CPB Memorandum

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Population Size and Participation Rates in WorldScan

This paper presents the new population numbers for the sixteen regions in WorldScan, which we use for our European scenarios. Except for population numbers we present labour participation rates and discuss our method to project these participation rates. Moreover, we show the data and projections for specific age cohorts, sexes, for the OECD and the non OECD.

1 Introduction

In our simulation analyses with WorldScan, population size and participation rates are exogenous variables.[1] Before carrying out simulations we have to construct time series for these variables of the relevant regions . This memorandum discusses the construction of these time series. It is an update of van Leeuwen and Lejour (2000).

We have several reasons to update our projections on population size and labour participation rates. The first is that new information becomes available. More in particular, the UN and Eurostat have provided more recent projections on the development of the population size until 2050. Second, the ILO have provided more recent information on current participation rates and projections until 2010. Third the projects of IEA concentrate more on European issues for which it is essential to distinguish several European countries and regions. In the recent past we have concentrated on more global issues for which we divided the world in twelve geographical regions. Therefore it makes sense to describe the demographic projections for our relevant European countries in more detail in this paper.

This paper starts with a short description of the of the population data with an overview of the ageing of the world population in section 2. Then we explain our method for projecting participation rates. First, we present the methodologies applied by the ILO to project participation rates (Section 3). Section 4 discusses our projection method, and Section 5 presents the historical and projected participation rates for the various age cohorts and sexes. The projected macro participation rates for the sixteen regions in WorldScan are discussed in Section 6. Section 7 summarizes the results. Appendix A provides a detailed documentation of the data.

2 Population projections

The United Nations have published the World Population Prospects: The 2000 revision, of February 2001. They provide demographic projections until 2050 for all countries.[2] In this extensive database four projection variants are available, namely low, medium, high and constant fertility variant. We choose the medium variant with annual numbers by age group, gender for the period 1950-2050.

For the 15 EU countries we use the baseline projections from Eurostat (2000) for the period 1999-2050. The reason for doing this is that we believe that the quality of Eurostat projections exceed those of the UN. In their projections Eurostat assumes in their baseline scenario a net

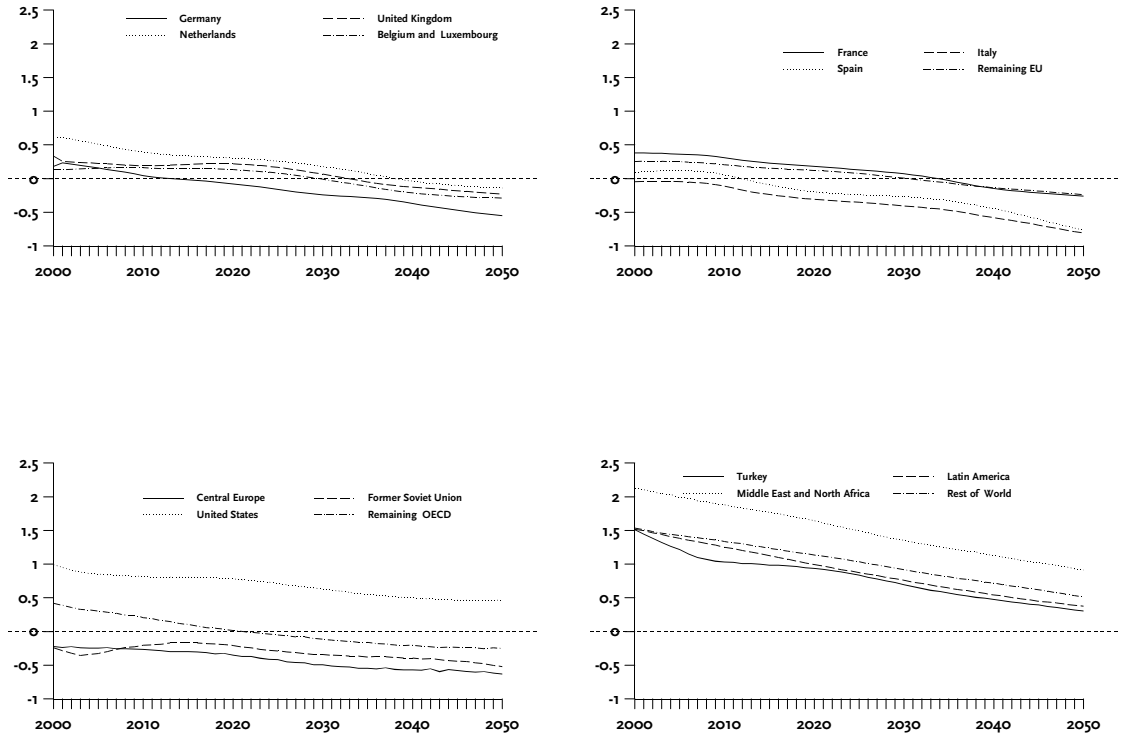
[1] CPB (1999) gives an overview of our applied general equilibrium model WorldScan.

[2] At a regional level UN even provides projections until 2100.

migration flow of 600 thousand migrants per annum from outside Europe (see De jong and Visser (1995)). The group of migrants consists of asylum seekers, labour migrants, family formation and reunification and aussiedler. About 35% of this group migrates to Germany, 15% to Italy, and about 10% to Spain, France and United Kingdom. Luxembourg, Finland and Ireland absorb nearly no migrants. The other smaller EU countries will receive about 5% of the migrants each year.

After aggregation of the individual country population numbers to the 16 WorldScan countries/regions the developments in the population size are shown in figure 2.1

Figure 2.1 Population in 16 WorldScan regions (percentage change over previous year)

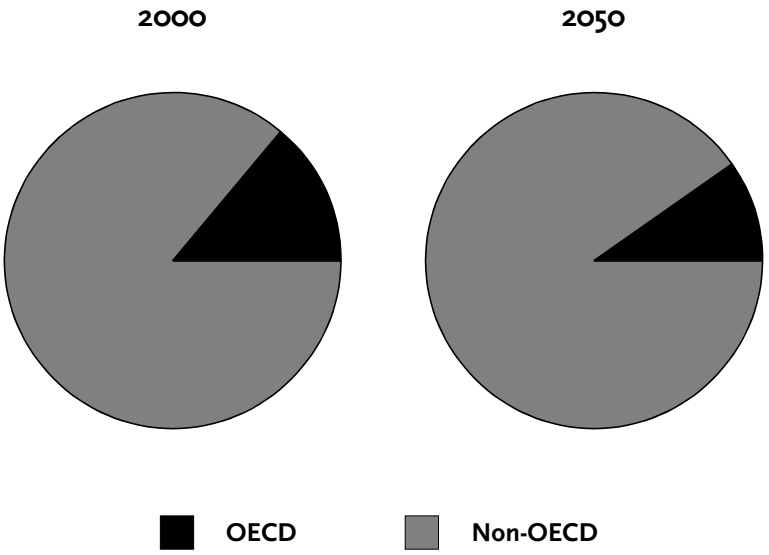


In all regions the growth of the population size diminishes. In nearly all Western European countries the growth rate becomes negative in 2050 that is to say the population will shrink. This is already the case in Central Europe, the Former Soviet Union, and Italy. Within Western Europe the reduction in population size is most pronounced in Germany, Italy and Spain. From 2020 onwards the population will shrink in Spain and Germany, while for the other EU countries this development only takes place from 2040 onwards . Population growth remains

positive in the United States due to immigration. Population will also increase monotonically in Turkey, the Middle East, Latin America and the rest of the World (Asia and Sub-Saharan Africa). Also in these regions the population growth rate decreases substantially.

In the next figure the shares of OECD population in the world population can be read for both 2000 and 2050. As expected this share drops from around 14% in 2000 to a little over 10% in 2050.

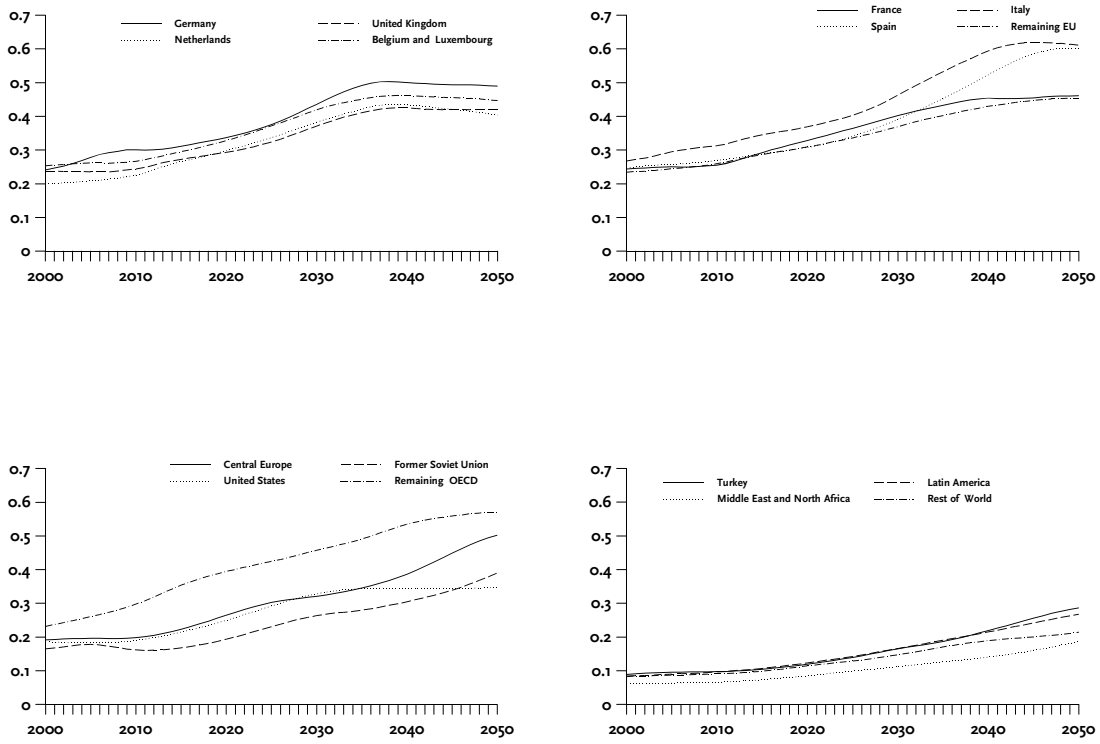
Figure 2.2 Share of population of OECD countries in the world population



In figure 2.3 an impression can be obtained from the ageing in the world population. We use the elderly dependency ratios as an indicator for this development. This ratio is defined as the population from 65 onwards divided by the potential labour force that is to say the population between 15 and 65, see (CPB, 2000).

We notice an increase in all sixteen countries / regions. In particular, ageing in Germany, Italy and Spain is impressive. In Central Europe ageing rises dramatically after 2030. Ageing is less pronounced in the United States. Also outside the OECD population will age, although this process will start later and is less impressive until 2050. An exception is China, where population becomes already a problem in the shorter term, see De Groot and Tang (2002).

Figure 2.3 Elderly dependency ratios in sixteen WorldScan regions



3 Participation rates: the ILO method

The labour supply trends in many applications of WorldScan are based on projected participation rates and projected population developments. The ILO (2000) provides projections on participation rates until 2010. The latter projections are available for about 160 countries, for both sexes, and for five-yearly age cohorts. The macroeconomic participation rates follow from combining these participation rates with the demographic projections of the United Nations.

These participation rates are projected until 2010. However, in our scenario studies the time horizon is at least 25 years and sometimes even 50 years. Therefore we need labour supply projections until at least 2050.

Participation rates are not constant in time. These are influenced by several factors. First, as economic development proceeds more and more younger people attain education for a longer time period and consequently the participation rates in these age cohorts will be pushed

downwards. Second, the last decades show that more and more people retire at a younger age, resulting in a downward trend in participation rates of older age cohorts. However, this trend may be reserved in future if governments, facing the ageing problem, can pursue successful policies.[3] Third, participation rates of women are affected by economic and cultural developments.

The ILO has published projections on participation rates at five occasions. The results of the third round have been published in 1986 and its methodology in 1990. The methodology used is based on economic development in the relevant countries. For the fourth and fifth round the ILO uses a method based on the historical trends of the participation rates per age cohort and sex. These results have been published in 1996. Below we present both methods.

participation rates based on economic development

In essence, the ILO method assumes that participation rates for each sex and age cohort are a function of the level of economic development. The ILO (1990) argues convincingly that the *share of the male labour force employed[4] in agriculture* (=PEAMPEA) is a good indicator for economic development. It is heavily correlated (0.90 or higher) with other indicators such as life expectancy at birth, the gross fertility rates, gross birth rate, infant mortality rate, rural population, and gross national product per capita.

Projections for participation rates also need a projected indicator for economic development, that is to say PEAMPEA. These projections are based on an interpolation function. This function is derived from the changes in PEAMPEA between 1970 and 1980. The share in 1970 is used as explanatory variable for these changes. This interpolation function is used to calculate the share of the male labour force employed in agriculture in 1980, and the change in this share between 1980 and 1990 is projected. Consequently, the projected share in 1990 is known, such that the change between 1990 and 2000 can be derived. This procedure is repeated until 2030.

The projected shares of the male labour force employed in agriculture for 1990 until 2030 are used as explanatory variables in the interpolation functions for the participation rates for males and each age cohort. The data from 1950 to 1980 show that the "*decrease in activity rates corresponding to a given decrease in the PEAMPEA (taking into account its initial level) is small between 30 and 44, but increase rapidly with distance from this age range, both in the direction of youth and in the direction of the elderly*", (ILO, 1990). By regressing the participation rates for a certain age cohort for all countries on PEAMPEA in 1980, the ILO

[3] This possibility is not included in our projections.

[4] Employed is used in a broad sense here. It does not only included wage earners, but also employers, own account workers, unpaid family workers etc.

derives the interpolation functions. These functions are used to extrapolate the participation rates by substituting the projected PEAMPEA's.

For women the ILO applies the same method. However, the statistical relationships are not as stable as for men. The participation rates generally decrease with PEAMPEA for the age 10 to 19 years and 55 years and older. For the age ranging between 20 and 54 years, the activity rates decrease with PEAMPEA until the latter reaches a value between 30% and 40%. At this level of participation rates, a further decrease in PEAMPEA is associated with a growing increase in the participation rate. These relationships are only valid for countries in which the activity rates for women are at least 30% relative to that of men. Based on the 1980 data the ILO regresses the participation rates for each age cohort on PEAMPEA. These functions are used to extrapolate the participation rates until 2030. For those 28 countries for which this is not the case, the ILO uses other methods, see ILO (1990) for details.

4 Participation rates: our method

Our aim is to extrapolate participation rates until 2050, because some of our scenarios and analysis run to 2050. The only data available are the years 1950, 1960, 1970, 1980, 1990 and 1995. The years 2000 and 2010 are ILO projections. The latter are also based on historical data. These data are available for both males and females and for 12 age cohorts.[5] For all 66 country/regions of the GTAP data set (see Dimaranan and McDougall (2002)) we make projections of each of the 24 cohorts before aggregating them to macro participation rates for the regions we discriminate in WorldScan .[6]

For several reasons we do not follow the old ILO method using an indicator for economic development as a predictor for participation for several reasons. First of all, this method used in round 3 for projections until 2030 does not incorporate the new ILO projections for 2000 and 2010. We can thus not use these new ILO projections in this method. Second, the share of the male labour force employed in agriculture remains constant at about 5% level from 2000 onwards for the OECD. As a result, participation rates in the OECD hardly change. Third, the used interpolation functions that predicted changes in PEAMPEA were based on data between 1970 and 1980. These differ from the functions for 1969 and 1979 using data between 1960 and 1970 and 1970 and 1980 respectively. Therefore it is unclear which interpolation function should be used to predict changes in PEAMPEA at later time periods.

[5] These are the age cohorts 10-14, 15-19, .. and 65+. The participation rates of the age cohorts 0-4 and 5-9 are ignored because these are negligible, see also ILO (2001).

[6] Appendix B gives an overview of these 66 countries/regions.

Therefore we extrapolate the current trends in participation rates between 1950 and 2010 until 2050. We estimate an auto-regressive model for the period 1950 to 2010. We use the estimation results to forecast the participation rates until 2050. First we transform the data using a logistic function, $y = \log(x/(1-x))$ for all sexes, age cohorts and countries/regions, x represents the participation rate. For those age cohorts which do not participate at the labour market in 2010 such as the age cohorts 10-15 in the OECD for both sexes - we ignore the data in the regression. We take the first differences of the variable y and estimate an first-order or second-order auto-regressive process for all age cohorts, and sexes in which the regions are pooled. We pool the data for two reasons. First, the trends in participation rates are similar in many regions. Participation rates for people between 10 and 20 years of age are decreasing, because educational attainment increases. Participation rates of elderly also decrease. Second, the time series per region, per sex and age cohort are very short. They consists of 7 or 8 data points only. By pooling the observations per age cohort and sex, the number of observations increases substantially. The data are presented in Section 5 together with the projections for each age cohort and sex.

From the data we eliminate the year 1995 because of the difference in time between two subsequent observations. Furthermore we include the projections of the ILO for 2000 and 2010. These data provide some additional information to the historical data, because the ILO estimates the trends for each country separately and uses also different algebraic functions. Moreover, the inclusion of these projections increases the length of the short time series. The AR(2) regression reads

$$dy_t = \alpha_0 + \alpha_1 dy_{t-1} + \alpha_2 dy_{t-2} + \epsilon_t$$

in which dy_t $(= y_t - y_{t-1})$ represents the first difference of the transformed participation rate per cohort and sex. ϵ_t represents a disturbance term with mean zero and variance σ^2.

The regression has been carried out for two country groups. First of all we have a pool estimation for 6 WorldScan Non-OECD regions[7]. Secondly 40 separate OECD countries, East European countries and the countries of the Former Soviet Union (called OECD from now on) have been pooled for an estimation. We do the pool estimation for these countries together, since they all have a similar picture concerning ageing (see figure 2.3). Table 4.1 and 4.2 present the estimation results of all age cohorts for men and women, respectively in the 6 non-OECD regions. Table 4.3 and 4.4 show the results per cohort group for both sexes in the 40 OECD

[7] These regions are Latin America, Sub-Saharan Africa, Middle East & North Africa, China, South-East Asia and South Asia & Rest.

countries. For nearly all estimated equations the constant term and the coefficient are significant at the 95% level. Only for the cohorts men 20-24 and 30-34 and women 55+ the coefficient is not significant in the non OECD. In these cases the equation has no explanatory power. For the OECD countries the estimations for the younger male age-cohorts (until 24) and 65+ do not produce significant coefficients.

For some cohorts the estimation results can probably be improved by other specifications. First of all we estimate an AR(2) process in first differences for all age cohorts and sexes in the non OECD regions. The estimation results do not improve compared to those in Table 4.1 and Table 4.2. For nearly all cohorts the estimated coefficient of the second lag is not significant. Second, the current specification in equation (1) implies that participation rates are rising or declining in time - depending on the cohort -, but does not include turning points. In our projections until 2050 this do not appear to be a serious problem.

For particular cohorts other improvements are possible. It is however not our aim to do an in-depth analysis of labour market participation of the various age cohorts. We carry out these estimations in order to forecast participation rates at the macroeconomic level for our scenario studies with WorldScan.[8] The forecasts per age cohort and sex are only an intermediate step in that process. Improved forecasts for a particular age cohort by means of better estimation results will nearly have no effect on the forecasted macro participation rates.

[8] For this reason it was also possible to estimate an auto-regressive process on the macro participation rates pooled by the regions. In that case we would have ignored age-specific trends in the participation rates and the changes in the population structure. The latter ones drive most of the changes in macro participation rates.

Table 4.1 Estimation results of participation rate of men per age cohort in six non-OECD regions, 1950-2010

Cohort	Constant term	Coefficient	Adj R^2	D.W.
10-14	-0.02 (0.06)	1.22 (0.17)	0.65	2.07
15-19	-0.10 (0.04)	0.59 (0.13)	0.42	2.06
20-24	-0.11 (0.04)	0.30 (0.16)	0.08	2.43
25-29	-0.06 (0.02)	0.47 (0.17)	0.19	1.95
30-34	-0.05 (0.02)	0.33 (0.19)	0.06	2.15
35-39	-0.04 (0.02)	0.13 (0.19)	-0.02	2.38
40-44	-0.06 (0.02)	0.27 (0.19)	0.04	2.45
45-49	-0.06 (0.02)	0.35 (0.17)	0.10	2.54
50-54	-0.08 (0.03)	0.29 (0.18)	0.05	2.40
55-59	-0.08 (0.03)	0.45 (0.16)	0.20	1.65
60-64	-0.06 (0.03)	0.57 (0.12)	0.42	1.88
65+	-0.12 -0.05	0.38 (0.18)	0.11	2.52

standard errors between brackets

Table 4.2 Estimation results of participation rate of women per age cohort in six non-OECD regions, 1950-

Cohort	Constant term	Coefficient	Adj R^2	D.W.
10-14	-0.06 (0.05)	1.16 (0.14)	0.71	1.93
15-19	-0.04 (0.03)	0.56 (0.17)	0.25	2.14
20-24	0.06 (0.02)	0.71 (0.14)	0.47	1.92
25-29	0.08 (0.03)	0.68 (0.14)	0.44	2.17
30-34	0.09 (0.03)	0.64 (0.15)	0.36	2.21
35-39	0.08 (0.03)	0.70 (0.13)	0.51	2.11
40-44	0.07 (0.03)	0.60 (0.15)	0.35	2.45
45-49	0.08 (0.03)	0.44 (0.16)	0.17	2.51
50-54	0.05 (0.02)	0.48 (0.16)	0.23	2.60
55-59	0.03 (0.02)	0.27 (0.18)	0.04	2.44
60-64	0.00 (0.03)	0.18 (0.18)	0.00	2.41
65+	-0.09 (0.03)	-0.10 (0.19)	-0.03	2.36

standard errors between brackets

Table 4.3 Estimation results of participation rate of men per age cohort in forty OECD regions, 1950-2010

Cohort	Constant term	Coefficient AR(1)	Coefficient AR(2)	Adj R^2	D.W.
10-14	-0.42 (0.23)	0.53 (0.31)		0.04	2.27
15-19	-0.15 (0.03)	0.12 (0.07)	0.15 (0.06)	0.06	1.99
20-24	-0.16 (0.02)	0.09 (0.06)		0.01	2.41
25-29	-0.17 (0.02)	-0.19 (0.06)	-0.06 (0.06)	0.04	1.45
30-34	-0.13 (0.02)	0.18 (0.06)	-0.12 (0.05)	0.07	2.52
35-39	-0.06 (0.02)	0.15 (0.06)		0.03	2.11
40-44	-0.07 (0.02)	0.30 (0.06)	-0.11 (0.06)	0.11	2.49
45-49	-0.05 (0.02)	0.24 (0.06)		0.07	2.22
50-54	-0.09 (0.02)	0.29 (0.06)		0.10	2.32
55-59	-0.15 (0.02)	0.29 (0.06)		0.10	1.91
60-64	-0.31 (0.05)	0.20 (0.07)	-0.14 (0.07)	0.05	1.73
65+	-0.33 (0.04)	0.12 (0.07)		0.01	2.02

standard errors between brackets

Table 4.4 Estimation results of participation rate of women per age cohort in forty OECD regions, 1950-2010

Cohort	Constant term	Coefficient AR(1)	Coefficient AR(2)	Adj R^2	D.W.
10-14	-0.52 (0.24)	0.30 (0.37)		-0.01	2.76
15-19	-0.19 (0.02)	0.16 (0.06)		0.03	1.96
20-24	0.09 (0.03)	0.04 (0.07)	-0.14 (0.07)	0.01	2.40
25-29	0.26 (0.04)	0.23 (0.07)	-0.22 (0.07)	0.09	2.03
30-34	0.33 (0.05)	0.23 (0.07)	-0.21 (0.07)	0.10	2.23
35-39	0.34 (0.05)	0.25 (0.06)	-0.24 (0.06)	0.14	2.05
40-44	0.33 (0.05)	0.33 (0.06)	-0.28 (0.06)	0.19	2.38
45-49	0.28 (0.04)	0.29 (0.06)	-0.23 (0.06)	0.15	2.24
50-54	0.15 (0.03)	0.33 (0.07)	-0.19 (0.06)	0.15	2.10
55-59	0.02 (0.02)	0.27 (0.07)	0.06 (0.06)	0.11	2.09
60-64	-0.07 (0.02)	0.27 (0.06)		0.09	2.22
65+	-0.15 (0.03)	0.26 (0.06)		0.07	2.19

standard errors between brackets

5 Participation rates per age and cohort

This section presents the participation rates per sex and age cohort. Moreover, we discriminate participation rates for the OECD (including the transition countries) and for the non OECD. We present these results in order to understand the development of the age- and sex specific participation rates. However, these data and projections are primarily used for illustration. Above all we are interested in macro participation rates.

We show the ILO data between 1950 and 1990, ILO projections between 1990 and 2010 and our projections between 2010 and 2050 in one graph. Figure 4.1 presents the trends in participation rates per age cohort from the age cohort 10-14 until the age cohort 65+ in twelve graphs. Each graph contains the participation rates for men and women and for the OECD and for the non OECD. Each graph depicts thus four lines.

The participation rates in the age cohorts 10-14 and 15-19 decrease in time. In general the participation rates in the non OECD are higher than in the OECD, but the trend is going downwards. For the age cohort 10-14 the participation rates is nearly negligible in 2050 for the non OECD. Nowadays this is already the case in the OECD.

In the age cohorts 20-24 to 55-59 labour market participation rates of women rise while they decrease (slightly) for men. This decrease is substantial in the age cohort 20-24 because of increasing attainment at higher education. This tendency also seems to appear in the age cohort 25-29 although to a lesser extent. For the older age cohorts 50-54 and 55-59 male participation rates also decrease substantially, but for the younger age cohorts the decrease is very modest.

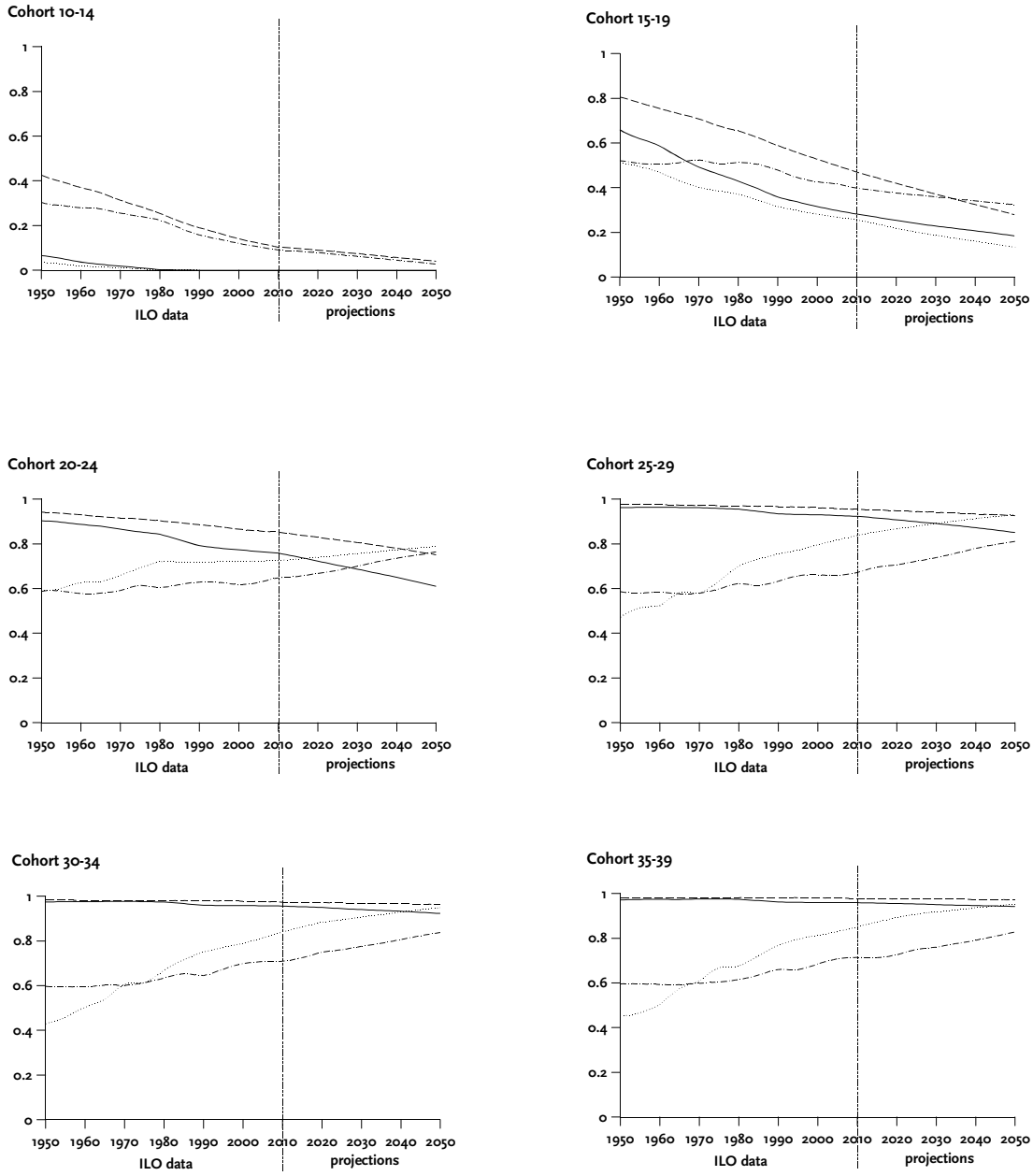
For the age cohorts 20-24 to 30-34 the participation rates of women in the OECD surpasses those of men in the OECD after 2020. This trend results from the strong upward trend in labour market participation of women in the OECD in our forecasts. We could try to improve these forecasts by using other specifications for the regressions in which the participation rates of men are used in estimating those of women. Then, participation rates of women could converge to those of men.[9] For the older age cohorts the participation rates seems to converge to the rates of men or excee them a bit.

For the age cohorts 60-64 and 65+ participation rates of men decrease sharply. Those of women remain constant in time or decrease slightly.

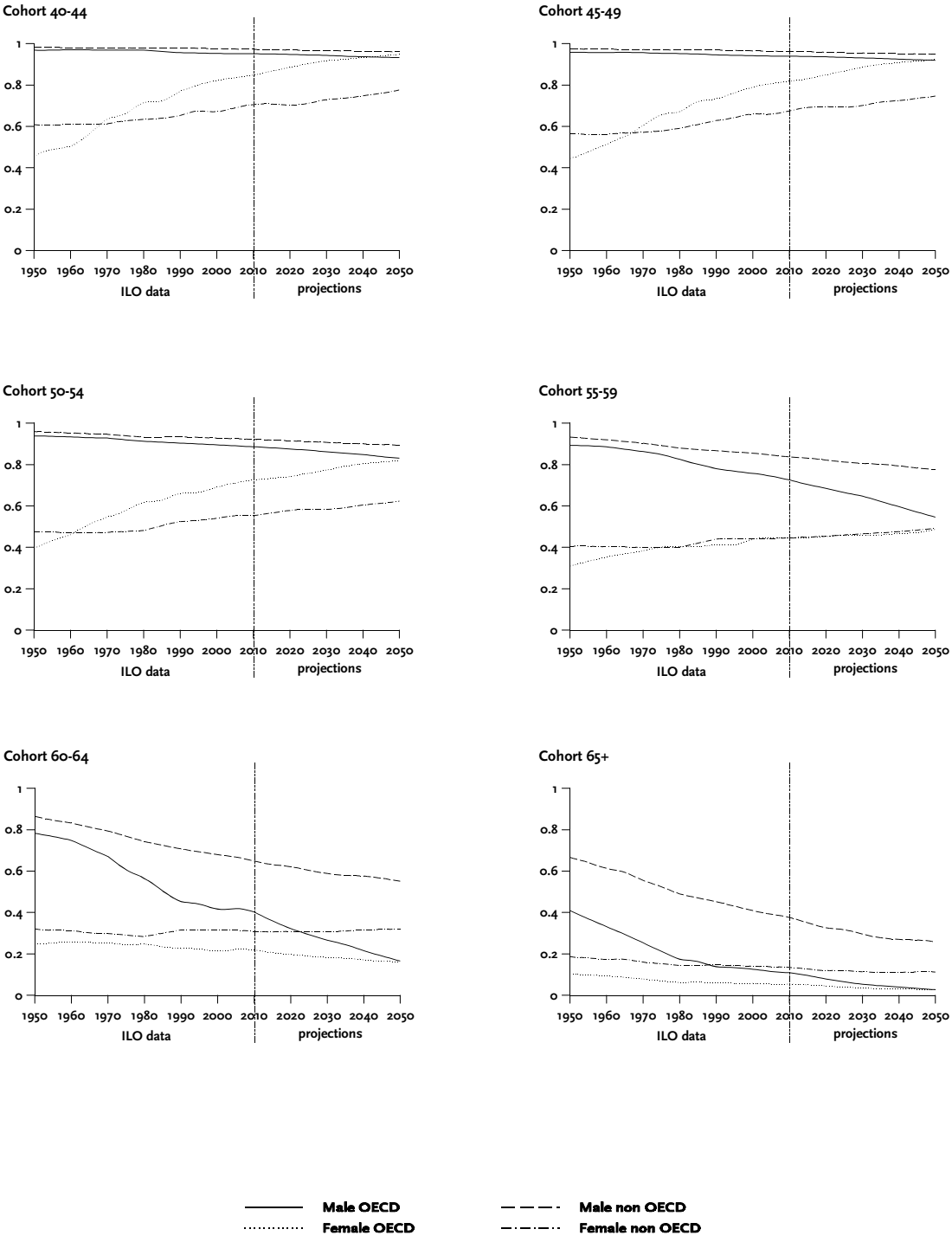
For all age cohorts the participation rates of men in the non OECD are higher than those in the OECD. For women this pattern only shows up between 1950 and 1980. From 1980 onwards female labour market participation in the cohorts from 20 to 54 is higher in the OECD than in the non OECD. This reflects the stronger rise in labour market participation of women in the OECD compared to the non OECD.

[9] It is unclear to which extent this assumption is very realistic. Moreover, which estimation procedure we would choose, the projecting period of about forty years is very long given the time period of the data of sixty years. In all cases the projections will be surrounded with a large degree of uncertainty.

Figure 5.1 Participation rate per age cohort and gender in OECD and non-OECD regions



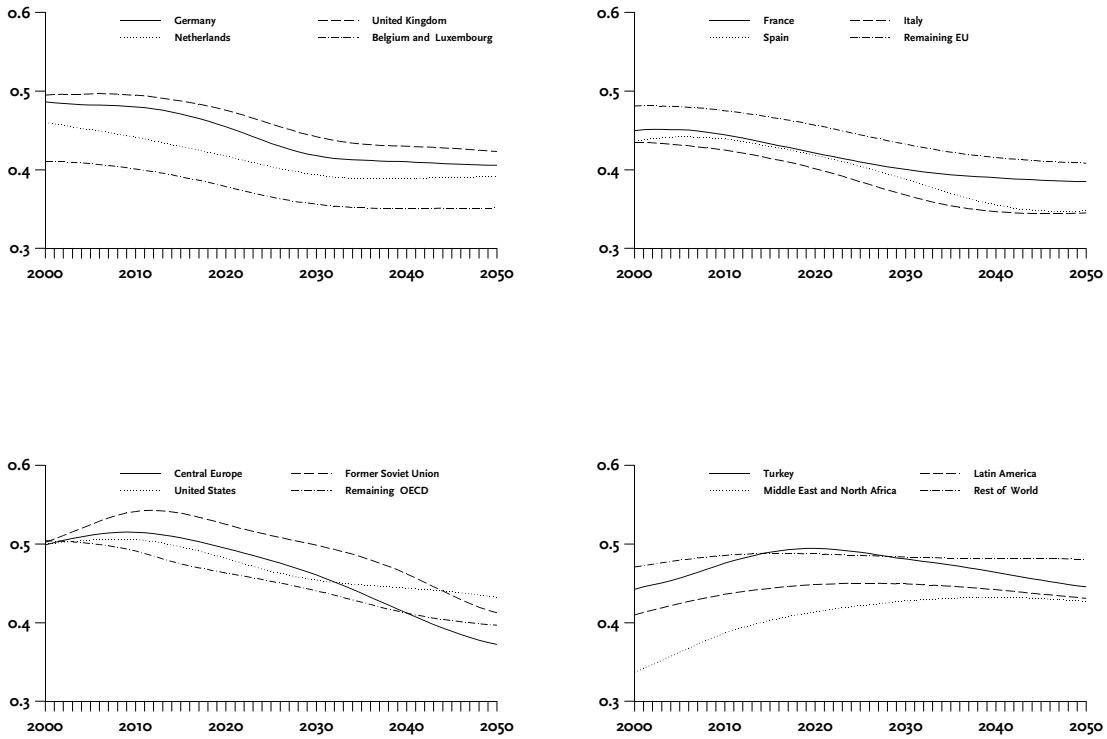
Participation rate per age cohort and gender in OECD and non-OECD regions (continued)



6 Projected macro participation rates

We use the estimated functions in Section 4 to project the participation rates in 2020, 2030, 2040 and 2050. For the specific age cohorts and sexes the results are presented in Section 5. This section presents the macro participation rates for the 16 regions in WorldScan.[10]

Figure 6.1 Participation rates for 16 WorldScan regions



The projections are surrounded with a substantial degree of uncertainty. Actual participation rates are influenced by various economic and cultural factors. Our mechanical projections cannot incorporate these influences. However, the extrapolation of trends seems to be more realistic than just keeping participation rates constant beyond 2010. For example, declining participation rates in the younger age cohorts as has been the case in the OECD countries and is the case in many developing countries now are heavily correlated with economic development and increasing attainment at the secondary school. As these developments will continue it seems more sensible to incorporate such trends also in the projections instead of assuming constant participation rates for each age cohort and sex from 2010 onwards.

[10] Appendix B explains the mapping between the 66 GTAP regions and those 16 regions.

Figure 6.1 shows that in nearly all countries 40% to 50% of the population participates at the labour market in 2000. In general participation rates decrease until 2050 to a range of 35% to 45% of the population. The exception is the Middle East and North Africa. Here participation rates are currently low because women do not enter the labour market. In time participation rates will increase. In Latin America and Turkey participation rates first increase and decrease later on. However, the participation rate of Latin America in 2050 is higher than in 2000.

In the OECD participation rates decrease. These follow the pattern of ageing although the steepness of the curves is less pronounced due to the increasing labour market participation of women. This offsets partly decreasing labour participation due to ageing. In Italy, Spain, Central Europe, Remaining OECD (including Japan) and the Former Soviet Union, decreasing participation seem to be a larger problem than in the other OECD countries.

7 Conclusions

This paper presents the new population numbers and macro participation rates for the 16 regions in WorldScan which we will use in our European scenario analyses. Moreover, we have discussed our method in deriving these projections and we have presented the data and projections for specific age cohorts, sexes, and differences between the OECD and non OECD. Because we have focussed on the macro participation rates the presented graphs on the age specific participation rates are primarily meant as a way of illustrating several trends. In this way the graphs are successful. They show clearly several trends going on for specific age cohorts, sexes and for the OECD and non OECD. We do not claim that our projections are very sophisticated. On the contrary, an in-depth analysis of labour market participation of specific age cohorts would require more efforts.

We are convinced that our simple regression analysis and projection method produces better projections for the macro participation rates than the old ones. However, our method has its limitations. First of all, the time horizon of the projections is very long given the time horizon of the data even if the latter include projections of the ILO for the years 2000 and 2010. Second, the estimation method using a first-order auto- regressive process is simple and does not include possible convergence of participation rates of men and women nor convergence between participation rates between the OECD and the non OECD. Third, all kinds of projected trends could be affected by changes in government policy. An example is the declining participation rates of the elder age cohorts in the OECD. Because of ageing, governments could try to increase these participation rates, such that the projected drops in these rates will not be realised.

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Appendix A: Data sources and preparation for estimations and simulations

1. Participation rates

- *Source:* "Economically Active Population, 1950-2010, Fourth Edition, Rev. 1, ILO, 2001", received as ZIP file from Messaoud Hammouya, ILO Bureau of Statistics. Used unzipped files: EAPM98.DAT for men and EAPW98.DAT for women, in the directory: P:\d_base_97\apop_org\ilo\input. On this file you will find the "Economically Active Population", the "Population" and the resulted participation rates for a great number of countries and genders for the years 1950, 1960, 1970, 1980, 1990, 1995, 2000 and 2010.
- *from DAT files to ISIS files:*

  ILODEMM98.BAT and ILODEMW98.BAT in the directory: P:\d_base_97\apop_org\ilo\run. This job produces two CDT files using GAWK: EAP98M.CSDT en EAP98W.CDT. Moreover two bat files are made, EAP98M.BAT en EAP98W.BAT which let ISIS run automatically. From this job these CDT files are translated to XIS files: EAP98M.XIS en EAP98W.XIS files.
- *Prepare a XIS file with participation rates of 66 GTAP regions and WKS files for the pool regression of participation rates per cohort:*

  Job: ILO2GTAP_WKS in directory P:\d_base_97\ilo_est\pad\execute.

  1. Transform EAP98?.XIS in ILO_?_1.WKS and ILO_?_3.WKS. In total we find 4 wks files, per gender respectively the population and the economically active population per cohort for the 8 years.
  2. Transform names, aggregation to 66 GTAP countries / regions and write participation rates per cohort en gender of these regions on a XIS file which will be used for prediction
  3. Transform names, aggregation of countries to 6 non OECD regions and calculation of participation rates per gender, 40 OECD countries / 6 Non OECD regions per cohort.
  4. Calculation macro participation rate en ageing index (equals pop > 65 / total pop.)
  5. Delete observations of 1995
  6. Prepare data for pool estimations (see input file for more information)
  7. Prepare WKS file per cohort (that means 12 files with both data for men and women including a macro participation rate and ageing index on each wks file
- *Pool estimations of participation rates per cohort and gender*

  Job: POOLCOMB.INP in directory P:\d_base_97\ilo_est\pad\eviews

1. Two pool estimations:
    a. 6 non OECD regions: MNA, SSA, LAT, CHI, SEA, en SAR
    b. 40 OECD countries: 23 OECD countries, 7 East-European countries and 15 countries of The former Soviet Union (the 3 Baltic countries are not included, because they are very small)
2. ad. a: only separate AR(1) and combined AR(1) and AR(2) estimations
   ad. b: as under a. but in both combinations we have added a simulation with an ageing index. Per gender we have 4 pool estimations.
3. In both cases we write coefficients and constant terms on a wks files. That means for case 1a we have 4 files, for case 1b we can find 8 files.
4. Finally the picked results will be written on wks files, incl. corrected R^2 en D.W. values to be used in tables in a CPB memorandum.
5. The estimation results are printed on the files: N_OES6_5.TXT en OEUFS_5.TXT.

- *Predict participation rates per cohort en gender per GTAP region for the years 2020, 2030, 2040 en 2050: the base participation rates*

  Job: ILO_2050B.INP in directory P:\d_base_97\apop_2000\pad\execute

  1. The 66 GTAP regions are split up in regions belonging to OECD and non OECD countries / regions.
  2. Participation rates of non OECD regions are predicted for the years 2020, 2030, 2040 en 2050 with coefficients and constant terms of WKS files (see for more information input-job)
  3. Participation rates of OECD countries / regions are predicted for the years 2020, 2030, 2040 en 2050 with coefficients and constant terms of WKS files (see for more information input-job)
  4. Linear interpolation of participation rates per cohort and gender for the 66 GTAP regions
  5. Export these participation rates to file: ILO_66_17B.XIS

- *Predict participation rates per cohort en gender per GTAP region for the years 2020, 2030, 2040 en 2050: the variant*

  Job: ILO_2050A.INP in directory P:\d_base_97\apop_2000\pad\execute
  See above, but participation rates for OECD countries is predicted using equations including ageing index in certain cohorts. (see for more information: input-job)

2. Population for all the countries in the world

- *Source:* "World Population Prospects: The 2000 revision", United Nations, Population Division, department of Economic and Social Affairs. Disk2: extensive set, February 2001.

  We have used 4 XLS files of the DB04_Population_ByAgeSex_Annual set:

  1. WPP2000_DB4_F2_AGE_ANNUAL_MALE_1950_2000.xls
  2. WPP2000_DB4_F2_AGE_ANNUAL_MALE_2001_2050.xls
  3. WPP2000_DB4_F3_AGE_ANNUAL_FEMALE_1950_2000.xls
  4. WPP2000_DB4_F3_AGE_ANNUAL_FEMALE_2001_2050.xls

  These files can be found on the CD rom:
  \\Cdrom05\un_wpp\WPP2000_EXCEL_FILES\DB04_Population_ByAgeSex_Annual

- *Adjustments and transformation to XIS files*

  1. Files are copied to: P:\d_base_97\apop_org\un2000\input
  2. In EXEL files are transformed to TXT files: ML_50_00.txt, ML_01_50.txt, FM_50_00.txt and FM_01_50.txt in the same directory.
  3. Run bat file: UN2000DEM.BAT in the RUN directory. This job uses a GAWK program to transform the txt files to country asci files (CDT files) in the two sub-periods with population data per cohort and gender . Hereafter an ISIS job per gender automatically starts to translate the ASCI files to four XIS files: ML_50_00.xis, ML_01_50.xis, FM_50_00.xis and FM_01_50.xis in the XIS directory.

- *Preparation to population data for 66 GTAP regions*

  Job: POP_66_17.INP in directory P:\d_base_97\apop_2000\pad\execute

  1. Read in the four above mentioned XIS files and express the population data in million persons.
  2. Create a cohort older then 80 years for the period 1950-2050
  3. Aggregation of population data per gender and 17 cohorts to 66 GTAP regions of version 5. Population of Taiwan is set to zero since no data are available on the UN diskette.
  4. Solve model and write results per gender and cohort to POP66_17.XIS file in the XIS directory.

3. Population for 15 EU countries

- *Source:* "Eurostat new national baseline population scenarios", Eurostat 2000.

We have copied the original file from the unit "arbeid" H:\a_arb\bev\eurostat\2000\rev99pop.xls to the P:\d_base_97\apop_org\eurostat2000\input directory.

- *Transformation of XLS file to WK1 files per country, readable for ISIS*
  1. In P:\d_base_97\apop_org\eurostat2000\input directory, the XLS file contains population data per age, and gender for 15 EU countries and for the period 1999-2051 (1st January). In EXEL they are transformed to 15 separate WK1 files, with names: ZZ???, in which ???= 3 letter code of EU countries.
  2. Run ORIG.ISI in ISIS 15 times, replacing each time the 3 letter code. This results in 15 readable wk1 files for ISIS: N???.WK1. On this file you will find population per age, gender for the period 1999-2051 on the 1st January.
- *Preparation to population data for 15 EU countries*

  Job: EUROS15_17.INP in directory P:\d_base_97\apop_2000\pad\execute
  1. Read each country wk1 file in and rename the names to unique names
  2. Aggregate the population per year to 5 year cohort numbers and express the numbers in million persons.
  3. Move the observations from 1st January to 1st July of each year.
  4. Store results on EUSTAT_17.XIS file.

4. High skilled ratio's for 12 WorldScan regions

Job: BL_AF4C.INP in directory: P:\d_base_95\apop_95\execute

This job is written in SIMPC and has not been adjusted to the ISIS language. Here we limit us to simply mentioning this job. For further documentation we refer to this job. Output for this job can be found in EDU_ARI.WKS in the input directory

Note: The most important source of this variable is the Barro and Lee database for the period 1960-1995. Recently this database has been updated and can be downloaded from the web. The database can also be found at: P:\poverty\data\barro_lee.

6. Compose demographic data set: the basic database

Job: POP_16B.INPin directory P:\d_base_97\apop_2000\pad\execute

1. Read in 3 XIS files
   - ILO66_17B.XIS (the participation rates without estimation of age index)

- POP66_17.XIS (the population estimations according to UN-2000)
- EUSTAT17.XIS (The population of EU15 according to Eurostat 2000)

2. Overwrite population numbers of EU countries by those of Eurostat for the period 1999-2050.
3. From the actual population number and the estimated participation rates per 66 GTAP countries / regions, cohort and gender we calculate the labour supply.
4. Aggregate population and labour supply to the 16 WorldScan regions European scenario project
5. Calculate macro participation rate per country / region
6. Read high skilled ratio from 12 old WorldScan regions from: D_BASE_95\APOP_95\INPUT\EDU_ARI.WKS
7. All European countries regions are assumed to have the same high skilled ratio as the Western Europe region of the old database. The rate of Turkey equals the one of Middle East and North Africa. Give other names and do an linear interpolation.
8. Compose Rest of World from Asian and African regions.
9. Solve model and write results for 1995-2050 on POP_16B.XIS
10. Solve model without high skilled ratio and write results on POP_16B_PL.XIS for 1950-2050 for figures in CPB memorandum

7. Compose demographic data set: the variant database

Job: POP_16A.INPin directory P:\d_base_97\apop_2000\pad\execute
This job is composed to prepare a data base for the period 1950-2050 for a possible variant. It is almost identical to POP_16B.INP.

8. Prepare files for the figures of CPB memorandum

Job: POP_16_PL.INPin directory P:\d_base_97\apop_2000\pad\execute
This job creates WKS files for the several figures in CPB memorandum. Apart from these files, WKS files are also produced to show the effects of introducing an ageing index in the pool estimation of the OECD regions. These figures are not included in the memorandum, since the result did not have the desired effect.

Appendix B: Aggregation template between GTAP 5 and WorldScan 16 regions

WorldScan 16 European scenario's regions

DEU	Germany
FRA	France
GBR	United Kingdom
NLD	Netherlands
BLU	Belgium and Luxembourg
ITA	Italy
ESP	Spain
REU	Remaining European Union
CEA	Central Europe
FSU	Former Soviet Union
TUR	Turkey
USA	United States
ROE	Remaining OECD
LAT	Latin America and Mexico
MNA	Middle East and North Africa
AAR	Rest of World

Regional Aggregation Mapping

Australia	ROE
New Zealand	ROE
China	AAR
Hong Kong	AAR
Japan	ROE
Korea, Republic of	AAR
Taiwan	AAR
Indonesia	AAR
Malaysia	AAR
Philippines	AAR
Singapore	AAR
Thailand	AAR
Viet Nam	AAR
Bangladesh	AAR
India	AAR
Sri Lanka	AAR
rest of South Asia	AAR

Canada	ROE
United States	USA
Mexico	LAT
Central America and Caribbean	LAT
Colombia	LAT
Peru	LAT
Venezuela	LAT
rest of Andean Pact	LAT
Argentina	LAT
Brazil	LAT
Chile	LAT
Uruguay	LAT
rest of South America	LAT
Austria	REU
Belgium	BLU
Denmark	REU
Finland	REU
France	FRA
Germany	DEU
United Kingdom	GBR
Greece	REU
Ireland	REU
Italy	ITA
Luxembourg	BLU
Netherlands	NLD
Portugal	REU
Spain	ESP
Sweden	REU
Switzerland	ROE
rest of EFTA	ROE
Hungary	CEA
Poland	CEA
rest of Central European associates	CEA
former Soviet Union	FSU
Turkey	TUR
rest of Middle East	MNA
Morocco	MNA
rest of North Africa	MNA

Botswana	AAR
rest of SACU	AAR
Malawi	AAR
Mozambique	AAR
Tanzania, United Republic of	AAR
Zambia	AAR
Zimbabwe	AAR
rest of southern Africa	AAR
Uganda	AAR
rest of sub-Saharan Africa	AAR
rest of world	AAR

For a further disaggregation of the 66 GTAP regions to the 211 individual World Bank countries we refer to the documentation of the GTAP 5 data package (2002), chapter 8: Guide to the GTAP Data Base, to be downloaded at: http://www.gtap.agecon.purdue.edu/databases/v5/v5_doco.asp