. Participation rates limits for age groups 20-24 to 50-54 in urban area do not vary from one model to another (see Table 3) and participation rate limits for groups aged between 25 and 50 in rural areas are fixed at the last observed male participation rates.

Table 3: Participation rate limits for the urban population

<table>
<thead>
<tr>
<th>Age group</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>32.8</td>
<td>43.8</td>
<td>38.3</td>
</tr>
<tr>
<td>20-24</td>
<td>83.1</td>
<td>83.1</td>
<td>83.1</td>
</tr>
<tr>
<td>25-29</td>
<td>93.8</td>
<td>93.8</td>
<td>93.8</td>
</tr>
<tr>
<td>30-34</td>
<td>96.9</td>
<td>96.9</td>
<td>96.9</td>
</tr>
<tr>
<td>35-39</td>
<td>96.8</td>
<td>96.8</td>
<td>96.8</td>
</tr>
<tr>
<td>40-44</td>
<td>95.6</td>
<td>95.6</td>
<td>95.6</td>
</tr>
<tr>
<td>45-49</td>
<td>93.7</td>
<td>93.7</td>
<td>93.7</td>
</tr>
<tr>
<td>50-54</td>
<td>89.1</td>
<td>89.1</td>
<td>89.1</td>
</tr>
<tr>
<td>55-59</td>
<td>78.1</td>
<td>83.4</td>
<td>80.7</td>
</tr>
<tr>
<td>60-64</td>
<td>54.4</td>
<td>75.6</td>
<td>65.0</td>
</tr>
<tr>
<td>65-69</td>
<td>31.6</td>
<td>66.3</td>
<td>49.0</td>
</tr>
<tr>
<td>70-74</td>
<td>10.0</td>
<td>52.5</td>
<td>31.2</td>
</tr>
<tr>
<td>75-79</td>
<td>2.5</td>
<td>39.1</td>
<td>20.8</td>
</tr>
<tr>
<td>80 and over</td>
<td>1.0</td>
<td>25.3</td>
<td>13.1</td>
</tr>
</tbody>
</table>

Source: CELADE (2006)
For each age-sex group in the urban area and the rural area of each country, LFPRs projections are made by linear interpolation between the base year (2000) and the chosen set of participation rate limits targeted for 2060 (2080 in the case of female participation rates in rural areas). Labour force projections are the product of projected participation rates and projected population.

**Projection horizon and frequency of updates:**
The 2006 labour force projections range from 2000 to 2030. Previous projections were published in 1999. Five-yearly projected labour force and participation rates are published by age-sex group for urban and rural areas both for Latin America and Caribbean countries.

**Use of scenarios:**
No use of scenarios.

**Main results of the projection:**
After reaching 3% per year in the 90's, overall labour force growth just exceeds 2% in 2005 and should continue to decrease to reach 1.2% at the end of the projection period. Being estimated at a level of 250 million in 2006, the labour force will reach 377 million in 2030. This trend is mainly driven by increases in labour force participation rates. More specifically, the adjustment of women participation rates recently began and the increase in participation rates of people aged 65 and over will sustain the labour force growth.

**Assessment of current methodology:**
No assessment found.

**Older methodology:**
In previous projections, participation rate limits were different for men and women but the latter were quickly inadequate due to the quick adjustment observed for female participation rates in Latin America in the 90's.

**Comments:**
There is no explanation on the method used to fix the participation rates limits.

**Reference papers:**
Institutions: European Central Bank

Link: [www.ecb.europa.eu](http://www.ecb.europa.eu)

**Objective of the projections:** Based on the findings that increases in LFPRs have sustained the economic growth in Europe over the last thirty years, the projections provide scenarios for the future evolution of this factor.

**Data:** Population, employment, unemployment data for detailed age and gender groups for Euro area countries are taken from the EU Labour Force Survey (LFS) compiled by Eurostat. Data are from 1983 to 2007 (second quarter results) and for ages 15 to those over 70. For projections, they use population projections from the New Chronos database by Eurostat (EUROPOP 2008).

**Current methodology:**
- **Type of model:** Use of a cohort-based model where a system of constrained least squares regressions is estimated for single ages 15 to 70 and over and for men and women.
- **Dependant variable:** the logistic transformation of the participation rate for males and females at each age.

\[
\ln \left( \frac{LFPR_{g,t}}{1 - LFPR_{g,t}} \right) = \alpha_g + \sum_{b=1917}^{1992} \beta_{b} C_{g,b,t} + \lambda_{g} X_{g,t} + \epsilon_{g,t}
\]

Where \( \alpha_g \) represents an *age fixed effect*, constant over time (average propensity to participate in the labour market at a certain age).

\( C_{g,b,t} \) represents dummies for the different birth years (equals 1 if the birth cohort \( b \) appears in age \( g \) at time \( t \). \( \beta_b \) is the coefficient estimated for each birth year. It is constrained to be the same across equations in order to allow an identification of cohort effects separately from the age and business cycle effects. \( \beta_b \) is constant over time (average propensity to participate in the labour force when born in a particular year). In other words it is a *cohort fixed effect*. It shifts the underlying age participation profile up or down.

\( X_{g,t} \) contains other variables that have explanatory power for participation rates of particular age groups (see Determinants).

The coefficient \( \lambda_g \) does vary freely across ages to allow the underlying age participation profile to tilt.

The total system is estimated based on 1400 age-year observations with 56 equations resulting in 56 estimated age, 168 estimated business cycle parameters and 72 cohort parameters.

To project participation rates forward, the model results are used assuming that age and cohort effects are fixed throughout the sample and the observed determinants are kept at their 2007 values. For young cohorts (last eight cohorts of the sample and those that enter the market after 2007), the cohort effect is fixed at the level of the last cohort effect estimated (birth year 1984).
Determinants:
In the basic model, one contemporaneous variable and two preceding lags variables of the output gap are included to encompass business cycle effects.
In the full model (estimated for the five largest euro area countries), a set of indicators of observed determinants, including time varying institutional variables which do not vary across ages but that can be included only in equations for certain groups of population, (i.e. number of children for female or youth in education for young) are added. It comprises union density, labour taxes, implicit tax on retirement for older workers, unemployment benefit replacement rate, the share of highly educated in the youth population, average number of children and life expectancy.

Projection horizon and frequency of updates
Data are observed from 1983 to 2007. The projections target the 2030 horizon. Detailed projected participation rates are not published. Only total labour force participation rates (projected for the five largest euro area countries) by gender are produced with intermediate figures for 2015, 2020, 2025 and 2030.

Use of scenarios:
Four scenarios are used:
1. Baseline scenario: Age and cohort effects are fixed throughout the sample and observed determinants are kept at their 2007 values. New cohort effects are fixed at the level of the 1984 cohort effect.
2. 2007 level scenario: participation rates by age and gender groups are kept unchanged at their 2007 level.
3. No migration scenario: the impact of migration on the population structure is taken out.
4. EC scenario: this scenario is derived from the European Commission projections.

Main results of the projection:
Over the observed period, the age and cohort effects can explain a substantial part of the increase in labour force participation rates in the euro area, although not the surge since the early 2000s. Over the projected period, positive cohort effects are not large enough to compensate for the downward impact of population ageing on aggregate labour force participation rates in the euro area.

Assessment of current methodology:
There is no proper assessment. The baseline scenario’s projection results are compared with the EC scenario results.

Older methodology:
The previous projections of labour force were carried out in 2002 for the euro area as a whole and assume five different scenarios for participation rate developments to provide upper and lower limit for the range of labour force growth projections. The projection horizon is 2010.
Scenario 1: constant participation rates fixed at 2001 level over the projection period.
Scenario 2: participation rates converge to the equivalent US level for 2001 by 2010 with a year-on-year constant rate of convergence.
Scenario 3: only female participation rates converge to the US female level for 2001, male rates remain constant.
Scenario 4: participation rates, for both genders, are projected using the changes observed over the last three years.
Scenario 5: male participation rates are kept constant and female participation rates are projected allowing convergence with the US gender gap in participation rates.

Comments
The current methodology is much more complex and detailed than the previous one.

Reference papers:
Institutions: European Commission – Ageing Working Group


Data: Population, employment and unemployment data for each country are taken from the Community Labour Force Survey of Eurostat. The data, labour force and participation rates are given by year, sex and age (not on the website).

Objective of the projections: to design a tool to estimate the impact of further pension reforms on the participation rate of older workers.

Current methodology:

Type of model: use of a cohort based approach similar to the one used by the OECD. The model calculates the rates of (net) entry and exit into the labour market for each single year of age (five-year age groups in the OECD model). They use different names of variables but the methodology of the core model is identical to the OECD model.

Entry and exit rates are calculated from ages 15 to age 71.

Exit rates:

- The conditional probability of a person aged \( x \) at time \( t \) to retire at time \( t+1 \) is
  \[
  \text{Re} \, x_{t+1} = \frac{OP_{t+1}^x}{LF_t^x} = 1 - \frac{PR_{t+1}^x}{PR_t^x}
  \]

  with \( OP_{t+1}^x \) being the number of individual expected to become inactive between age \( x \) and \( x+1 \), \( LF_t^x \) being the labour force aged \( x \) at time \( t \) and \( PR_t^x \) being the rate of participation at time \( t \).

- Use of \( Rex \) observed a given year or period (here the average over the period 1998-2007) to project participation rates of future older workers:
  \[
  PR_{t+1}^{x+1} = (1 - \text{Re} \, x_{t+1}) \cdot PR_t^x
  \]
  \[
  PR_{t+n}^{x+n} = (1 - \text{Re} \, x_{t+1}) \cdot (1 - \text{Re} \, x_{t+2}) \cdot (1 - \text{Re} \, x_{t+3}) \cdots (1 - \text{Re} \, x_{t+n+1}) \cdot PR_t^x
  \]

- Exit rates of workers aged 55 to 71 were adjusted to take into account the potential effects of recently enacted pension reforms in 20 countries.

Entry rates:

- The conditional probability that individuals aged \( x \) at time \( t \) enter on the job market at time \( x+1 \) is calculated as:
  \[
  \text{Re} \, n_{x+1} = 1 - \frac{(PR_{max} - PR_{t+1}^x)}{(PR_{max} - PR_t^x)} \geq 0
  \]

  With \( PR_{max} \) being the upper limit on participation rates (fixed at 99% for men and women).
- Use of $Ren$ observed a given year or period (here average over the period 1998-2007) to calculate participation rates over the period of projections:

$$PR_{x+1} = Ren_{x+1} \cdot (PR_{\text{max}} - PR') + PR'$$

- A floor to the participation rates of the younger cohorts, in the age bracket 15-24, is set to avoid that any increase in school enrolment rates (and then any decrease in the corresponding participation rates) would result in a future decrease in the prime age participation rates according to the cohort approach method.

Exit and entry rates used for the projections are the average rates calculated for the period 1998 to 2007 (instead of a single year reference in OECD model). This is done “in order to avoid that the choice of a single year of calculation is overly conditioned by the cyclicality of labour market conditions and/or possible statistical errors due to a small sample”.

Assumptions: The baseline projections are made under the assumption that there won’t be changes in policy, working patterns or economic conditions.

Determinants:
In the baseline model, age and cohort effects, including the added effects of the already enacted pension reforms, are the only determinants.

Projection horizon and frequency of updates:
The latest projections, dated 2008, target the 2060 horizon and provide yearly figures for each country and age band. Published data include overall labour force supply and participation rates for each country of the European Union (and geographically aggregated figures) in 2007, 2020 and 2060. The participation rates for each country are also given for four age bands (15-24/25-54/55-64/65-71) in 2007 and every five-year from 2015 to 2060.

Previous projections, dated 2005, targeted 2050 horizon.

Use of scenarios:
Scenarios give the impact of potential pension reforms on the participation rates of older workers. These reforms include increase of the statutory retirement age and the removal of early retirement schemes.

Main results of the projection:
Overall participation rates and labour supply is negatively impacted by the population composition. Changes in participation rates of specific cohorts are generally positive, except for several young cohorts in some countries.

Assessment of current methodology:
In the last projection exercise, the authors compare their results with the projections made in 2005. They found that the main differences between the two projections came from changes in population projections and in pension system reforms.
Older methodology:
Before 2005, projections were based on ILO projections of participation rates for the period to 2010. For subsequent projection periods, participation rates were assumed to stay constant for men aged 20 to 54 and 55 to 64. Participation rates for women aged 20 to 54 and 55 to 64 were assumed to rise progressively towards a ceiling equal to five percentage points below those of men in countries with subsidized childcare and ten points below those of men elsewhere.

Comments:
This model is part of a wider project run by the Economic Policy Committee’s Ageing Working Group.

Reference papers:

EUROSTAT

Institutions: Eurostat and Statistics Netherlands

Link: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

Data:
Population and labour force data are taken from the Eurostat database. They are broken down by age, sex, country and region.

Objective of the projections:
This study was commissioned by Eurostat to produce labour force projections at national and regional levels.

Current methodology:
The study is based on the analysis of three variant labour force scenarios:
- A baseline scenario where current trends will continue.
- A low scenario where the economic perspectives are rather gloomy and there is resentment towards cultural changes.
- A high scenario where the economic perspectives are good and there is a positive attitude towards cultural change.

In the case of the baseline scenario, the assumptions include a continued growth of the EU economy; modest increases in labour demand; moderate rise in the labour force participation of young people (under 25); significant increase in labour force participation of women aged 25-49; considerable increase in participation of women aged 50 and over; slight rise of participation of men aged 50 and over.

No detailed explanation is given on the methodology used to convert these assumptions in projected participation rates by age-sex and country. It is specified that countries were distinguished in three groups on the basis of age patterns of participation rates: the northern, the western and the southern group of countries. In compiling national scenarios, these similarities in participation patterns are maintained.

The labour force participation rates vary up to 2020 and the last value is kept constant for the remainder of the projection period (1995-2050).
Each scenario's participation rates are combined with the corresponding population scenarios (baseline, low and high) in order to produce the labour force projections.

Projection horizon and frequency of updates:
For each scenario, the labour force projections range from 1995 to 2050. Most of the results are published graphically and national participation rates are only given for 2020 and by ten-year age bands.

Use of scenarios:
See current methodology.
Main results of the projection:
In the baseline scenario, European (based on 15 countries) labour forces will cease to grow around 2020 and will shrink at a rate of 0.5% per year afterwards. In the projected period, European male labour force participation will stabilise around 70% and the female rate will continue its upward trend reaching 55% in 2020. If the male trend is quite uniform across Europe, the female upward trend will be stronger in western and southern countries as opposed to the northern ones where participation rates patterns are already U-inverted shaped (in these countries, having children no longer significantly affects women's economic activity).

Assessment of current methodology:
No assessment found.

Older methodology:
Not found.

Comments:
It would have been interesting to have more details on how future participation rates are determined.

Reference papers:
FRANCE

Institution: INSEE, in collaboration with other institution DARES

Link: http://www.insee.fr/fr/themes/document.asp?ref_id=ip1089&reg_id=0

Current methodology:
Use of logistic trends in function time and with four parameters in order to project the activity rates. The four parameters are the two asymptotes, the speed of diffusion and the date of inflexion. The logistic also includes a structural demographic effect specific to the age band and explanatory variables, also specific to each age band. Since, it is a non linear method, the trends are estimated using maximum likelihood. More formally, using the terminology of Coudin (2007):

\[ TA_t = (1 - D_t) \left[ \frac{T_0 + T_1 \cdot e^{x(t-d)}}{1 + e^{v(t-d)}} \right] + X_t \beta + \epsilon_t \]

\( TA_t \) is the activity rate (“Taux d’activité”) of a given category for year \( t \); \( D_t \) is the structural demographic effect specific to the age band; \( T_0 \) and \( T_1 \) are the two asymptotes (\( T_0 \) is the historical asymptote and \( T_1 \) the future one); \( v \) (“vitesse”) is the speed of diffusion and \( d \) is the date of inflexion. The variable \( X_t \) is a vector of explanatory or corrective variables and \( \beta \) is the corresponding vector of parameters; \( \epsilon_t \) is the residual.

In addition a specific module called Destinie is used for the age band (60-64) to simulate the impact of changes in retirement scheme and the lengthening of school duration.

Determinants:
There are different determinants (\( X_t \) variables) that are captured: unemployment (for 20-24 age band), rate of pre-retirement (for the 55-64), rate of apprenticeship (15-24), parental benefits (women, 25-44). The paper does not explain how these explanatory variables are projected.

Projection horizon and frequency of updates
The latest projections, dated 2006, are targeting the 2050 horizon and provide intermediate figures for 2010, 2015 and 2030. The previous exercise of 2002 was also targeting the 2050 horizon and provided intermediate figures for 2007, 2012 and 2020.

Use of scenarios:
Different scenarios are used. They are two sets of hypotheses: hypotheses regarding demographic effects (migration, fertility rate) and activity effects (low, high activity).

Assessment of current methodology:
For each exercise, the projections from the previous exercise are assessed. The assessment is only possibly for short-run projections. For example, as of 2006, it is possible to assess the accuracy for projections made in 2002 for the year 2005 but not beyond. Therefore this assessment is not complete.

In the last two exercises, there are non-negligible discrepancies between projected and actual figures. For example the projections made in 1996 for the year 2000 have underestimated the increase in active population. The projection error was mainly due to the stabilisation of the activity rate of youth. For the 15-24 age group, the actual participation rate (PR) was 29.74% against a projection of 25.4%.
**Older methodology:**
The method changed in 2002. The previous version used the same logistic curve but without including the vector of explanatory variable $X_t$. In other words, it was a pure extrapolative approach.

**Comments**
It is important to mention that comparison with past projections is not always possible. The ILO concept of activity differed in the past with the national concept, that included also pre-retired people and people not working that are legally exempt from looking for a job (eg. disabled persons).

The decomposition of changes in active population in demographic and activity effects is used for analytical purposes (see notably Brondel et al. 1996), in order to analyse which are the dominant effects on historical data and projections.

**Reference papers:**


HAITI

Institutions: Institut Haïtien de Statistique et d'Informatique (IHSI) et Centre Latino Américain de Démographie (CELADE)

Link: http://www.ihsi.ht/produit_demo_soc.htm


Objective of the projections: Provide official labour force projections.

Current methodology:
LFPRs projections are made by linear interpolation between last available observed data (here 2000) and targeted participation rates fixed by CELADE for 2060 (2080 in the case of women living in a rural area). The targets are broken down by age group and type of areas (urban vs rural). Those targets are taken from CELADE (Model 2, semi-industrialised countries) except for rural age groups 15-19 and 20-24, for which the participation rates are expected to be lower than those projected by CELADE.

Labour force projections are the product of projected participation rates and projected population.

Projection horizon and frequency of updates:
The labour force projections range from 2000 to 2050. Five-yearly projected labour force and participation rates are published by age-sex group for urban and rural areas.

Use of scenarios: No use of scenarios.

Main results of the projection:
Overall labour force is projected to regularly increase until the end of the projection but showing a slowdown in its growth rate. From a current level close to 3% per year, it should reach 1.3% at the end of the projection period. The growth is essentially generated in urban areas and female progression is moderately quicker than that of males. Labour force is estimated at 9.6 million in 2050 nearly equally divided between men and women (4.88 million and 4.75 million respectively).
If female participation rates for all age groups are expected to rise over the projection period, male participation rate will increase to a smaller extent, attaining 74.6 and 78.9% respectively.

Assessment of current methodology: No assessment found.

Older methodology: Not found.

Comments: There is no explanation on the method used to fix the participation rate targets.

HONG KONG

Institutions: Hong Kong Census and Statistics Department

Link: http://www.censtatd.gov.hk/home/index.jsp

Data: Observed LFPRs are taken from the General Household Survey and population data from the 2006-based Population Projections.

Objective of the projections: Provide official labour force projections.

Current methodology:
Type of model: extrapolation techniques are used to project LFPRs. The population is broken down into 33 groups categorised by sex, age (11 groups) and for females by marital status (never married versus ever married women). Over the observed period, female LFPRs depending on the marital status are dissimilar (sensibly higher for the never married ones) and, with the expected increases in the proportion of never married women in future, this dichotomy will have an effect on the projected labour force.

The time series models, employed to project each group participation rates, are not described. It is only stipulated that the choice of the model depends on its statistical relevance and on expert views on the latest developments in various social and economic spheres.

Foreign domestic helpers are estimated apart; a projection of the expected number of this population category is made separately and added back to the labour force projections.

Projection horizon and frequency of updates:
The labour force projections range from 2007 to 2026 and annual labour force and participation rates are provided by age-sex groups. A paragraph at the end of the article mentions that labour force projections should be updated periodically to take into account the latest developments in the population and the labour market.

Use of scenarios: No use of scenarios.

Main results of the projection:

Overall labour force participation rate is projected to decline from 61.5% in 2007 to 55% in 2026 mainly due to demographic structure changes. Added to this, slight decreases in LFPRs for males across all age groups are expected. The expected increase of the proportion of never married females and higher participation rates for ever married females (mainly explained by their improved educational attainment and the postponement in childbirth) should partially counterpart the demographic and male trends.

As a result of the combined effect of the changing demographic structure and LFPRs for different age-sex groups over time, the total labour force is projected to reach a peak in 2018 and then fall slowly. Interestingly, the female labour force is projected to exceed the size of the male labour force in 2014 due to the projected increase in female foreign domestic helpers.
**Assessment of current methodology:** No assessment found.

**Older methodology:** Not found.

**Comments:**
The methodology description is quite general and details on it would have been relevant for this study.

**Reference papers:**
INTERNATIONAL LABOUR OFFICE

Institutions: International Labour Office


Data: For most of the countries, data on labour force participation is taken from national sources, preferably labour force surveys or household surveys. Official estimates and population census are second best sources and are not used systematically. For a few countries, there is no historical data at all and estimates are derived from data of countries from the same region and level of development. For many countries, historical time series are incomplete and estimates are derived from different imputing techniques.

Data need to be harmonised, both in terms of definition (geographic coverage, civilian population) and age group distributions (conversion to 5-year age bands). Data from second best sources is checked and adjusted when judged appropriate, for example when there is evidence of underestimation of women working in agriculture.

Objective of the projections: The ILO programme on estimates and projections of the economically active population is part of a larger international effort on demographic estimates and projections in which several UN agencies contribute. Estimates and projections of the total population and its components by sex and age group are produced by the UN Population Division, the economically active population by the ILO, the agricultural population by FAO and the school attending population by UNESCO.

Current methodology:
The present methodology is based on the use of growth curve with four parameters:

\[ y_t = y_{\min} + \frac{y_{\max} - y_{\min}}{1 + e^{a t+b t}} \]

Where \( y_t \) is the participation rate for year \( t \). The parameters \( y_{\min} \) and \( y_{\max} \) represent the two asymptotes.

The parameters are estimated in two phases. Firstly, the values of the asymptotes are determined by looking at the trajectories of male and female participation rates. Five scenarios are possible: the rates are diverging, the rates are crossing just before the projection window, the rates will converge quickly during the projection interval type four, the rates will converge slowly during the projection interval and finally the rates are a constant distance apart. In each case, the long-term asymptotes are extrapolated using simple formulas and recent data. For example, if there is quick convergence on historical data, this convergence is supposed to continue in the long run. The average between the male and female rates is computed and extrapolated based on its growth during the last five years. If there is a slow convergence, the same formulas are used but based on the last ten years.

Also note that for the age groups covering the 20s and 30s a gap is forced between males and females based on the assumption that child-bearing will always imply slightly lower rates for females than males, even if they are appearing to converge.
In a second phase, the parameters \(a\) and \(b\) are estimated by a simple linear regression of \(Y'_t\) on time based on the last eleven observations, \(Y'_t\) is defined as:

\[
Y'_t = \ln \left( \frac{y'_t}{(1-y'_t)} \right) \quad \text{where} \quad y'_t = \frac{y_t - y_{	ext{min}}}{y_{	ext{max}} - y_{	ext{min}}}
\]

Finally, the projections are checked graphically for consistency across the 11 age bands. For example if there is a fast convergence for the 55-59 age band and a constant gender difference for the 60-64 age band, there is a potential inconsistency. In that case, the ILO experts set manually the values for the asymptotes, based on country specific knowledge or its own judgment.

**Projection horizon and frequency of updates:**
In the last exercise, the projections, dated 2008, were targeting the 2020 horizon. Projections for all intermediate years are provided for the 22 age-sex groups in addition to time series plots and distribution of LFPR by age group and gender. Since 2006 (first release of the fifth edition), the projections are updated every two years.

**Use of scenarios:**
No use of scenarios.

**Assessment of current methodology:** no assessment of previous projections has been found.

**Older methodology:** The first ILO projections were released in 1971. The methodology has changed a few times but was based primarily on extrapolative techniques. In the previous methodology (fourth edition, published in 2000), four types of assumptions and six extrapolation functions were covered. In that edition, detailed metadata on the estimates and projection assumptions were provided for each country.

**Comments:**
In the last two releases, there were no country specific metadata for the estimated historical data. In the last edition, the values for the asymptotes had to be adjusted manually in many cases (around 50% of time series), making the exercise extremely time-consuming.

The methodology paper does not document why the parameters are estimated using the last five (or ten years) for the asymptotes and the last 11 years for the other two parameters.

The methodologies for imputing values on one side and for deriving projections on the other side are based on two different methodologies and possible inconsistencies may occur for countries for which few or no data points are available.

In the case of diverging difference between male and female participation rates, the divergence is supposed to continue on the forecasting horizon, which is a very strong assumption.

**Reference paper:**
IRELAND

Institutions: Central Statistics Office

Link: www.cso.ie/releasespublications/po_lab_project.htm

Data: Observed data on labour force participation rates by age and sex are provided by the Labour Force Survey (1996) and the Quarterly National Household Surveys (2002, 2006). Population data are given by the 2006 Census. Only people over 15 years old are considered.

Objective of the projections: Provide official labour force projections.

Current methodology:

Type of model: In this case, there is no use of any statistical model to derive projections of labour force participation rates. The approach is purely judgmental.

Projections: A group of experts determines the future evolution of the participation rates on the basis of the observed data broken down by age and gender. In addition to this classification, certain age-sex groups are split to take account of other criteria influencing the labour force participation. Age groups 15-19 and 20-24 are divided between those in the education system and those outside it. Women aged 25 years and above are classified by marital status to take into consideration the impact of children on mothers' labour force participation. A specific participation rate is set for each group under the following assumptions:

<table>
<thead>
<tr>
<th>Males:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• LFPR of 25-44 year old males largely unchanged</td>
</tr>
<tr>
<td>• Minor increases in LFPR of males aged 45 and over reflecting a greater propensity to remain in the labour force</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Married females:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Further LFPR gains for married females aged 25-49 years</td>
</tr>
<tr>
<td>• Moderate gains in LRPR of married females aged 50 years and over</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other females:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Moderate increases in LFPR of other females</td>
</tr>
</tbody>
</table>

Source: CSO (2008)

Projection horizon and frequency of updates:
The projection horizon is 2021 and labour force participation rates are given by age-sex groups for 2011, 2016 and 2021. Labour force projections are also published for the same years.

Use of scenarios:
Labour force projections are derived from projections of participation rates and population. Three scenarios are considered for the projected population: one called "M0" with no net migration, "M1" with immigration continuing at a high level (+60000 per annum in 2006/2011, +50000 per annum in 2011/2016 and +40000 per annum in 2016/2021) and "M2" with immigration continuing at more moderate levels (+50000 per annum in 2006/2011, +35000 per annum in 2011/2016 and +25000 per annum in 2016/2021). In this projection (2021 horizon for population aged 15 and over), fertility assumptions have no incidence and only one mortality scenario is assumed.
Main results of the projection:
Under the three migration scenarios, overall population is projected to grow slower than the 2.1 percent rate recorded between 1996 and 2006. This trend is also reflected on the labour force growth which won't remain at the recently observed level.

By holding labour force participation rates constant at their 2006 level it is possible to decompose the overall projected increase in the labour force between its demographic and participation rate effects.

Assessment of current methodology: No assessment found.

Older methodology: Not found.

Comments:
They give no indication on how the expert group determines the expected participation rates.

Reference papers:
MEXICO

Institutions: Consejo Nacional de Población

Link: http://www.conapo.gob.mx/

Data: Population, employment and unemployment data for Mexico are taken from two sources: labour force surveys ENEU and ENE (from 1994 to 2004) and ENOE (Encuesta Nacional de Occupación y Empleo, from 2005 onwards) and the Population Census.

Objective of the projections: Provide Mexico’s official labour force projections.

Current methodology:
Type of model: The model consists of a dynamic approach (cohort-based approach) but using multi-state life tables methodology to model transition rates between two functional states (here activity and inactivity). The estimation and projection are based on observed entry and exit rates for each age-sex groups simultaneously. As a result, the multi-state model gives the distribution of cohort members among functional states at each age.

Transition rates:
- Economically active population (PEA) aged x, x+4 at time t is defined as:
  \[ 5P E A_x(t) = 5P_x(t) - 5P E I_x(t) \]
  where \( 5P_x(t) \) is the total population and \( 5P E I_x(t) \) is the economically inactive population.
- Participation (A) and non participation (I) rates (or proportions) for cohort aged x, x+4 at time t can be calculated as:
  \[ 5A_x(t) = \frac{5P E A_x(t)}{5P_x(t)} \quad \text{and} \quad 5I_x(t) = \frac{5P E I_x(t)}{5P_x(t)} \]
- Five years later:
  \[ 5P E A_{x+5}(t+5) = 5P E A_x(t) \cdot 5S_{x+4}^{aa}(t,t+5) + 5P E I_x(t) \cdot 5S_{x+4}^{au}(t,t+5) \]
  \[ 5P E I_{x+5}(t+5) = 5P E A_x(t) \cdot 5S_{x+4}^{ua}(t,t+5) + 5P E I_x(t) \cdot 5S_{x+4}^{uu}(t,t+5) \]
  where \( 5S_{x+4}^{aa}(t,t+5) \) is the transition rate of active people aged x, x+4 at time t who survive and remain active five years later, \( 5S_{x+4}^{au}(t,t+5) \) is the transition rate of inactive people aged x, x+4 at time t who survive and become active five years later and so forth.
- Using the participation and non participation rates definitions above-mentioned, the projected rates are calculated as
  \[ 5A_{x+5}(t+5) = 5A_x(t) \cdot 5S_{x+4}^{aa}(t,t+5) + 5I_x(t) \cdot 5S_{x+4}^{au}(t,t+5) \]
  \[ 5I_{x+5}(t+5) = 5A_x(t) \cdot 5S_{x+4}^{ua}(t,t+5) + 5I_x(t) \cdot 5S_{x+4}^{uu}(t,t+5) \]
- In matrix form:
  \[ 5T_{x+5}(t+5) = 5S_x(t,t+5) \cdot \bar{T}_{x}(t) \]
  where \( \bar{T}_{x}(t) = \begin{bmatrix} 5A_x(t) \\ 5I_x(t) \end{bmatrix} \)
  and \( 5S_x(t,t+5) = \begin{bmatrix} 5S_{x+4}^{aa}(t,t+5) & 5S_{x+4}^{au}(t,t+5) \\ 5S_{x+4}^{ua}(t,t+5) & 5S_{x+4}^{uu}(t,t+5) \end{bmatrix} \)

\(^6\) The model also includes an additional step to take into account for mortality and international migration that is skipped here in order to be more concise.
To estimate the transition rates, the model uses entry and exit rates (respectively \( \hat{m}^{ea} \) and \( \hat{m}^{ai} \) calculated from the labour force surveys data) and a relation established by Nour and Suchindra (1984), is applied.

**Projections:**
The following assumptions based on the observation of historical rates are made:

a. The entry rates for men remain constant over the projection period.

b. Overall entry rates for women continue to grow following a linear time trend (based on historical data from 1994 to 2007) but maintaining unchanged the age distribution observed during the period 2000-2007.

c. Concerning the exit rates, variations are observed at older ages for men and women but the trends are less obvious than for entry rates. It is assumed that exit rates stay unchanged for both sexes until age 55-59 for male and 60-64 for female in the future.

d. For older ages and both sexes, the exit rate for 2050 grow at a rate 2.5 times higher than that observed between 2000-2003 and 2004-2007 periods and intermediate figures are linearly interpolated.

Using these entry and exit rates, transition rates and then participation rates are calculated.

**Determinants:** Age, gender and cohort effects are the only determinants.

**Projection horizon and frequency of updates:**
Population rates projections, dated 2005, are targeting the 2050 horizon. Published data include yearly labour force and participation rates for each age-sex groups (from 12-14 and 15-19 to 85-89).

**Use of scenarios:** No use of scenarios.

**Main results of the projection:**
The labour force will still continue to grow for the next few decades from 44.2 million in 2005 to a maximum of 61.9 million in 2042. Female participation rates will grow twice as quickly as their male counterpart (respectively 1.35% per year and 0.64% per year). This is only at the end of the projection that population ageing will begin to show a negative impact on labour force with more people retiring than beginning to work.

**Assessment of current methodology:** No assessment found.

**Older methodology:**
Previous projections were made using extrapolations of observed participation rates or regression models. Two projections, made in the late 60’s, already used a cohort based approach but modelling net entry or exit rates for each age (excluding the possibility to model simultaneously entry and exit rates).

**Comments:**
This type of model needs pure panel data to estimate entry and exit rates. It would not be possible to apply it using a cross-sectional database or panel data based on a different survey group.
Reference papers:
NEW ZEALAND

Institutions: Statistics New Zealand

Link: www.stats.govt.nz

Data: Observed data on labour force are derived from the Household Labour Force Survey (HLFS) and observed and projected population data from the National Population Projections: 2009(base)-2061.

Objective of the projections: Provide official labour force projections.

Current methodology:
Type of model: a scenario based model is used to project the labour force participation rates. Nine projection series are provided, each of them using a different combination of fertility, mortality, migration, and labour force participation assumptions (combining high, medium and low assumptions).

The mid-range projection series, called "M5", is rated by the authors as the best indication of future labour force changes.
The three alternative labour force participation variants (low, medium and high) assume that LFPRs will vary until 2051, when the average working life (to age 80 years) for men will be 45.8, 48.3 and 50.8 years respectively, and for women, 38.8, 40.9 and 43.0 years, respectively. To compare, the base average working life in 2006 was 45.3 years for males and 36.9 years for females.
Projections: Labour force projections assumptions are formulated taking into account historical trends, trends in other countries, government policy and any other relevant information. The medium variant includes, among others, the assumption that LFPRs for males and females will increase significantly for age groups over 55 years as a consequence of the increasing flexibility of the age of retirement and of increasing life expectancy and well-being in the older ages.

Projection horizon and frequency of updates:
The projections cover the period 2006-2061 at one-year intervals and results are broken down by a one-year age band (eg. 55 years old) and sex. The last projections are dated 2008 and it is planned to update them every 2 to 3 years.

Use of scenarios: see above

Main results of the projection:
All projection series show a slowdown in growth and an ageing of the labour force over the projection period. The overall proportion of people in the labour force is projected to decline despite constant or increasing LFPRs at most ages due to the changing age structure of the population.

Under the M5 scenario, labour force is projected to rise from 2.24 million in 2006 to 2.75 million in 2031 and 3.00 million in 2061.

Assessment of current methodology: No assessment found.
Older methodology: Not found.

Comments:
The population and labour force pyramids are very helpful in order to visualise the results.

Reference papers:
OECD

**Institutions:** OECD Economic Department

**Link:** www.oecd.org/eco

**Data:** Population, employment and unemployment data for each country are taken from the Labour Force Statistics book published by the OECD. The data are given by quinquennial age groups.

**Objective of the projection:** to have a tool to quantify the impact of alternative policy options on future labour supply in OECD countries.

**Current methodology:**
Type of model: Use of a cohort based approach also called dynamic cohort method. The model calculates the rates of (net) entry and exit into the labour market for each cohort. Inflows and outflows from the labour market that cancel out each other are neglected.

In this study, in absence of longitudinal data, life-time participation rates at different ages comes from year based surveys and do not refer to the same people. For instance, the change in participation of a cohort born year $t$ between age $a$ and $a+1$ is calculated by comparing people aged $a$ in year $b+a$ and people aged $a+1$ in year $b+a+1$ with the assumption that they have the same characteristics.

Entry and exit rates are calculated from age 15 to age 75 and over by quinquennial age-sex groups.

**Exit rates:**
- The conditional probability of a person aged $x,x+4$ to retire at age $x+5$ is
  \[ W^{*}x_{x,x+4}^{*} = 1 - \frac{PR_{x+5,x+9}}{PR_{x,x+4}} \geq 0 \]
  with $PR$ being the rate of participation age groups $x, x+4$ and $x+5,x+9$.
- Its supplement $S^{*}x_{x,x+4}^{*} = 1 - W^{*}x_{x,x+4}^{*}$, is the probability of persons aged $x, x+4$ still to be in the labour force at age $x+5,x+9$.
- The overall probability that any individual will still be in labour force at age $x, x+4$ is:
  \[ s^{*}x_{x,x+4}^{*} = \prod_{j=35,39,...}^{x,x+4} s^{*}x_{j,j+4}^{*} \]
- The probability of exit at age $x+5$ is calculated as: $w^{*}x_{x,x+4}^{*} = s^{*}x_{x,x+4}^{*} \cdot W^{*}x_{x,x+4}^{*}$

**Entry rates:**
- The conditional probability that individuals aged $x, x+4$ enter on the job market at age $x+5$ is calculated as:
  \[ W^{*}x_{x,x+4}^{*} = 1 - \frac{(PR - PR_{x+5,x+9})}{(PR - PR_{x,x+4})} \geq 0 \]
  Where $\overline{PR}$ is an upper limit on participation rates (fixed at 99% for men and 95% for women).
- The overall probability of still being inactive at age \( x; x+4 \) is:

\[
 sn_{x, x+4} = \prod_{j=15}^{x+4} SN_{j, j+4}
\]

Where \( SN_{x, x+4} = 1 - WN_{x, x+4} \), the probability of a person aged \( x; x+4 \) still to be inactive at age \( x; x+5; x+9 \).

- The probability of entry on the job market at age \( x+5 \) is calculated as:

\[
 wn_{x, x+5} = sn_{x, x+4} \cdot WN_{x, x+4}
\]

The projections are made for each country by applying fixed probabilities of entry and exit calculated for the last available cohort to the projections of population. In other words, the participation of one age group cohort is projected in year \( t+1 \) by assuming the same slope as it is observed in reference year \( t \) (2000 here) for the participation on profile of the previous cohort.

Therefore, people not yet in the labour force in 2000 are assumed to have the same individual characteristics as the cohort entering or exiting the job market in 2000. Participation rates gradually stabilize over time as the labour force comprises only people with the same characteristics than those of the last cohort.

**Determinants:**
In the baseline model, cohort effects are calculated and then, other effects are added such as projected participation effects of already planned reforms and known changes in pension systems. This step is done separately for each country.

**Projection horizon and frequency of updates:**
The latest projections, dated 2003, are targeting 2050 horizon and provide figures for each OECD’s country by age-band and for every five-year period. Only average annual growth rate or percentage point changes for a selection of labour market indicators are published.

**Use of scenarios:**
Three scenarios give the impact in participation rates of potential policy reforms concerning the pension systems:

1. The removal of early retirement schemes.
2. The move towards actuarial neutrality of old age pension systems.
3. The convergence of standard retirement age at 67.

Four scenarios give the impact in women’s participation rates of related policy measures:

1. An equal tax treatment of second earners relative to single individuals.
2. The increase of public childcare spending to the OECD average of $2314 per child (only for countries below average).
3. The increase of public childcare spending in all countries to the maximum value of $8009 per child observed in Denmark.
4. Part time participation of married women is stimulated through increasing tax incentives to share market work between spouses.

One scenario simulates a shortening of the school-to-work transition in OECD countries where the level of youth participation is very low.
Main outcome of the projection:
The combined effect of possible reforms targeting prime-age women, older workers and youth might suffice to stabilize the average participation rate in OECD countries over the next 25 years but will be insufficient to offset the additional reduction of participation likely to be caused by demographic changes beyond 2025.

Assessment of current methodology: No assessment found.

Older methodology: Not found.

Comments:
The aggregate participation rates are calculated over the population aged ≥ 15 which differs from the commonly accepted definition (aggregate rates calculated over the working-age population, comprising individuals aged 15 to 64).

There is no further OECD publication about labour force projections. Recently, the European Commission used the specifications of this model for their own projections.

Reference papers:
SINGAPORE

Institutions: Department of Economics, National University of Singapore


Data: Data from 1973 to 1999 on labour force participation rates by age and sex were provided by the Singapore Department of Statistics. Population projections are computerized using the PEOPLE software. Eleven different scenarios are projected for the population.

Objective of the projections: The 1999-2049 projections, made in 2002, were part of a study of Singapore's labour market where they modelled the demand for labour and used the labour force projections to derive the demand for foreign workers in the next decades.

Current methodology:

**Type of model:** observed participation rates by age and sex (time series based on 27 years) are fitted using linear time trends. There are thirteen age groups for male and female each, which totals twenty six time trend equations. Outlying values are excluded from the regressions.

**Projections:** In a first phase, LFPRs are extrapolated until 2049 using time trends. Then, the extrapolations are controlled for imposed ceilings and floors. These limits are the highest or lowest labour force participation rates (by age and sex) currently achieved in Germany, Japan, Sweden and Hong Kong. The first three countries were chosen because they have almost the highest LFPRs in the world and the choice of Hong Kong was based on the economic similarities with Singapore. The following table shows ceilings and floors chosen for the projections.

<table>
<thead>
<tr>
<th>Age Groups (Years)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-19</td>
<td>15.8 (f)</td>
<td>13.6 (f)</td>
</tr>
<tr>
<td>20-24</td>
<td>66.7 (f)</td>
<td>84.7 (c)</td>
</tr>
<tr>
<td>25-29</td>
<td>None</td>
<td>95.1 (c)</td>
</tr>
<tr>
<td>30-34</td>
<td>98.5 (c)</td>
<td>97.0 (c)</td>
</tr>
<tr>
<td>35-39</td>
<td>98.7 (c)</td>
<td>97.3 (c)</td>
</tr>
<tr>
<td>40-44</td>
<td>None</td>
<td>96.5 (c)</td>
</tr>
<tr>
<td>45-49</td>
<td>None</td>
<td>95.8 (c)</td>
</tr>
<tr>
<td>50-54</td>
<td>None</td>
<td>90.6 (c)</td>
</tr>
<tr>
<td>55-59</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>60-64</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>65-69</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>70-74</td>
<td>0.6 (f)</td>
<td>0.3 (f)</td>
</tr>
<tr>
<td>75+</td>
<td>0.4 (f)</td>
<td>0.2 (f)</td>
</tr>
</tbody>
</table>


To project the labour force, they multiply the projected LFPRs with the projected population for each of the eleven scenarios.
Determinants:
There is no explicit use of determinants. The use of four benchmark countries for defining upper and lower limits presumes that the determinants in Singapore are merely the same as in the benchmark countries.

Projection horizon and frequency of updates:
The projection horizon is 2049 and labour force participation rates are given by age and gender for each five year period between 1999 and 2049. Overall projected labour force is also published for the eleven demographic scenarios every five years up to 2049.

Use of scenarios:
The eleven demographic scenarios taken into account in the projection of the labour force give an idea of the impact of the demographic variables in future labour force.

Main results of the projection:
Analysing the results for the different demographic scenarios, the authors come to conclusion that even with positive fertility assumptions, the country will need migration to sustain labour force growth.

Assessment of current methodology: No assessment found.

Older methodology:
Former labour force projections were made in 1987 and 1996 based on previous population prospects. In these projections, migration was not taken into account.

Comments:
Benchmark countries (Germany, Japan, Sweden and Hong Kong) LFPRs can possibly be used when setting upper and lower bounds for future LFPR for Singapore.

Reference papers:


**SPAIN**

**Institutions:** Banco de España

**Link:** [http://www.bde.es](http://www.bde.es)

**Data:** Historical activity rates data are given by the Spain Labour Force Survey (Encuesta de Población Activa), compiled by the INE (Instituto Nacional de Estadística), from 1977 to 2004. Population data are based on 2004 Population Register (Pladón) and projections are made by applying fertility, mortality and immigration rates used by the National Institute of Statistics for their own projections based on the 2001 Census.

For this study, data are broken down by single year of age (from 16 to 63 years old), sex, birth year, education level and nationality. This study is limited to activity rates and does not include labour force projections.

**Objective of the projections:** LFPR projections were part of a broader debate on Spain’s economic perspectives. In the past years, the increasing LFPR and decreasing unemployment sustained the GDP per capita growth.

**Current methodology:**

**Type of model:** a linear regression model is used to estimate participation rates. In the first place, in order to avoid out of range predictions, activity rates are logistically transformed: $p_c = \ln[p_c/(1-p_c)]$ where $p_c$ is the participation rate for cohort $c$ and age $e$. Then, Spanish nationals and foreigners are compiled separately and the model specifications are determined by trial and error.

In the case of Spanish nationals, a variant model is estimated for each sex and the three levels of education. The explanatory variables are selected by testing alternative combinations of determinants and retaining the ones which fit best the observed data.

- Activity rates for Spanish men with a primary education level are estimated as:

$$
\ln\left[\frac{p^h_{ce}}{1-p^h_{ce}}\right] = \alpha^h_0 + \alpha^h_1 e + \alpha^h_2 e^2 + \alpha^h_3 e^3 + \alpha^h_4 e^4 + \beta^h_1 c + \beta^h_2 ce + \phi^h_1 u_e + \phi^h_2 u_e e
$$

where $e$ is the age, $c$ is the birth year and $u$ is the NAIRU (Non-Accelerating Inflation Rate of Unemployment).

- Activity rates for Spanish women with a primary education level can’t be directly estimated due to too many differences between cohort’s trends. Based on the observation that activity rates per age and generation become more and more similar to those of men, it was decided to estimate the difference between male and female activity rates for each age and cohort as follows:

$$
diff_{ce} = \alpha^d_0 + \alpha^d_1 e + \alpha^d_2 e^2 + \alpha^d_3 e^3 + \alpha^d_4 e^4 + \beta^d_1 c + \beta^d_2 ce + \beta^d_3 ce^2 + \beta^d_4 ce^3 + \beta^d_5 ce^4 + \phi^d_1 u_e + \phi^d_2 u_e e
$$

where $diff_{ce} = \ln\left[\frac{p^h_{ce}}{1-p^h_{ce}}\right] - \ln\left[\frac{p^m_{ce}}{1-p^m_{ce}}\right]$ with $h$ (hombres) for male and $m$ (mujeres) for female.
- Activity rates for Spanish men with a secondary and tertiary education level are estimated separately but with the same set of determinants. In both cases, there are is relevant change between cohorts and no interacted effect between age and the NAIRU indicator:

\[
\ln \left[ \frac{P_{xc}^h}{1 - P_{xc}^h} \right] = \alpha_0^h + \alpha_1^h e + \alpha_2^h e^2 + \alpha_3^h e^3 + \alpha_4^h e^4 + \phi^h u_i
\]

- Activity rates for Spanish women with a secondary and tertiary education level are also estimated separately but with the same set of determinants. For them, cohort*age variables are needed to capture the cohort effects on their activity rates:

\[
\ln \left[ \frac{P_{xc}^m}{1 - P_{xc}^m} \right] = \alpha_0^m + \alpha_1^m e + \alpha_2^m e^2 + \alpha_3^m e^3 + \alpha_4^m e^4 + \beta_1^m ce + \beta_2^m ce^2 + \beta_3^m ce^3 + \beta_4^m ce^4 + \phi^m u_i
\]

**Determinants:** demographic effects are captured by polynomial equation of cohort and age, and their combinations; macroeconomic effects are seized by the Spanish NAIRU indicator and its combination with age (to allow NAIRU’s effect to vary depending on the age).

In the case of foreign residents, the observed activity rates show a continued increase for both sexes which reflects a time trend. The estimation model takes into account this trend and adds, for the women, a cohort effect (recent cohorts’ activity rates are higher than those of older generations) as follows:

\[
\ln \left[ \frac{P_{xc}^f}{1 - P_{xc}^f} \right] = \alpha_0^f + \alpha_1^f e + \alpha_2^f e^2 + \alpha_3^f e^3 + \alpha_4^f e^4 + \beta_1^m ce + \beta_2^m ce^2 + \beta_3^m ce^3 + \beta_4^m ce^4 + \lambda_1 c + \lambda_2 c I
\]

where \( I \) is a dummy variable to indicate if immigrants are females.

**Projections:** the above-mentioned models are used to project activity rates as follows for the Spanish residents:

\[
tacti(s, educ, e, c) = \frac{e^{p_{xc, educ}^s}}{1 + e^{p_{xc, educ}^s}}
\]

Among other things, it is assumed that cohort effects will remain at the 2004 cohort level and in the case of immigrants, the time trend will remain three years longer and cease thereafter. To project the population by education level, they use linear regression models to fit the logistic transformations of the percentages of people who attained a primary and a tertiary level of education, respectively. Then, projected percentage of population in each education level is deducted from these models. Finally, the NAIRU is assumed to grow 7.4% year on year up to 2008 and to remain constant thereafter.

**Projection horizon and frequency of updates:**

The projection covers the period from 2005 to 2020. It seems to be a one-shot exercise. The only results published are overall activity rates per sex and per year.
Use of scenarios:
To analyse the sensitivity of projected data to macroeconomic and education factors, four scenarios are considered. In two projections, the NAIRU increases by 4% and 10% respectively until 2013 and remains constant thereafter. In the two others, the projected percentage of population in each education level varies from the base scenario: the primary education level percentage is fixed to zero for cohorts born in 1979 and onwards and aged 25 and older in one case and 10% is added to the percentage of people attaining a tertiary level of education for cohorts born in 1979 and onwards and aged 25 and older in the other case.

Main results of the projection:
Activity rates are projected to continue to increase due to a better education and a projected decreasing NAIRU for men; added to these, women also take advantage of a favourable cohort effect. For both sexes, these effects offset the ageing of the population. But even so, growth will eventually slow down.

Assessment of current methodology:
A simulation has been made using the 2000-2004 period as projections. The model was estimated on the 1977-1999 period and the accuracy of the projections has been assessed; in all cases, the projection method fitted reasonably well to the data and the projections were in line with the observed trend.

The data projected for 2005 and 2006 are also compared with observed data for the same years and a discrepancy of less than 0.5 percentage point is found.

Older methodology:
There is one reference to projections made by the National Institute of Statistics in 2000 using different methodology.

Comments:
Taking into account the education level and the nationality in modelling, LFPR allows a more accurate projection but requires a lot of data that may not be available. The use of scenarios for NAIRU seems to be highly relevant, in the light of the sharp increase in unemployment in Spain in recent years.

Reference papers:
SRI LANKA

Institutions: Sri Lanka, Department of Census and Statistics

Link: No internet website found

Data: Historical data are taken from the 1981 Population Census and from the 1990 Labour Force Survey. Labour force is calculated for a population aged 10 and over and participation rates are broken down by sex and quinquennial age group.

Objective of the projections: to provide official labour force projections.

Current methodology:
In this case, labour force projections are the product of projected population and future participation rates based on experts' assumptions. In the baseline scenario for men, the overall participation rate is assumed to slightly rise from 1990 level of 67.4% to 75.7% in 2006. More specifically, prime working ages (15-54) participation rates will remain stable. The participation rate for the age group 10-14 will slightly decrease and, at the other end of the age pyramid, people aged 55 and over will show increasing participation rates due to increasing life expectancies. Women participation rates are assumed to increase from 1990 level of 38.5% to 46.3% in 2006 with an age pattern beginning to take the "M" shape that is common in countries where female participation rates have undergone transition from low to high levels.

Projection horizon and frequency of updates:
The labour force projections range from 1991 to 2006. Five-yearly projected labour force and participation rates are published by gender and age group.

Use of scenarios:
In order to estimate the impact of changes in participation rates, the labour force is derived from projected participation rates and also from naive projections (maintaining constant participation rates at 1991 level). It is estimated that increasing participation rates will cause 75 percent of the growth in labour force.

Main results of the projection:
Labour force was expected to grow faster than total population at a rate of 3% over the 1991-1996 period (versus 1.3% for the population) and would then gradually decline. Labour force estimated at 7.45 million in 1991 was expected to reach 10.62 million in 2006. During the first five years of the projection, women were expected to contribute strongly to this increase and then labour force growth rates for both genders were anticipated to converge at a level of 1.7% per year. Overall, 2006 labour force was expected to be older and to include slightly more women.

Assessment of current methodology: No assessment found.

Older methodology: Not found.
Comments:
The projections are only based on assumed participation rates and even so, can be a useful tool to evaluate future scenarios of labour force supply.

Reference papers:
**SWITZERLAND**

**Institutions:** Office fédéral de la Statistique OFS : section Démographie et migration, section Travail et vie active, section Système de formation.

**Link:** [http://www.bfs.admin.ch/bfs/portal/fr/index/themen/01/03/blank/key/ges_alt.html](http://www.bfs.admin.ch/bfs/portal/fr/index/themen/01/03/blank/key/ges_alt.html)

**Data:** Historical labour force and participation rates are taken from the Swiss Labour Force Survey (Enquête Suisse sur la population active, ESPA) from 2007 to 2009. Population projections are the official figures provided by the Swiss Statistics Office.

**Objective of the projections:** Provide Switzerland official labour force projections.

**Current methodology:**

**Type of model:** Use of a model based on scenarios. Population is divided in two groups: Swiss nationals and foreigners. The projections for Swiss nationals include three steps:

1. Estimation of a multivariate model linking participation rates by sex and age groups and some of its determinants (% of population in education, level of education, number of children per women, % of disability in population, etc.)
2. Projections of scenarios for the selected explanatory variables
3. Use of the projections of explanatory variables in order to derive the participation rates.

Due to lack of data, another approach has been followed for foreign residents. It is supposed that the gap between their participation rates and the Swiss ones will gradually narrow to half of its previous level. In this regard, a coefficient gradually reducing the gap between foreigners and nationals participation rates is applied.

**Determinants:**

- Percentage of population in education depending on the type of education or training (5 modalities). Depending on the type of education, you can be considered as active or not (apprentices are active).
- Highest level of education attained (3 modalities). There is a positive link between the level of education and participation rates.
- Number and age of children by woman for female LFPR. This determinant is supposed to have no influence on male participation rates.
- Percentage of population with disabilities.
- Percentage of population with early retirement benefits
- Percentage of population working beyond the retirement age.

**Projections:**

It is assumed that these explanatory variables will remain relevant in the future. Different assumptions on the future evolution of these determinants are made and provide a set of scenarios of possible future participation rates which can be combined with the demographic scenarios used to project the population.

More specifically, future scenarios for education are set by a multi-state model including transition probabilities between education levels for each age, sex and nationality (Swiss or others). These transition probabilities are estimated on recent statistics taken from the ESPA and projected using different types of time trends.
Assumptions for the impact of children on female labour force participation in the future are based on a multivariate regression analysis with children age groups as explanatory variables. The three scenarios consist in a gradual reduction of this "child effect" reaching 10%, 30% and 50% respectively in 2050, and followed by a constant effect afterwards.

Three scenarios are also forecast for the combined effect on participation rates of people with anticipated retirement benefits and of people working beyond retirement age. Their proportions are maintained at the 2009 level in the medium scenario. In the high scenario, they are assumed to simultaneously and gradually increase and decrease up to 2050, reaching 1.5 times the 2009 level of people working beyond retirement age and half of the 2009 rate for people with anticipated retirement benefits. The low scenario simulates the reverse.

Finally, the percentage of people with a disability is forecast to remain unchanged.

**Projection horizon and frequency of updates:**
The latest projections, dated 2010, are targeting the 2060 horizon and provide intermediate figures every five years. The previous projections were done in 2006 and were also targeting the 2060 horizon providing intermediate figures every five years since 2005.

**Use of scenarios:**
To project the labour force supply, the scenarios determined for the participation rate are combined with the demographic scenarios (based on fertility, mortality, migration and naturalization hypothesis).

**Main results of the projection:**
Most of the scenarios show a higher labour force participation rate by age. However, the demographic evolution remains the main determinant of the labour force supply and therefore, ageing has a negative (slowing down) impact. Recent growth in female participation rates will slow down and approach male growth.

**Assessment of current methodology:** No assessment found.

**Older methodology:** The same methodology is used since at least 2000.

**Comments:**
No information is given on the statistical multivariate model used to project LFPR of Swiss nationals. This method uses a lot of data (for example, transition probabilities between education levels) unavailable in many countries.

**Reference papers:**
**UNITED KINGDOM**

**Institutions:** Office for National Statistics


**Data:** Population data are given by the Government Actuary’s Department’s 2004-based resident population projections. Historical labour force participation rates are derived from the Labour Force Survey between 1984 and 2005 (a few adjustments are made to take into account changes in the methodology of the LFS in 1992). The population is divided into 28 subgroups, including combinations of two gender groups and twelve age bands. In addition for the age groups 16-17 and 18-24, the occupation status (in full time education or not) defines another grouping criterion.

**Objective of the projections:** Provide official labour force projections.

**Current methodology:**

**Type of model:** A time trend approach is used to project the labour force participation rates. Most of the age/sex/student groups' activity rates exhibit clear trends over observed time and econometric modelling is used to estimate and extrapolate them into the future. Here, long term movements reflect a combination of structural factors, such as changes in the composition of family structure or in government policies, and their net effect is captured by the statistical modelling.

Based on the analysis of their results (significance and value of the coefficients, robustness, sensitive analysis, etc.), each population subgroups activity rates are fitted in one of the following time trends model: a linear trend, a logarithmic trend, a linear or logarithmic trend with a structural break and finally, no time trend, therefore the observed average activity rate is calculated. In addition, the output gap (or a lag of this measure) is included as an explanatory variable to account for any cyclical movements around the long-term trend.

The basic model takes the following form:

\[ AR_{it} = f \left( GAP_{t}, T, \sum_{i=1}^{n} AR_{i(t-a)} \right) \]

where \( AR_{it} \) is the activity rate of subgroup \( i \), at time \( t \),

\( GAP_{t} \) is the output gap at time \( t \),

\( T \) is the time trend.

For some of the models, three dummy variables have been included to account for special government policies that had an impact on activity rates series, such as the introduction of the Jobseeker’s Allowance in 1996 for prime age men, the replacement of the Sickness and Invalidity Benefits with the Incapacity Benefit in 1995 for older men and the shift in the Government’s education policy in 1998 for young people.

In all the cases, the equations are estimated using the OLS regression method.

**Projections:** Each subgroups model is used to extrapolate results over the projection period. For example, "men 55-59" subgroup’s equation is:

\[ MG11_{t} = 0.6302 - 0.0306 \cdot \log(T) - 0.197 \cdot IB_{t} + 0.0716 \cdot IB_{t} \cdot \log(T) + 0.3017 \cdot GAP_{t-1} + 0.2764 \cdot MG11_{t-1} \]

Where \( MG11_{t} \) is the LFPR for men aged 55-59 year \( t \) and \( IB_{t} \) is the dummy variable to indicate if the new Incapacity Benefit is in force or not.
Projection horizon and frequency of updates:
The projection covers the period from 2006 to 2020. It replaces the previous projection published in 1998 that covered the period from 1998 to 2011. The next update was planned two years later.

Use of scenarios:
The article refers to a set of projections made with variant population projections in order to assess the sensitivity of the labour force projections to the change of demographic assumptions. At the projection horizon 2020, fertility has no incidence on projected activity rate in the UK. However, higher life expectancy is associated with a lower projected activity rate of people aged 16 and over (higher proportion of old people with a lower activity rate) on the one hand. On the other hand, a higher level of migration is associated with a higher activity rate of people aged 16 and over (the proportion of young and active persons is higher amongst migrants).

Main results of the projection:
Labour force is projected to grow continuously up to 2020 but slower than in the past. Even so, activity rate of people aged 16 and over is projected to decrease by 1.4 percentage points, from 63.1 per cent in 2005 to 61.7 per cent in 2020. The driving force behind this trend is demographic change, with more people entering older age groups, who are associated with lower activity rates. More specifically, the demographic effect is compounded by the overall declining trend in labour market participation for men. On the other side, the demographic effect is partially offset by the trend towards increased participation rates for women. Added to this, the convergence of the female state pension age to men's level (65 years) also compensates the negative demographic effect. In order to evaluate separately the demographic effect and the activity rate effect on the variations in the labour force, the labour force is firstly projected assuming constant activity rates to measure the demographic effect, then maintaining a constant population to measure the activity rate effect.

As the population is ageing and the baby-boomers beginning to retire, the population effect declines throughout the period from 2006 to 2020. On the other hand, the activity rate effect becomes the driving element of the labour force growth from 2016 onwards.

Assessment of current methodology: No assessment found.

Older methodology: There is no reference to older methodology.

Comments:
The projection period is relatively short in comparison with projections of other countries.

Reference papers:
USA

Institutions: Bureau of Labor Statistics (BLS)

Links: http://www.bls.gov/emp/

Current methodology:

The BLS makes projections about the future labour force by applying LFPR projections made by the BLS to the Census Bureau's projections of the population. The Census Bureau carries out long term projections using certain assumptions about mortality, fertility, and net international migration. Because these projections include all residential citizens, a few groups must be subtracted to create the non-institutionalized population used as the labour force. Using the CPS (Current Population Survey) the BLS subtracts the population under the working age of 16, all armed-forces by age, race, gender and ethnic categories, and also the institutionalized population.

The BLS keeps a database of annual averages of the labour force participation rates gathered by the CPS for all 136 groups relating to age, gender, race, and ethnic groups. The trends and past performance of this data are analyzed. The 136 groups are divided into 2 sexes, 17 age groups and 4 ethnic groups (White non-Hispanic, Black, Asian, Hispanic). The groups are then divided into these age cohorts by sex.

Firstly, the historical participation rates for these groups are smoothed. Secondly, the smoothed data are transformed into logits, or natural log of the odds ratio. Then, the logits of the participation rates are extrapolated linearly by regressing against time and then extending the fitted series to or beyond the target year. When the series are transformed back into participation rates, the projected path is nonlinear. For more detailed information on the methods used to smooth the data see Velleman (1980).

Finally, projected labour force participation rates are reviewed for consistency. If the trend rate of change is inconsistent with the results of the time-path, cross-section in the target year, and cohort patterns (meaning the past trends of that specific cohort) the trend rate of change is then modified judgmentally. Projected labour force participation rates are applied to the population projections, producing labour force projections for each of the different age, gender, race, and ethnicity groups. Groups then are summed to obtain the total civilian labour force, which becomes an input to the next stage of the projections (BLS 2010).

Determinants: there is no explicit use of determinants

Projection horizon: Every two years, the BLS makes projections of the labour force levels for the next 10 years.

Use of scenarios: Yes (High, Moderate, and Low)

BLS Assessment of current methodology:

The BLS assesses its past performance typically after the target year has passed. The assessments calculate the percentage error in overall and individual participation rates for each of the years the data was projected. In the latest assessment in 2000, four of the five labour force participations

Most of the projection error was mainly due to the underestimated population projections. Although the LFPR projections were too high, the aggregate labour force projections were fairly accurate with less than 1 percent error for all years except 1986 and 1990, both of which had a 1.5 percent error in projections of aggregate labour force. See the detailed assessment of past projections by Fullerton (2003).

Assessment of 2009 projections: Table 5 shows the errors of projection of LFPR for the year 2009 at different projection horizons. The highest projection errors concern the participation of young people. The magnitude of errors usually increases with the length of the projection horizon.

Table 5: Projections of LFPR for 2009 at different projection horizons

<table>
<thead>
<tr>
<th>Projected LFPR</th>
<th>16 to 19</th>
<th>20 to 24</th>
<th>25 to 54</th>
<th>55 to 64</th>
<th>65 and Over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error (In % Points)</td>
<td>Error (In % Points)</td>
<td>Error (In % Point)</td>
<td>Error (In % Points)</td>
<td>Error (In % Points)</td>
<td>Error (In % Points)</td>
</tr>
<tr>
<td>2000</td>
<td>52.3</td>
<td>14.8</td>
<td>78.44</td>
<td>5.54</td>
<td>85.4</td>
</tr>
<tr>
<td>2002</td>
<td>46.8</td>
<td>9.3</td>
<td>77.66</td>
<td>4.76</td>
<td>84.5</td>
</tr>
<tr>
<td>2004</td>
<td>41.6</td>
<td>4.1</td>
<td>74.4</td>
<td>1.50</td>
<td>83.1</td>
</tr>
<tr>
<td>2006</td>
<td>41.8</td>
<td>4.3</td>
<td>73.76</td>
<td>0.86</td>
<td>83.1</td>
</tr>
<tr>
<td>2008</td>
<td>39.5</td>
<td>2.0</td>
<td>74.09</td>
<td>1.19</td>
<td>83.0</td>
</tr>
<tr>
<td>Actual 2009</td>
<td>37.5</td>
<td>72.9</td>
<td>82.6</td>
<td>64.9</td>
<td>17.2</td>
</tr>
</tbody>
</table>

Older methodology: Since the 1970’s the basic methodology has remained the same

Selected reference papers:


