

# Chapter 5: Population trends

## Forecasting population

Some forecasts have been successful but this is probably due to good luck. It is very hard to point out a long-range economic forecast that is nearly accurate. According to the United Nations (UN) we are entering a period of slowing population growth. They predict that the population size will be stabilized around the year 2200.

To make a forecast function some economists make use of two tools:

- The age-specific survivorship function
- The age-specific fertility function.

This method of forecasting is difficult because we cannot whether mortality and fertility will change in the future.

Improvements in mortality have a significant positive effect on the net rate of reproduction (NRR). However, in forecasting future population size this has a much lower effect. Another effect of an improvement of mortality is that if the number of births remains constant while people can live longer, there will be more people alive at a given time.

Fertility is usually forecasted relative to the **replacement fertility**. This is the level of fertility that is consistent with a constant population size in the long run. This replacement fertility is slightly higher in developing countries than in developed countries.

The UN predicted that over the next 50 years all countries would have a total fertility rate moving towards the replacement fertility. For poor countries this meant a severe decrease in fertility while for rich countries it would mean a severe increase in fertility.

The average total fertility rate in the Organisation for Economic Co-operation and Development (OECD) in 2009 was 1.74 children per woman. But the variation within this group was wide. Many discussions have risen whether it is natural to have fertility at the replacement level. The outcome of these discussions was no.

**Tempo effect:** A low total fertility rate does not necessarily mean that women are having fewer children. This is because a rise in the average age of childbirth affects the TFR.

From past experience we can see that forecasting fertility is very difficult. Past forecasts have been far away from actually outcomes today.

**Demographic momentum:** If the number of women in their reproductive years rises, then the number of babies born will also rise, even if the rate at which women are having babies stays constant.

With demographic momentum, the number of children born each year will increase rapidly. This leads to more people in the young age groups than in the older age groups. The highest demographic momentum is found in the countries with the highest fertility rates.

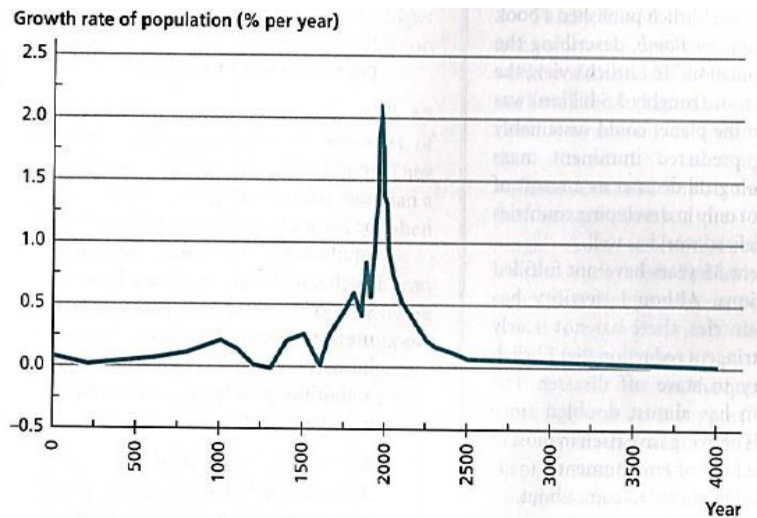
One way to measure demographic momentum is to use the fraction of the population under age 15. When this fraction is very large then the country will probably have rising population growth over the next decades.

Demographic momentum is an important factor in explaining population growth. However, in the future its importance diminishes and therefore we use fertility to determine population growth in the future.

'The great spike' in world population is located around the year 2000. For almost all years in human history, the growth rate of population was almost zero.

The population started to grow after the Industrial Revolution, around 1770. W.W.Rostow argues that this population growth will slow down to zero in the upcoming 200 years.

The great spike in world population can be seen in the next graph:



This slowdown of population growth is based on the power of compounding. If the population should continue growing at a 1% rate per year, then there would be a population of 45 billion in 2200 and 1 trillion by 2512. Such an outcome is viewed as impossible to many people. Rostow argues that the population growth will fall to zero but it could also be the case that growth will fall below zero. We cannot predict with certainty what will happen to population growth in the future.

### Economic consequences of demographic change

In the period 2000-2050 population growth is expected to be half of the growth rate in the previous 50 years. Below is a table representing average annual population growth in the different groups:

	1950 -2000	2000 - 2050
<b>More developed</b>	0.8%	0.0%
<b>Less developed</b>	2.1%	0.8%
<b>Least developed</b>	2.4%	2.1%

The decline in population growth will be most extreme in the less developed countries. Population growth is forecasted to fall to zero percent in the developed, rich countries.

We assume that population growth lowers the level of output per worker due to capital dilution. The steady-state income per worker in two countries with different growth rates is given by the equation:

$$\frac{y_i^{SS}}{y_j^{SS}} = \left( \frac{n_i + \delta}{n_j + \delta} \right)^{\alpha / (1 - \alpha)}$$

Where i and j denote the two countries with their growth rates of population, n. y represents the level of income per worker,  $\delta$  is the depreciation rate and  $\alpha$  is the capital exponent in the Cobb-Douglas production function.

This steady-state ratio increases when the value of the parameter  $\alpha$  increases. A higher parameter  $\alpha$  results from a reduced effect of capital dilution. A slowdown in population growth, by reducing the effect of capital dilution, will raise the pace of economic growth.

In the period 2000-2050 the median age of the population is expected to rise by almost 10 years. This is the result of declines in both mortality and fertility. The fraction of population consisting of children falls while the fraction of population consisting of elderly rises.

Populations in the world can be divided into three age categories:

1. Children (0-14)
2. Working age (15-64)
3. Elderly (65 and older)

The timing of the change in population structure differs among countries. In the more developed countries we already see a decline in the fraction of children and a high increase in the fraction of elderly. It is forecasted that in these countries there will be 1.7 times as many elderly as children in 2050. In the less developed countries there will also be a fall in fraction of children and a rise in fraction of elderly but in 2050 children will still outnumber the elderly.

To understand why population growth is relevant for economic growth we recall GDP per worker and GDP per capita:

$$GDP \text{ per worker} = GDP / \text{number of workers}$$

$$GDP \text{ per capita} = GDP / \text{total population}$$

Combining these two equations gives us:

$$GDP \text{ per capita} = GDP \text{ per worker} \times (\text{number of workers} / \text{total population})$$

From this we can conclude that differences in levels of GDP per capita between countries can result from different levels in GDP per worker or different ratios of workers to total population.

Labor force participation rates for children and elderly are very low and therefore the fraction of population that is of working age influences the fraction of the population that works strongly.

The change in the fraction of working-age people will affect the growth rate of income per capita. We assume that the fraction of people that works grows at the same rate as the fraction of the population that is of working age. With this information the following equation can be made:

$$\begin{aligned} \text{Growth rate of GDP per capita} &= \text{growth rate of GDP per worker} \\ &+ \text{growth rate of working-age fraction of population} \end{aligned}$$

Most developed countries have faced a period in which the working-age fraction increased and are now facing several decades of a decline in the working-age fraction.

The aging of population may have an effect on the nature of society itself. Teenagers and young adults account for the majority of criminals. As the population ages and the fraction of teenagers and young adults decreases, crime rates may fall.

A significant phenomenon is the shift in how the population of the world is distributed among countries. There is a change in relative population sizes. In the middle of the 17<sup>th</sup> century, Europe and Africa had roughly equal populations. But in the 250 years after that, Europe's population increased while population in Africa was stagnant.

There have been intercontinental redistributions of population as well as changes in the relative populations of incomes. Developed countries experienced decreasing populations while developing countries experienced increasing populations. Shifts in relative population sizes can have significant economic and political effects.

Countries that are relatively poor will face higher population growth. This means that the fraction of people living in rich countries will decrease over time. This redistribution of the population has an effect on the growth rate of average income in the world.

**Composition effect:** The effect of population redistribution reducing the average growth rate of income in the world.