

III. THE APPROACH: METHODOLOGY AND ASSUMPTIONS

As part of its regular work programme, the Population Division biennially prepares population estimates and projections for all countries of the world, with estimates for the period from 1950 to 1995, and with four projection variants for the period 1995 to 2050. The last such revision is published in *World Population Prospects: The 1998 Revision* (United Nations, 1999a, 1999b and 1999c).

The four projection variants in the *1998 Revision*, i.e., high, medium, low and constant, are prepared for countries and areas using the cohort-component method. The different variants are based on different assumptions about the future course of fertility. All variants incorporate the same assumptions about the future course of mortality and, for most countries, the assumptions about future international migration trends are also the same for all four variants.

The high, medium and low variants constitute the core of the official estimates and projections of the United Nations. They are meant to encompass the likely future path of population growth for each country and area of the world. The high and low variants provide upper and lower bounds for that growth. The medium variant is a useful central reference for trends over the longer-term future. The constant variant projects the population of each country by maintaining fertility constant at the level estimated for 1990-1995. The results of this variant are meant to be used for illustrative purposes and are not considered to represent a likely future path for any country or area.

Building upon the medium variant of the *1998 Revision*, the replacement migration study considers five different scenarios with regard to migration streams needed to achieve particular population objectives or outcomes. The five scenarios for the above-mentioned ten countries and regions are:

- Scenario I. The medium variant of the *1998 Revision*.
- Scenario II. The medium variant of the *1998 Revision*, amended by assuming zero migration after 1995.
- Scenario III. This scenario computes and assumes the migration required to maintain the size of the total population at the highest level it would reach in the absence of migration after 1995.
- Scenario IV. This scenario computes and assumes the migration required to maintain the size of the working-age population (15 to 64 years) at the highest level it would reach in the absence of migration after 1995.
- Scenario V. This scenario computes and assumes the migration required to maintain the ratio of the working-age population to the retired-age population (population 15-64 years divided by population 65 or older) at the highest level it would reach in the absence of migration after 1995.

The study examines the situation for eight countries, namely: France, Germany, Italy, Japan, Republic of Korea, Russian Federation, United Kingdom and United States. In addition, computations are also done for Europe and for the European Union, treating them as if they were each a single country from 1995 on. The time period covered is roughly a half a century, i.e., from 1995 to 2050.

All the data pertaining to the eight countries and two regions mentioned above for the period 1950 to 1995 come from the estimates in the *1998 Revision*. For the period 1995 to 2050, projections are carried out using the cohort-component method, taking as a base the 1995 population by sex and five-year age groups and applying the age-specific fertility and mortality rates assumed in the medium variant of the *1998 Revision*.

More specifically, the number of survivors in each age and sex category at the end of each five-year period is calculated by applying to the base-year population age- and sex-specific survival rates which are derived from an observed or estimated national life-table, using the United Nations model for future mortality improvement. The number of births expected to take place during each five-year period is derived by applying the estimated age-specific fertility rate, which is obtained from the national fertility pattern and assumed future fertility trend, to the average number of women in the age-group. The births are distributed by sex on the basis of the estimated sex ratio at birth. The assumed net number of international migrants, classified by age and sex, is incorporated into the calculations.

The detailed past results and future assumptions of the *1998 Revision* for each of the countries and regions examined in this study are presented in the annex tables. A detailed description of the methodology used for the estimates and projections may be found in *World Population Prospects: The 1998 Revision, volume III* (United Nations, 1999c).

The future population trends according to the medium variant are mainly determined by the assumed future course of fertility. For each of the countries and regions considered in this study, the total fertility rate is below replacement level, i.e., below 2.1 children per woman. For those countries whose latest estimated total fertility rate was between 1.5 and 2.1 children per woman (France, Republic of Korea, United Kingdom, and the United States), it is assumed that the fertility rate will move toward a target level of 1.9 children per woman and will remain constant to the end of the projection period, i.e., 2050. For those countries and regions whose latest estimated total fertility rate was less than 1.5 children per woman (Germany, Italy, Japan, Russian Federation, Europe and European Union), the fertility rate is expected to rise to a target level of 1.7 children per woman and remain constant thereafter. It should also be noted that the target total fertility rate was modified when there was information on the completed fertility of the cohort of women born in 1962. In those cases (France, Germany, Italy, Japan, Europe and European Union), the target level is set as the average of either 1.9 or 1.7 and the estimated completed fertility of the 1962 cohort. In general, recorded post-1995 trends in fertility were assumed to continue until the year 2000, and then stabilize at the 2000 level until 2005. After 2005, fertility was assumed to move toward the target level at a pace of 0.07 children per woman per quinquennium.

Scenario I, which is the medium variant of the *1998 Revision*, already has migration assumptions for the period 1995-2050. In each of the other four scenarios the net total number of migrants during each five-year period is computed so that the projected results meet the particular requirements of the scenario.

Scenario II assumes that the total net number of migrants is zero for each five year period. Scenario III involves computing the total net number of migrants for each five-year period needed to maintain the size of the total at the highest level it would reach in the absence of migration after 1995. Scenario IV determines the total net number of migrants for each five-year period required to maintain the size of the working age population (15-64 years) at the highest level it would reach in the absence of migration after 1995. Finally, scenario V computes the total net number of migrants required to maintain the ratio of the working age population to the retired age population, that is those 15-64 years old divided by those 65 years or older) at the highest level it would reach in the absence of migration after 1995.

Another critical assumption concerns the age and sex distribution of the total net number of migrants. The age and sex structure of the migrants is assumed to be the same for all countries. This

assumption, while unlikely, permits comparisons among the countries and regions. It is assumed that the structure of the migration streams is the average age and sex structure of migrants into the United States, Canada and Australia. These three countries were selected because they are the three major traditional countries of immigration.

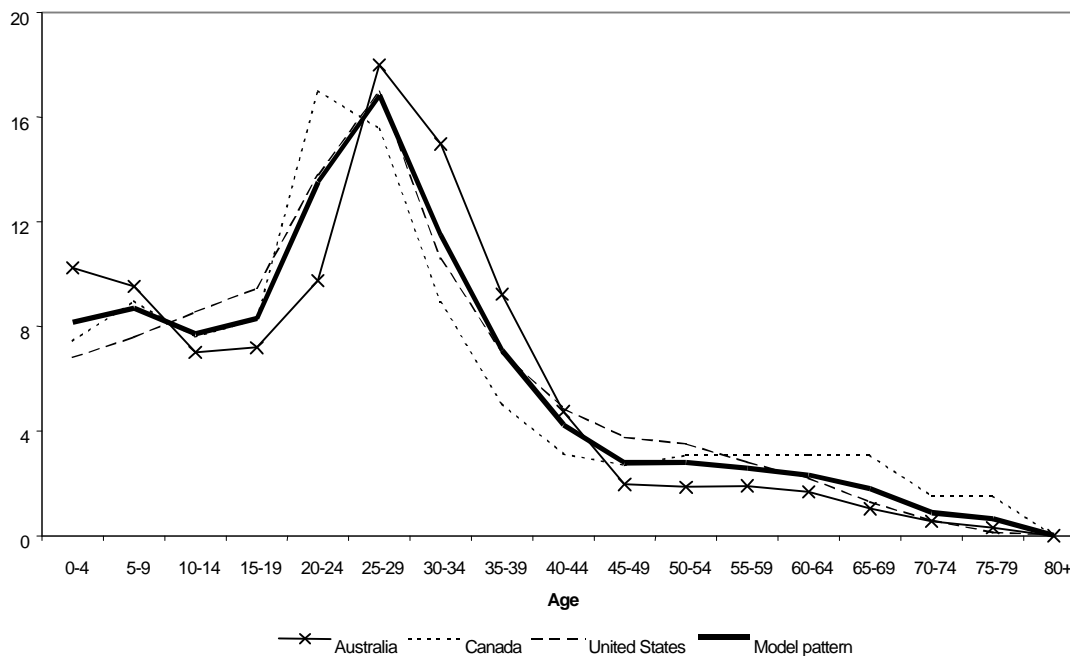
The age structures of the three countries and their average, or model pattern for this study, are shown for males and females in figures III.1 and III.2, respectively. The per cent distribution by age and sex of the immigrants in the model pattern, which are used in the scenarios, is shown in table III.1 and illustrated as an age-sex pyramid in figure III.3.

The projection methodology also assumes that, after the immigrants arrive in a country, they experience the average fertility and mortality conditions of that country. While this is typically not the case, especially when immigrants come from a country that differs greatly demographically from the receiving country, this assumption permits computations to be more straightforward and also facilitates comparisons between countries and regions.

Figure III.1. Per cent distribution of male immigrants by age in Australia, Canada, United States of America and model pattern



Figure III.2. Per cent distribution of female immigrants by age in Australia, Canada, United States of America and model pattern



NOTE: The model pattern is the average of the three countries.

TABLE III.1. PER CENT DISTRIBUTION OF NET NUMBER OF MIGRANTS
BY AGE AND SEX, MODEL PATTERN

Age groups	Males	Females	Both sexes
0-4	4.33	4.29	8.63
5-9	4.69	4.58	9.26
10-14	4.24	4.06	8.30
15-19	3.94	4.37	8.31
20-24	5.13	7.12	12.25
25-29	7.79	8.86	16.65
30-34	6.01	6.05	12.06
35-39	3.95	3.73	7.68
40-44	2.27	2.24	4.51
45-49	1.28	1.47	2.76
50-54	0.91	1.48	2.40
55-59	0.88	1.37	2.25
60-64	0.83	1.22	2.05
65-69	0.60	0.95	1.55
70-74	0.30	0.47	0.77
75-79	0.21	0.34	0.56
80+	0.01	0.01	0.02
Total	47.40	52.60	100.00

Figure III.3. Age-sex pyramid of immigrants, model pattern

