III. THE APPROACH: METHODOLOGY AND ASSUMPTIONS

A. THE SIX SCENARIOS

As part of its regular work programme, the Population Division prepares population estimates and projections biennially 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 can be found in *World Population Prospects: The 1998 Revision* (United Nations, 1999a, 1999b and 1999c).

The four projection variants in the *1998 Revision* (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 create a range that encompasses 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 present replacement migration study considers six different scenarios with regard to the migration streams needed to achieve particular population objectives or outcomes. The six scenarios are described below:

Scenario I. This scenario is based on the medium variant of the *1998 Revision*.

Scenario II. This scenario is based on 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 prevent the ratio of the size of the population aged 15-64 to the size of the population aged 65 or over, called the potential support ratio (PSR), from declining below the value of 3.0.

Scenario VI. This scenario computes and assumes the migration required to maintain the potential support ratio (PSR) at the highest level it would reach in the absence of migration after 1995.

The study examines the situation for eight countries: France, Germany, Italy, Japan, Republic of Korea, the Russian Federation, the United Kingdom and the United States. In addition, from 1995 on computations are also made for Europe and for the European Union, treating each as if it was a single country. The time period covered is roughly a half a century, 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 that 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 the replacement level of 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, the United Kingdom and the United States), it is assumed that the fertility rate will move towards a target level of 1.9 children per woman and will remain constant to the end of the projection period, 2050.   For those countries and regions whose latest estimated total fertility rate was less than 1.5 children per woman (Germany, Italy, Japan, the Russian Federation, Europe and the 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 information was available on the completed fertility of the cohort of women born in 1962. In those cases (France, Germany, Italy, Japan, Europe and the European Union), the target level was 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 towards 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 five 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. Scenario V computes the total net number of migrants required to prevent the ratio of the population aged 15-64 to the population aged 65 or over from declining below 3.0. Finally, scenario VI

computes the total net number of migrants required to maintain the potential support ratio 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 Australia, Canada and the United States. 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 3 and 4 respectively. The per cent distribution by age and sex of the immigrants in the model pattern, which is used in the scenarios, is shown in table 4 and illustrated as an age-sex pyramid in figure 5.

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 3. Per cent distribution of male immigrants by age in Australia, Canada,
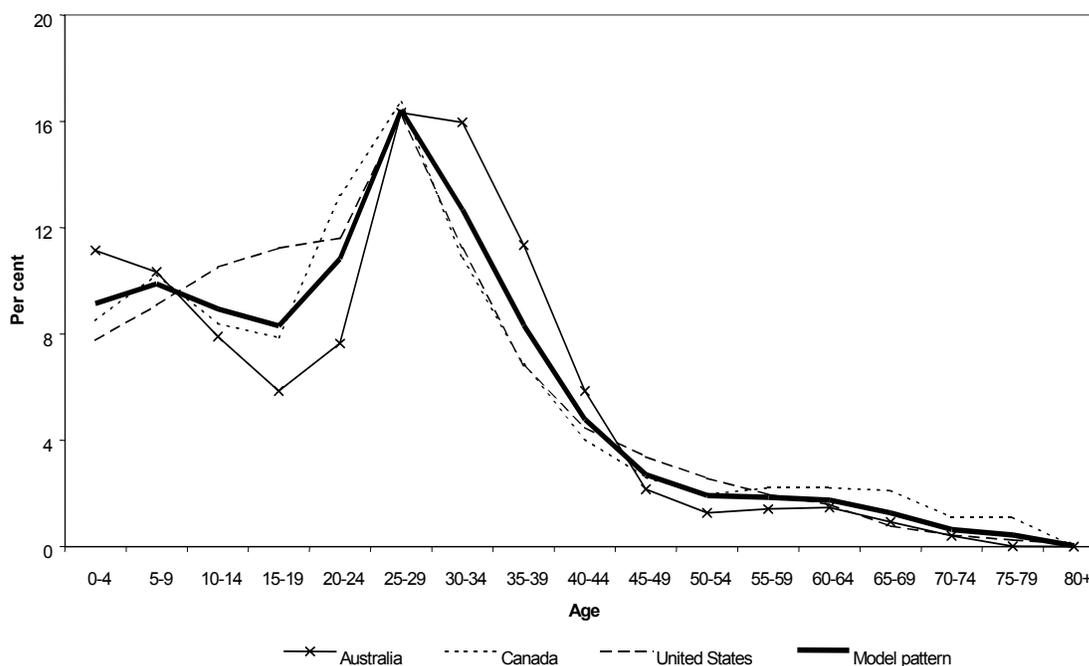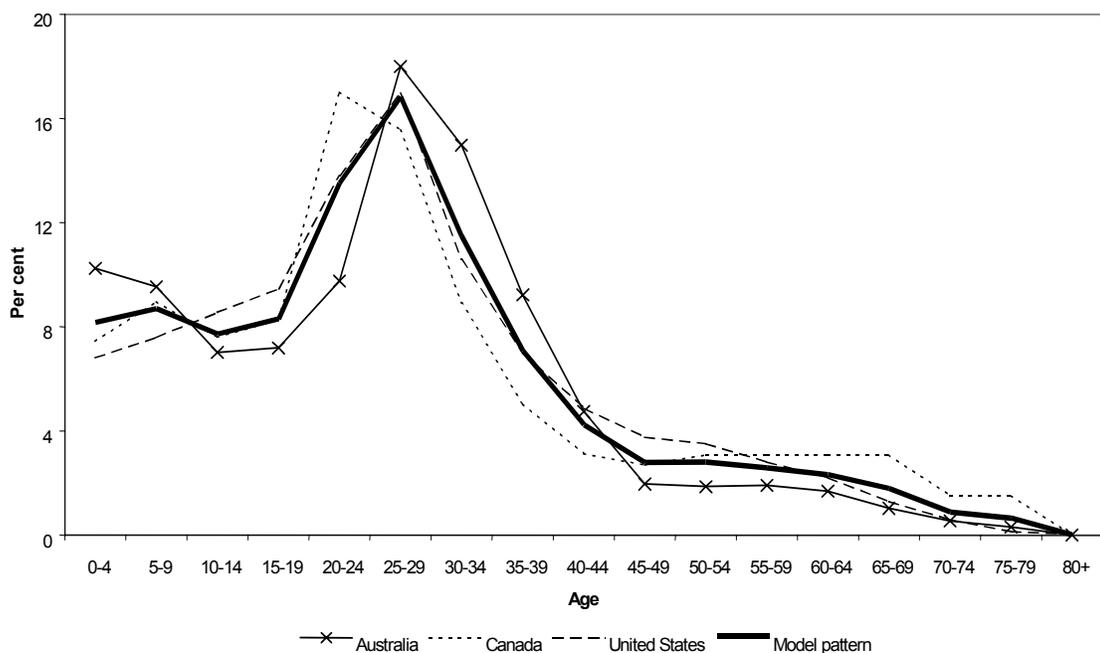United States of America and model pattern**

**Figure 4. Per cent distribution of female immigrants by age in Australia, Canada,
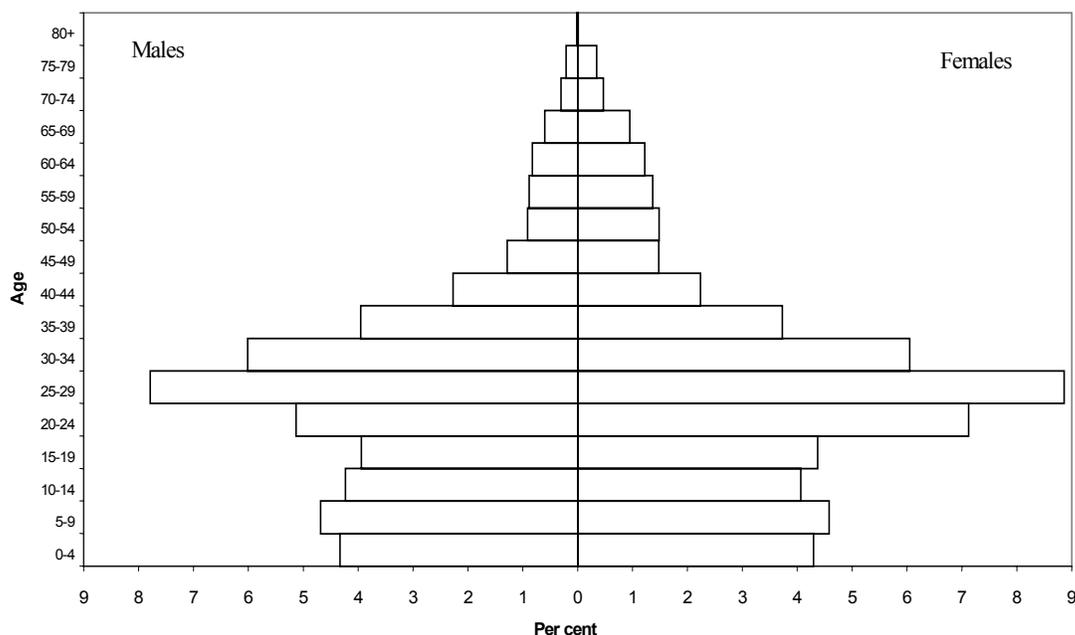United States of America and model pattern**

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

TABLE 4. 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 5. Age-sex pyramid of immigrants, model pattern

B. THE IMPACT OF ECONOMIC ACTIVITY RATES ON SUPPORT RATIOS

In recent discussions about the impact of population ageing on the economically active, it has been mentioned that increasing economic activity rates could to a large extent counterbalance the effects of the transformation of the age structure. A special simulation was carried out to analyse the possible impact of changing economic activity rates on support ratios.

The potential support ratio (PSR) measures the potential numbers of active persons per each retired person, assuming that everybody aged 15-64 is economically active and that everybody aged 65 or over is no longer active. The ratio provides an indication, across country and time, everything else being assumed equal, of the impact of an age structure on old-age dependency.

Economic activity rates, however, are not uniform and vary by age and across countries. The active support ratio (ASR) measures the number of active persons aged 15 or over for each non-active person aged 65 or over, taking into account observed age-specific activity rates. In contrast to the PSR, the ASR more closely reflects in relative terms the number of active persons per each inactive elderly person.

In order to measure the maximum theoretical gain that could be obtained by increasing activity rates between age 25 and 64, the ASR resulting from the assumption that the entire population aged 25 to 64 is active economically has been computed and is named ASR1. ASR1 therefore represents 100 per cent economic activity rates for men and women in the age groups 25 to 64. The starting points were the age-specific activity rates reported for the year 1998 in the eight countries of this study.