

World Population Changes from 1990 to 2005 Viewed Through the Stationary Population Equivalent.

The Stationary Population Equivalent, SPE, is the population a country or any other population would have if mortality remains constant at some predetermined level and fertility changes to a replacement level appropriate for that mortality and thereafter remains constant. Neither the mortality rate nor the fertility rate need be currently applicable to that population. As used in this paper the SPE is as sum of the female population by age times the number of future female children a woman of that age would have times the number of generations alive at any one time. This gives the female stationary population, a final adjustment is then made to add the males.

A major advantage of the SPE measure is that comparisons can be made between times and countries using only the age structure and total population. This requires only that the same fertility and mortality schedules be used for the populations being compared. For this paper I use all of the countries of the World and follow their changes in actual population and the SPE from 1990 to 2005. I use the International Data Base of the US Census Bureau, 4/30/04 release, to provide the age structures and total populations of the 227 countries. In a few cases where the age structures in this data base are not included some estimates have been made.

For all calculations in this paper I assume a life expectancy for females of 79.41, for males 72.73, a sex ratio at birth of 1.046 and a fertility schedule with a mean age of childbearing of 26.446. The number of generations is thus 3.0003. Adding males yields 5.879 for the SPE value of a female birth. These schedules represent conditions in the United States around 1990 and were chosen to represent current mortality and fertility schedules of developed countries.

The weights for women as used in this paper to reflect their impact on the future SPE stationary population are as follows:

Age	0-5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
SPE	5.921	5.929	5.932	5.600	4.193	2.499	1.057	.272	.029	.0002

The numbers initially rise to reflect the impact of survival peaking at ages 10-14. Starting at the beginning of childbearing the numbers fall rapidly during the twenties to reflect the impact of children women have already had. Women past 35 have little impact on the SPE.

I define the momentum in the age structure as the difference between the actual population and the SPE for a country in any given year. This allows the division of population growth into two parts, that associated with using up momentum and that associated with the growth in the SPE. These can be interpreted as growth due solely to the non-stationary of the age structure and growth which with either above replacement fertility or immigration.

For example in the United States for the years 1990 to 1995 population grew by 16.4 millions from 250.1 to 266.6, while the SPE grew by only 10.2 million from 285.8 to 296.0. Thus the US momentum decreased by 6.2 million from 37.7 to 29.5. In other words 37.7% of US growth during this period was using up the momentum of past above replacement fertility or migration and not growth that could be reflected in the potential for further population growth.

When looking solely at population growth the last fifteen years have not been very dramatic. For the 172 less developed countries in the International Data Base, population growth has declined slowly from 381.3 million, or 1.78% per year from 1990 to 1995 to 353.1 million or 1.41% per year from 2000 to 2005. However change in SPE growth during this period has been dramatic. From 1990 to 1995 SPE growth was essentially the same as actual growth 364.9 million or 1.77% per year. By 2000-2005 this rate of growth had decreased to 209.1 million or .86% per year. What this means is that much of the population growth particularly in the 2000-2005 period is using up of momentum. In each of the three periods the amount of momentum in the less developed world decreased substantially. The amount of this decrease accelerated, from 16.3 million from 1990 to 1995 to 144.1 million from 2000-2005. This means that an increasing proportion of population growth in the less developed countries does not reflect a potential for future growth, but reflect the consequences of past high fertility. From 2000 to 2005 fully 40% of all population growth in the less developed countries reflects this decline.

The countries of the World can be divided into five broad categories using population, SPE and momentum growth. First there are the continuing high fertility countries. They have similar growth of all three measures. Generally the SPE is between 2.0 and 1.8 times the actual population. Momentum is growing and practically as large as the population. In this case the actual growth underestimate the potential for future growth.

The second group of countries shows the beginning of declining fertility, the SPE is growing slower than fertility. Momentum is still growing but a declining rate. Such countries have ratios of SPE to actual of around 1.5.

The in the third group of countries fertility has declined still further, now momentum starts to decline. A portion of population growth is explained by using up momentum. Population growth overestimates the potential for future growth. The ratio of SPE to actual population is now around 1.2.

In the next stage the SPE is not growing, fertility is below replacement and not balanced by immigration. Thus all population growth is explained by using up momentum. Not only does population growth overestimate the potential for future growth, but the sign is reversed. The potential for future growth is declining.

The fifth category are countries where the population is declining. The SPE generally also declines. The sole exception in the data used in the study is Albania from 1990-1995, which was subject to unusual migration patterns. In this stage SPE populations are often less than the actual population.

Table 1. Gives the distribution of countries for the developed and less developed countries among this five group for the period 1990-1995, 1995-2000, 2000-2005.

55 Developed Countries

	Group 1	Group 2	Group 3	Group 4	Group 5.
1990-1995	1	2	14	27	11
1995-2000	0	3	9	31	12
2000-2005	0	1	11	32	11

172 Less Developed Countries

	Group 1	Group 2	Group 3	Group 4	Group 5.
1990-1995	51	54	31	27	9
1995-2000	40	53	41	27	11
2000-2005	31	51	42	41	6

What table 1 shows is that there is very little change during this period in the developed countries, with over half the countries with either negative population growth or in group 4 with negative SPE growth and population growth which is all using up momentum. For the majority of the population in the less developed countries there have been more substantial changes, thus there has been a significant decrease in the number of countries in group one, countries which continue to increase the amount of their momentum, and a corresponding increase in countries in groups 3 and 4, with sharply decreasing momentums, where all or most of reported population growth occurs because of the using up of momentum.

Conclusions. The SPE is very easy to calculate and can be used both to measure the amount of future population growth inherent in the age structure and to divide that which is due to immigration and above replacement fertility and population growth which occurs due to using up the momentum in the population.

The period 1990-2005 was significant for world population dynamics particularly in the less developed world in that a increasing proportion of that growth is due to the using up of the momentum in the age structure. Thus while the actual population growth has not changed significantly, the proportion of that growth due to using up momentum has increased substantially. This means that the potential for future growth inherent in the age structure of the less developed world has substantially decreased and that a real sense population growth rates have declined.