11

POPULATION AND DEVELOPMENT

Introduction

The relation between population growth and economic development is a complex one and the historical quantitative evidence is ambiguous, particularly concerning what is cause and what is effect. Does economic development precede population growth, or is population growth a necessary condition for economic development to take place? Is population growth an impediment or a stimulus to economic development? Many people consider rapid population growth in developing countries to be a major obstacle to development, yet there are several ways in which population growth may be a stimulus to progress, and there are several rational reasons why families in developing countries choose to have many children.

In this chapter, we first consider the facts on world population, which has grown at unprecedented rates in the years since the Second World War, particularly in developing countries, although the growth is now slowing down.

Then we turn to the question of family size and the determinants of fertility. There is a rationale for poor families to have several children, and it is clear that fertility declines as people and countries get richer. This is the theory of **demographic transition**. The evidence also shows that fertility is heavily influenced by female education and the opportunity for women to work.

The costs to society of rapid population growth are considered, especially the effect of a high young dependency ratio on saving and capital accumulation. The potential benefits of rapid population growth are also considered, including how population pressure can be a stimulus to technical progress, and the fact that young people are more receptive to change and new ideas and ways of doing things. It turns out that the empirical evidence across countries shows no statistically significant relation (positive or negative) between the growth of population and the growth of living standards.

The question then arises of what is the optimum population of countries? This can be defined in a number of ways; and it is argued that the claim that a country is 'overpopulated' or 'underpopulated' needs to be viewed with some caution unless a precise definition of terms is given. The resource base of a country, the size of the country, and the level of technology are crucial to any calculations.

The chapter ends with an exposition of Nelson's well-known model of the **low-level equilibrium trap**, which shows how a poor region or country may get stuck in a situation where its population growth exceeds its output growth, pushing income per capita down to its minimum subsistence level, and how a 'big push' or 'critical minimum effort' may be necessary to get per capita income to a level where the growth of per capita income becomes self-sustaining. The Nelson 'trap' model is similar to the Malthusian trap in which some communities in developing countries still find themselves, with large families and living standards oscillating around subsistence level.

Facts about world population

The pertinent facts about the level and growth of world population are shown in Table 11.1. Today, the world's population is nearly 7.5 billion, of which more than two-thirds live in developing countries and nearly one-half reside in Asia. This level compares with approximately 179 million at the time of Christ, and fewer than 1,000 million as recently as AD 1800. The current rate of growth of the world population is 1.1% per annum, which has no precedent historically. From AD 1 to 1750 the rate was no more than 0.05% per annum; from 1750 to 1850 it was 0.5% per annum; and even between 1900 and 1950 it was only 0.8% per annum (see Kremer (1993) for a history of world population).

Table 11.1 Population statistics

	Population millions 2014	Average annual population growth % 2000-14	Dependency ratio: young, % of working-age population 2014	Dependency ratio: old, % of working-age population 2014	Crude death rate per 1,000 people 2013	Crude birth rate per 1,000 people 2013
World	7,261	1.23	40	12	8	19
Low income	622	2.73	79	6	9	36
Middle income	5,240	1.25	40	10	7	19
Lower middle income	2,879	1.60	49	8	8	23
Upper middle income	2,361	0.84	29	12	7	15
Low and middle income	5,862	1.39	43	10	8	21
East Asia and Pacific	2,021	0.77	28	11	7	14
Europe and Central Asia	264	0.54	33	15	9	16
Latin America and Caribbean	525	1.28	40	10	6	18
Middle East and North Africa	357	1.81	49	8	5	25
South Asia	1,721	1.55	47	8	7	22
Sub-Saharan Africa	973	2.74	80	6	10	38
High income	1,399	0.62	26	24	9	12

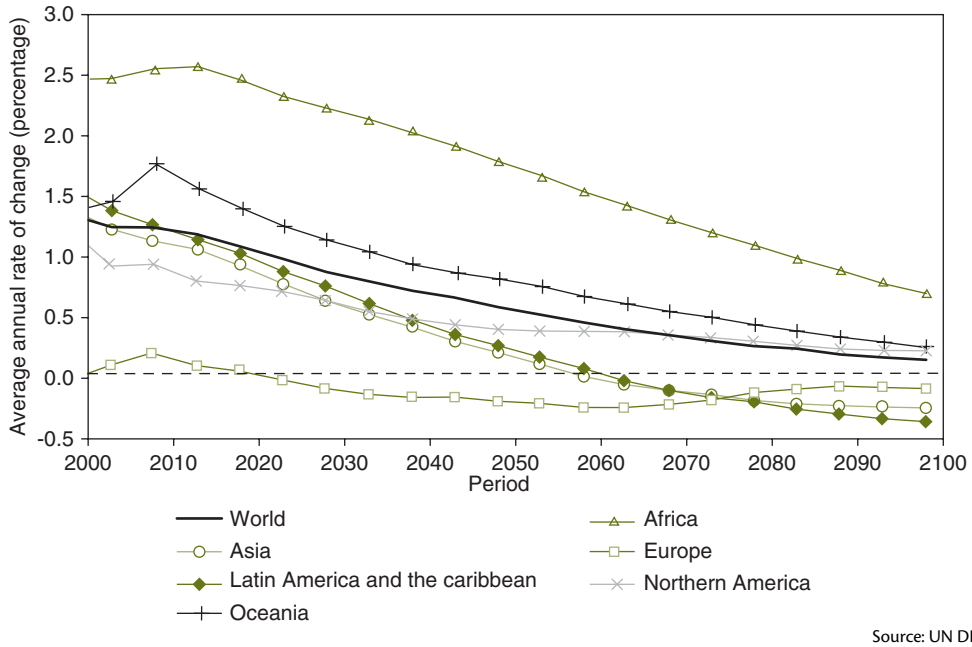
Source: World Bank, 2015.

At the present rate of increase, the world population will double every 65 years. The current projection from the UN is that, by the year 2050, the population will rise to 8 billion if birth rates continue to fall dramatically, or 12 billion if birth rates come down only slowly. Figure 11.1 gives the recent and projected growth rates for various regions of the world up to 2100. All the regions show the rates of population growth slowing down, but with Africa and Oceania still above the world average. In Europe, the population growth rate is already close to zero and forecast to be negative from 2020. In Asia, and Latin America and the Caribbean, population is forecast to fall from 2060.

The country with the largest population is China, with an estimated current population of 1,400 million, followed by India, the USA, Indonesia, Brazil, Pakistan, Nigeria, Bangladesh, Russia, Japan, Mexico and the Philippines, all with populations in excess of 100 million. China and India alone currently add 25 million people to the world's population every year. In the last minute, approximately 300 babies have been born and 150 people have died, increasing the world's population by 150 persons, giving a yearly increase of 80 million.

The rate of growth of population is the difference between the number of live births per thousand of the population and the number of deaths per thousand. In a country where the birth rate is 40 per 1,000 and the death rate is 20 per 1,000, the rate of population growth will therefore be $(40 - 20)/1{,}000 = 20$ per 1,000, or 2% per annum. If (in normal circumstances) a birth rate of 60 per 1,000 is considered to be a 'biological' maximum, and a death rate of 10 per 1,000 is considered a 'medical' minimum, the maximum possible growth rate of population, ignoring immigration, would be about 5% per annum. The current maximum birth rates recorded are 40 per 1,000 in some African countries. For low-income countries, the average birth rate is about 36 per 1,000 and

Figure 11.1 Average annual rate of population change by major area, estimates, 2000–15, and projection, 2015–2100



Source: UN DESA, 2015.

the average death rate is now about 9 per 1,000, giving an average rate of population increase of approximately 2.7% per annum (see Table 11.1). This rapid rate of population growth, compared with advanced countries (and also in relation to the growth of national income), is the result of relatively high birth rates coupled with death rates that are as low as in advanced countries. If population growth is a 'problem' in developing countries, this is the simple source of the difficulty and the long-run solution is plain: there must be a reduction in fertility.

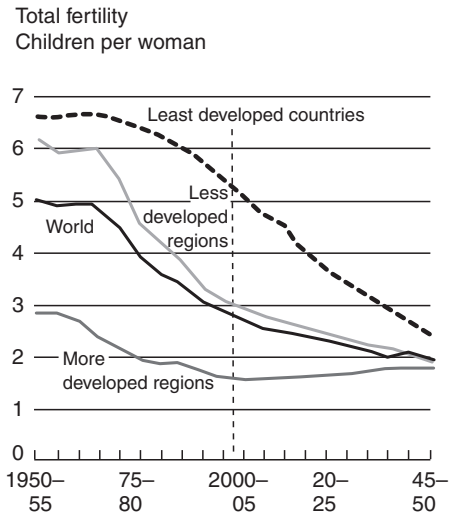
The determinants of fertility[1]

The vital questions are: Can high birth rates be expected to fall naturally with development, and if so, what is the crucial level of development and per capita income (PCY) at which the adjustment will take place and how long does the process take? The conventional wisdom used to be that fertility decline would come only with rising levels of per capita income, urbanization and industrialization. This is the theory of **demographic transition**.

If the fertility rate of countries, that is, the number of children per woman, is plotted against the level of PCY, a definite negative relationship is observable. It is also true that through time, the fertility rate decreases at a given level of PCY, and that there are big differences in the fertility rate between countries at the same level of income. Clearly, there are important factors, other than the level of PCY, that affect the level of fertility through time and across countries.

Past and projected fertility rates are shown in Figure 11.2. The data show fertility declining in all regions of the world, with the world fertility rate falling to 2.0 children per woman by the year 2050. The number of children per woman required for the population to replace itself is 2.1. In developed countries, fertility has already fallen below this critical level, with an average of 1.6 children per woman.

Figure 11.2 Past and projected fertility



Source: UN DESA, Population Division (2003).

Reductions in fertility can occur with improvements in a wide range of socioeconomic conditions, such as access to family planning services, the provision of healthcare and a reduction in child mortality, greater employment opportunities for women, and, above all, the education of women and the promotion of female literacy. Where women are excluded from secondary education, the average number of children per woman is six. In countries where half of women go to secondary school, the average number of children is three. Figure 11.3 shows the strong negative relationship between female literacy and the reduction in fertility across 93 countries.

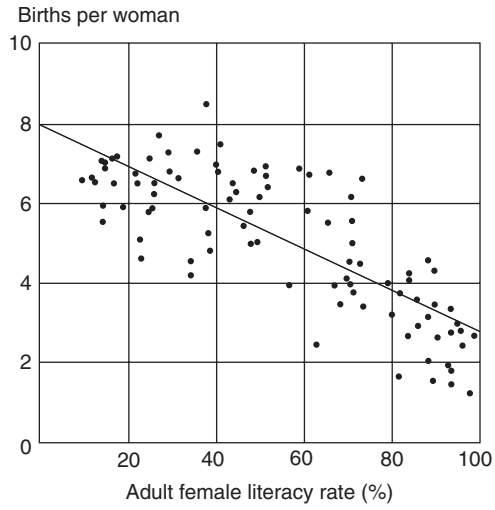
There are a number of reasons why women's education lowers fertility:

- Education improves work opportunities for women, which makes having children more costly in terms of income forgone.
- Educated women want their own children to be educated, which raises the cost of having children.
- Education and literacy make women more receptive to information about contraception.
- Education and employment delay marriage and the time available to rear children.
- Education improves the status, bargaining power and independence of women, encouraging and enabling them to make their own choices.

From a **vicious circle** of no education, high fertility, poor health of children and low productivity, the education of women can lead to a **virtuous circle** of lower fertility, better care of children, more educational opportunity and higher productivity. The countries where fertility is declining most rapidly are those with the highest levels of female schooling, the lowest levels of child mortality and the widest availability of family planning services. Bangladesh is a prime example where the fertility rate has fallen to 2.2 births per woman (see Case example 11.1).

The reductions in fertility in different parts of the world over the past two decades are shown in Table 11.2. In developing countries as a whole, the reduction has been 30%, from 3.8 children per fertile woman in 1990 to 2.6 in 2014. In low-income countries, however, the number of

Figure 11.3 Fertility rate and female literacy, 2010



Source: Authors' compilation based on World Bank 2014.

Case example 11.1

Reducing fertility in Bangladesh

Bangladesh provides an excellent case study of the impact that a government-led family planning policy can have on fertility in a poor country. In the mid-1970s, the fertility rate for a Bangladeshi woman was more than six children. This high fertility rate not only jeopardized the health of the woman and children but also acted as a major constraint on the country's economic development and social progress. The Bangladesh family planning programme, launched in the 1980s, relies on a large cadre of female outreach workers going door to door to provide information, motivate clients, and provide contraceptives. The programme has also used the mass media to stimulate a change in attitudes about family size, promoting the merits of smaller families. As a result, virtually all women in Bangladesh are aware of modern family planning methods. The fertility rate has decreased from six children per woman to less than three today. The programme is estimated to have cost between $100 million and $150 million a year, but the benefit–cost ratio is high. The cost-effectiveness is estimated at $13–18 per birth averted.

Source: Center for Global Development, Washington, DC.

children is still nearly 5. Sub-Saharan Africa has the highest fertility rate and Europe and Central Asia the lowest.

The birth rate of a country is equal to its fertility rate multiplied by the ratio of fertile women to the total population. Even though fertility rates decline, birth rates do not necessarily decline in the same proportion because of the young age structure of the population produced by high fertility levels in the past. Thus, even if fertility continues to decline substantially, it will still take decades for the population level to stabilize because of the sheer number of couples having families. There is a **population momentum** built into the present age structure of the population of most developing countries. It is estimated that even if fertility rates were reduced immediately

Table 11.2 Total fertility rate (births per woman), 1990 and 2014

	1990	2014
World	3.3	2.5
Low income	6.3	4.9
Middle income	3.5	2.4
Lower middle income	4.3	2.9
Upper middle income	2.8	1.9
Low and middle income	3.7	2.6
East Asia and Pacific	2.7	1.9
Europe and Central Asia	2.6	2.0
Latin America and Caribbean	3.3	2.1
Middle East and North Africa	4.9	2.8
South Asia	4.3	2.6
Sub-Saharan Africa	6.4	5.0
High income	1.9	1.7

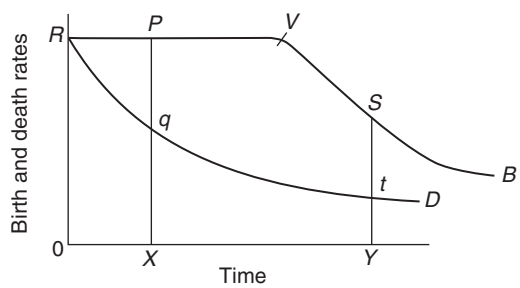
Source: World Bank, 2015.

to the level of replacement (that is, one daughter per woman, which means approximately 2.1 children per family), the population of developing countries will not stabilize until 2050, at a level of about 9 billion.

Given that there may be a time lag between the death rate falling and a subsequent decline in the birth rate, rapid population growth may be considered a transitional or more enduring 'problem' for a country depending on the currently prevailing level of the rate of births and deaths. This proposition is best illustrated by means of a simple diagram (Figure 11.4).

The curves *RB* and *RD* represent the time paths of the birth rate and death rate, respectively. Population growth is determined by the gap between the two curves. To save drawing more diagrams, let us suppose that points *X* and *Y* in Figure 11.4 represent two countries with the same current rate of population growth ($Pq = St$). In the case of country *Y*, population growth will soon slow down since the death rate has reached its minimum and the birth rate is falling. In the case of country *X*, however, which has the same *current* population growth, the population growth rate can be expected to increase in the future as the gap between the birth and

Figure 11.4 Population momentum



death rates widens. The death rate is falling but the birth rate remains constant to the point *V*; only after this point will population growth decrease. Here, then, are two countries with the same observed population growth at present but with radically different future prospects. When comparing countries, and their population 'problems', the time profile of countries must be borne in mind. But the crucial questions, as we suggested earlier, are: What is the length of the time lag between the death rate falling and the downturn of the birth rate? What is the length of the **demographic transition**? It is the length of this time lag that determines the short-run prospects of countries emerging from a transitional state and attempting to take-off into self-sustaining growth.

The experience of developing countries today has no historical parallel, at least in Western Europe. In nineteenth-century Europe, the birth and death rates tended to fall together and population growth never exceeded 1% per annum. It could almost be argued that the 'balance of nature' has been upset in today's developing countries. The introduction of public health measures and medical advances reduced death rates suddenly and dramatically, but the means and know-how to effect an equally dramatic fall in the birth rate were not provided at the same time. Modern science and public health improvements have contributed to the ending of premature death, but, until recently, have not exerted a significant impact on births.

Costs and benefits of population growth

Population growth plays a conflicting role in the development process. It can act as a stimulus and an impediment to growth and development. The question, to which there is no easy answer, is: At what point do the economic disadvantages begin to outweigh the advantages? Where does the balance lie?

The conventional view is that high levels and rates of growth of population constitute a problem for the world as a whole and for developing countries in particular. Population growth, it is argued, depresses human welfare because it:

- Uses up scarce (non-renewable) resources and causes environmental degradation.
- Puts pressure on food supplies.
- Leads to overcrowding and congestion in cities.
- Adds to the employment problem.
- Reduces the savings ratio and dilutes the quantity of capital per person employed.

There are elements of truth in all these arguments, especially in parts of the world where there are particularly heavy concentrations of population in relation to habitable land. Asia, for example, contains over one-half of the world's population and over 2 billion people live in big cities, which already suffer the highest levels of air pollution in the world, not to mention the congestion. Asia is now the biggest source of greenhouse gases. As we shall see later in the chapter, however, there are also arguments to be put on the other side. See Case example 11.2 for the challenge of population growth in the Philippines.

The pessimistic view of population originated with Malthus (see Chapter 4), and in recent years it has been revived by ecologists, environmentalists and various eco-doomsters of different persuasions. The pessimism of Malthus stemmed from the pervasive classical belief

Case example 11.2

The challenge of population growth in the Philippines

The population of the Philippines is now over 100 million. The country is home to one of Asia's youngest and fastest-growing populations. The country is not expected to reach its demographic peak until around 2077, well after China, South Korea and other powerful economies in the region. But the Philippines may never enjoy its demographic dividend if poverty, unemployment and inflation aren't addressed. Unemployment has remained stubbornly high even as the economy has grown an average of 5% per year over the past decade. The country's economic growth has largely benefited the top 20% of the income distribution. Almost a quarter of the population lives below the poverty line, earning less than $386 a year or just over $1 a day. Although the percentage of Filipinos living in poverty has declined slightly over the past few years, it has increased among youth and urban residents – the two segments of the population that are growing the fastest. A growing population and labour force is not good for unemployment. About 1 million Filipinos enter the labour force every year, but only one-quarter of them find stable jobs. As much as 75% of workers are employed in the informal sector, which means that they have no protection from job losses – a figure that is likely to increase as the population surges. There is urgent need to reduce fertility through expanding female education and employment opportunities.

in the law of diminishing returns, and the underestimation of humankind's response to the challenge of diminishing productivity with the expansion of numbers through invention and innovation.

According to Malthus ([1798]1983), there is a 'constant tendency in all animated life to increase beyond the nourishment prepared for it'. Thus, every mouth is accompanied by a pair of hands, but every pair of hands produces less and less additional output. Technological progress (always grossly underestimated by pessimists in general and by classical economists in particular) would not be rapid enough, it was thought, to offset the tendency. However, Malthus became much less pessimistic between the first and fifth editions of his book, and at one point conceded that, if it were not for population increase: 'no motive would be sufficiently strong to overcome the acknowledged indolence of man and make him proceed to the cultivation of the soil'.

The main argument of the pessimistic school regarding rapid population growth is that it leads to a high **dependency ratio** and reduces an economy's savings because the young spend more than they produce, so that capital accumulation per worker is lower than it would otherwise be, which leads to a lower level of productivity and therefore living standards. This traditional argument, however, ignores the fact that many young children in developing countries do, in fact, work (see Dasgupta, 1995). It must also be remembered that many of the older members of a community also consume without producing and that the proportion of retired members of the community to total population will rise as population growth slows. Thus, what happens to the aggregate savings ratio as the population growth rate changes will depend on how the composition of the *total* dependency ratio alters, and on the propensity to save (or dissave) of the two groups of dependents. For example, if the propensity of the retired to dissave was greater than that of the inactive young, the aggregate savings ratio might fall with a reduction in the birth rate as the retired dependency ratio rose.

It should also be noted that the effect of children on a society's total savings works primarily through the family as a unit and depends on how the family reacts to the increase in the number of children. There may just be a substitution of one form of expenditure (on children) for another. Alternatively, the family may work harder to provide for the children, in which case there may be

no adverse effect on saving at all. Saving in some families may even increase if there is a sufficient increase in output and a high degree of substitution. The degree of substitution between one form of expenditure and another will depend on the ability to substitute, determined by living standards and the level of saving already achieved.

The question of an output response to population pressure comes back to the point made earlier of the possibility of a positive relation between population growth and total productivity growth. It may well be that the sheer increase in numbers creates work and production incentives that affect output and productivity favourably. In fact, there is a good deal of theory and empirical evidence to suggest a positive relation between population growth and the growth of output per unit of labour, especially in the manufacturing sector, assuming some growth in employment as the population expands. This is **Verdoorn's law** (discussed in Chapter 3), which hypothesizes a positive relation between the growth of the population, employment and output on the one hand and the growth of labour productivity on the other.

The possible explanations for such a relation are numerous:

1. It has been argued (see Chapter 6) that an economy with a faster rate of growth of employment and output may be able to learn more quickly and hence raise its rate of technical progress.
2. If there are internal and external economies of scale in production, increased employment and output will lead to a faster rate of growth of labour productivity.
3. There are likely to be economies of scale in the use of capital. Capital requirements, in most cases, do not increase in the same proportion as population. There are many important indivisibilities in the provision of capital, especially in the field of transport and other social overhead capital.

It is also possible that population pressure can favourably affect individual motivation and lead to changes in production techniques that can overcome the negative consequences of population growth. In this connection, it has been argued that a major stimulus to the Green Revolution in Asia in the 1960s and 1970s came from the pressure of population on food supply. The young age structure of a country also makes it more amenable to change, more receptive to new ideas, more willing to shift resources from low-productivity to high-productivity sectors and so on, all of which may raise income per head. In Hirschman's model of development (see Chapter 9), population growth increases the supply of potential decision-makers, expands markets and leads to development via shortages.

It must not be forgotten that the world as a whole has grown progressively richer while the population has expanded. Would the world be as rich today if the population had remained static? Would Britain have been the first country to industrialize if its population had not grown? Would the USA have become the richest country in the world without the great influx of people from beyond its shores to exploit its abundant natural resources?

All that has really been said so far is that population growth presents a paradox. On the one hand, increases in population may reduce living standards owing to the adverse effect of population growth on savings and capital per head. On the other hand, increases in population and the labour force can raise living standards through the learning, specialization and scale economies that larger numbers, wider markets and a higher volume of output make possible. What may be called the **paradox of labour** can be seen more easily by taking the identity $O = P(O/P)$, or in differential form, $(\Delta O/O) = \Delta P/P + \Delta(O/P)/(O/P)$, where O is output, P is population and O/P is output per head of population (and a constant fraction of the population is assumed to work). Decreasing amounts of capital per worker (and possibly diminishing returns to land) imply a negative relation between the terms on the right-hand side of the equations, so that output per

head and living standards are lower than they would otherwise be as the population increases. On the other hand, the possibility of increasing returns, due to the factors mentioned, implies a positive relation between the two terms, so that living standards rise as the population increases.

The question is: Which forces predominate? The debate as to whether population growth acts as a stimulus or an impediment to the growth of living standards is largely a question of whether the relation between $\Delta P/P$ and $\Delta(O/P)/(O/P)$ is significantly positive or negative. If the relation is negative, then population growth is an impediment to rising living standards. If the relation is positive, then the effect of population growth on the growth of output and output per head is unambiguously favourable. Evidence across countries suggests that population growth and the rate of capital accumulation are inversely related, which decreases the growth of labour productivity, but population growth and technical progress are positively related, which increases the growth of labour productivity. The two effects offset each other, leaving the total effect of population growth on the growth of per capita income roughly neutral (see Thirlwall (1972) for an early study).

This is indeed the conclusion of studies that examine *directly* the relation between population growth and the growth of living standards by correlating the two variables for a cross-section of countries to see whether the relation is positive or negative. When this is done, there is very little systematic relation to be found between intercountry rates of population growth and rates of growth of per capita income. This does not take account of the environmental degradation associated with population growth and the use of non-renewable resources, which are not measured as a cost in the calculation of GDP.

The fact that the international cross-section evidence lends very little support to the notion that curbing population growth will have much impact, if any, on the growth of income per head is not to deny, of course, that curbing population growth may be desirable for other reasons, such as to relieve overcrowding, to relieve pressure on food supplies and, in general, to improve the distribution of income. To be sceptical of an inverse relation between population growth and per capita income growth is not to pour cold water on population control programmes. On the contrary, given the uncertainty of the population growth/living standards relation, and the force of other arguments for limiting numbers, the most sensible strategy is to pursue programmes on the hypothesis that population control increases PCY. In simulation studies of the gains from population control that use the effect on PCY as the criterion for success, however, it is important that explicit account should be taken of the positive relation between population growth and technical progress if the gains from population control are not to be exaggerated. See Case example 11.3 for a general discussion of the concern over population growth.

Case example 11.3

Population concern

Population concern is fundamentally about the balance between human needs and the resources available to meet those needs now and in the future. From the period of Confucius and Aristotle, observers throughout history have noted the consequences of unsustainable population growth. The most famous writer on population was Thomas Malthus (1776–1834), who wrote when the human population was 900 million and observed that 'population when left unchecked increases in a geometric ratio [while] subsistence grows in an arithmetic ratio'. The

Case example 11.3

Population concern – *continued*

famines that Malthus predicted were averted by the agricultural and industrial revolutions that followed his lifetime, which facilitated a dramatic increase in food productivity.

Following the Second World War, the population reached 2,500 million and improvements in public health spread to the developing world and population numbers took a huge leap forward. Robert McNamara, then president of the World Bank said: 'Short of nuclear war itself, population growth is the greatest issue the world faces. If we do not act, the problem will be solved by famine, riots, insurrection and war.' These views were shared by such diverse people as Albert Einstein, Martin Luther King and Lynden Johnson. Concerned nations and international organizations accelerated support for family planning programmes. In 1968, world population had climbed to 3,600 million. Paul Ehrlich, US biologist, warned in his book *Population Bomb* (1968) that population growth was again raising the spectre of widespread famine. However, another development occurred at this time, the Green Revolution, which transformed agricultural productivity in many developing countries through the introduction of high yield crop variants and the use of modern high input farming methods. Ehrlich reissued his book in 1990 as the world population reached 5,200 million. The predicted famine never took place, although in 2009 the UN estimated that up to 1 billion in the world were undernourished.

In 2010, the global population reached 6,800 million, Some countries continue to limit their population growth by providing reproductive health services and adopting a variety of approaches to limit family size. Pressure on individuals is firmly rejected by international bodies and NGOs, who emphasize the importance of a rights-based approach, such that couples freely make their own reproductive choices. As we look ahead to the middle of this century, world population is projected to reach 8–11 billion, and increasing numbers of people are voicing concern about population numbers, in the context of biodiversity loss, climate change and rapid depletion of oil, fresh water, land, habitat and wildlife resources.

For more on the subject, go to www.populationmatters.org/the-issue/overview.

Population and the growth of cities

One of the major consequences of population growth, and the process of rural–urban migration, is the rapid growth of cities in developing countries. At present, just over one-half of the world's population lives in cities, and this is predicted to rise to two-thirds by 2025. In fact, virtually all the predicted increase in world population will live in cities. The urban population of developing countries is already increasing by almost 700 million a year, which puts huge pressure on resources. While cities only occupy 2% of the land's earth surface, they absorb 75% of natural resources – food, energy and water (Reader, 2005).

Currently, the top ten cities in the world (by population) are Tokyo (35.7m), Mexico City (19m), New York (19m), São Paulo (19m), Mumbai (18.8m), Delhi (15.9m), Shanghai (15m), Kolkata (14.8m), Dhaka (13.5m) and Buenos Aires (12.8m). By 2025, it is predicted that there will be 30 cities in developing countries with more than 10 million people, and 400 cities with more than 1 million.

Living conditions in the cities of developing countries are often extremely poor. One-third of city dwellers live in slums, and many are very insecure because of lack of land rights. There is overcrowding, poor sanitation, lack of clean water, pollution and disease. Over 500 million people lack access to clean water and 2 million die each year as a result.

Simon's challenge

The most concerted challenge to the view that population growth is uniformly depressing for the material well-being of mankind has come from the economist Julian Simon (1992, 1996). Simon's major thesis is that 'the ultimate resource is people – skilled, spirited and hopeful people – who will exert their wills and imaginations for their own benefit, and so, inevitably, for the benefit of us all'. William Petty, seventeenth-century English political economist, was making the same point when he said: 'it is more likely that one ingenious, curious man may rather be found among 4 million than among 400 persons' (Petty, 1682). Simon brings together the theoretical arguments and empirical evidence on both sides of the population debate and presents simulation results on the relation between population growth and living standards. He finds that the initial effects of population increase on per capita income are negative, but that, in the longer term, the positive feedback effects resulting from the stimulus of population growth to technological progress, and other factors that improve the rate of productivity growth, outweigh the negative effects. Simulations suggest that, for countries already industrialized, the initial negative effect of population is offset within 50 years. For less developed countries, the conclusion is that moderate population growth is more favourable to the growth of living standards than either a stationary population or very rapid population growth.

An overall judgement of population growth, and whether it is beneficial or not, therefore depends very much on weighing the balance between the present and the future. In economic analysis, the present and the future are made comparable using the concept of a discount rate. Whether the positive long-run benefits of population growth are considered to outweigh the short-run negative effects depends on the discount rate and the time period taken. The less future benefits are discounted and the longer the time period taken, the more beneficial (less detrimental) population growth appears, and the shorter the time period considered and the more future benefits are discounted, the less beneficial (more detrimental) population growth appears. There will be some time period and some discount rate at which additional population is exactly on the borderline of having a negative or positive value.

What are the positive feedback effects that population increase can have on economic progress that vitiate the classical prediction that population growth is uniformly depressing on living standards? In his simulation model of the relationship between population growth and per capita income in advanced countries, Simon attempts to capture the effect of additional children on factors such as the savings ratio, labour supplied by the parents, scale economies and technical progress. In his simulation model for developing countries, Simon (1992) considers the following important feedback mechanisms:

- the stimulus to new methods in agriculture
- the supply response of families
- the provision of social infrastructure (particularly transport)
- scale economies
- demand-induced investment.

Let us briefly consider some of these factors.

A society under pressure from population growth may be expected to respond by finding new and more efficient ways of meeting given needs. In agriculture, the Malthusian view would be that improvement in agricultural techniques is independent of population and that improvements simply induce population expansion. Others would argue that even if population pressure does not induce the production of new techniques, it certainly induces the *adoption* of new techniques. It is difficult to see how the Green Revolution in Asia in the 1970s would have occurred without the pressure of numbers on food supply.

Agricultural families may respond to the needs of additional children by changing methods, working harder and producing more. Studies suggest that the elasticity of output to increases in the number of children is about 0.5; that is, an increase in family size, say, from four to five (25%) would result in a 12.5% increase in output. Simon argues that population growth also has a large positive effect on agricultural saving, which tends to be overlooked because a large fraction is non-monetized.

Population pressure provides a stimulus to develop social infrastructure, transport and communication facilities, which have far-reaching external repercussions, extending beyond the additional numbers they are designed to serve. Population growth also makes these facilities more economical to provide because of the scale economies involved in their provision. Simon (1992) argues: 'if there is a single key element in economic development other than culture and institutions and psychological make-up, that single key element is transportation together with communications'. Adam Smith (1776), an early contemporary of Malthus and much more optimistic about the development process, was impressed by the benefits of communications:

> good roads, canals and navigable rivers, by diminishing the expense of carriage, put the remote parts of the country more nearly upon a level with those in the neighbourhood of the town. They are upon that account the greatest of all improvements – they break down monopolies … they open new markets.

To the extent that population growth exerts pressure for these facilities to be provided, a significant output response is to be expected.

Increased population has many other productivity effects that are subtle and indirect, yet nonetheless important. It is very difficult, for example, to improve health and sanitation in sparsely populated areas, but once sanitation and health improvements become feasible and economical with greater numbers, substantial benefits may result – more than in proportion to the increase in population. A growing population also facilitates change without disrupting the organization and positions of those already established. Thus, government and administration may be expected to improve and become more in keeping with the needs of development. Youth itself has positive advantages. Young people are more receptive to change and modernization than older people. The younger a population, the more education (or human capital) per head of the population. Young people tend to be more mobile, which is an asset when structural change is required. With a growing population, investment is less risky. Many economists are of the view that one of the major obstacles to development is not a shortage of savings but a lack of willingness to invest. An expanding market resulting from population growth provides an incentive to investment.

The great difference between the results of Simon and those of the pessimists is that all the beneficial feedback effects of population on output mentioned above are not considered. But any of the feedback factors referred to may partially or fully offset the capital dilution effect of greater numbers in the short run, which is the factor that the predictions of conventional models reflect.

A complete analysis of the relation between population and living standards must have due regard to the longer term benefits that population expansion can confer on societies, as well as the short-term costs. Indeed, only when the benefits are considered, is it possible to comprehend why societies are infinitely wealthier today than centuries ago, despite population expansion.

The 'optimum' population

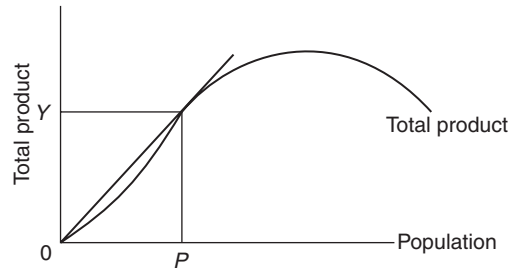
What is the 'optimum' population? The term **optimum population** is used in several different senses, but four in particular are commonly employed. First, it is sometimes used to refer to the size of population that *maximizes the average product or income per head*. It is in this situation that a society's savings ratio is likely to be maximized. Thus, if the total product curve for an economy is drawn as in Figure 11.5, the optimum population is *P*, where a ray from the origin is tangential to the total product curve. At *P*, total product (*Y*) divided by population (*P*), or average product per head of population, is at its maximum. The condition for maximum average product per head is that the marginal and average product per head should be equal. If the marginal product of an addition to the population is above the average, the average product could be increased by an expansion of the population. Conversely, if the marginal product is below the average, a further increase in population will reduce the average product and the population will exceed the optimum level in the way defined. If there was no saving, the maximization of product per head would maximize welfare per head because consumption per head would then also be at a maximum.

On the surface, this concept of optimum population seems an attractive one upon which to base a population policy. It provides the greatest scope for maximizing savings per head if desired or, in the absence of forced or compulsory saving, it will lead to the maximization of welfare per head. Yet, a population policy based on maximizing per capita income has frightening implications (not entirely fanciful) for all submarginal groups in society that may be deemed to be depressing the average standard of life.

A second approach to the concept of 'optimum' population adopts the criterion of *total welfare maximization*. This is the utilitarian approach, adopted by Henry Sidgwick, English economist cum philosopher, in his *Methods of Ethics*, originally published in 1874. Sidgwick argues:

> If the additional population enjoy on the whole positive happiness, we ought to weigh the amount of happiness gained by the extra numbers against the amount lost by the remained. So that, strictly conceived, the point up to which, on utilitarian principles, population ought to be encouraged to increase is not that at which *average* happiness is the greatest possible – as appears to be often assumed by political economists of the school of Malthus – but at which

Figure 11.5 Maximization of average product



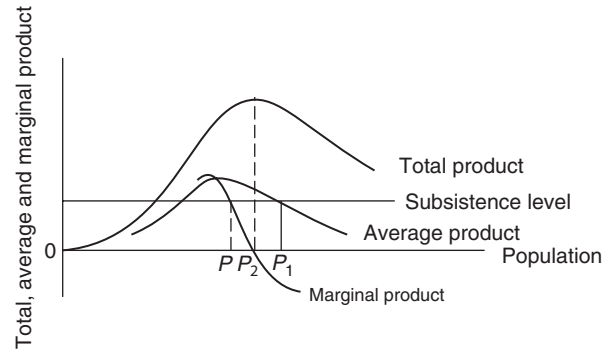
the product formed by multiplying the number of persons living into the amount of average happiness reaches its maximum (emphasis added).

According to this criterion, the population would be suboptimal if the marginal product of labour was above some notional welfare subsistence level, and would reach the optimum when all incomes were equalized at the welfare subsistence level (assuming a diminishing marginal utility of income). But in conditions of poverty, if increments to population reduce the average standard of living still further, it seems perverse to call this an improvement in welfare simply because the number of people 'enjoying' such an impoverished state has risen. As Rawls (1972) argues in his *Theory of Justice*, if a rational observer was asked to choose membership of one or other society from behind a veil of ignorance, they would undoubtedly reject the maximization of total welfare and choose the society with the prospect of a higher per capita income.

A third definition of optimum population refers to the level of population beyond which the average product in an economy falls below the level necessary for subsistence, on the assumption that the total product is equally shared. In this case, the term 'optimum' simply refers to the maximum population that can be supported with existing resources, and is the point of Malthusian equilibrium. In Figure 11.6, a population beyond P_1 could not be supported because the average product of the population would be below the level of subsistence. If total product was not equally shared, a total population of P_1 would not be supportable, for some would have more income than necessary for subsistence and others less. But note that if the product is equally shared, a much larger population can be maintained than the population at which the marginal product falls below subsistence, that is, P. In fact, the optimum population, P_1, is consistent with a negative marginal product.

This last point leads us to the fourth sense in which the term 'optimum' population is sometimes used, which is to describe a state of affairs where a country's population is so large that further increases lead to a fall in total output, implying a negative marginal product. The population is optimal in this sense when total product is maximized, at P_2 in Figure 11.6. This definition of optimum population is closely linked with the notion of population density, and attempts to define underpopulation and overpopulation in terms of the relation between population and resources and, in particular, land. Since resources such as land vary considerably in quality, however, intercountry comparisons of ratios of population to resources must be treated with great care. One country may be regarded as 'underpopulated' in relation to another country even though it has a higher population–resource ratio, simply because the technology it uses to exploit

Figure 11.6 The 'optimum' population



its resources is superior. Technology will influence the position and shape of the total product curve – and hence the optimum population – for any given ratio of population to resources. In view of the variety of interpretations of the concept of optimum population, the claim that a country is 'overpopulated' or 'underpopulated' needs to be viewed with some scepticism unless a precise definition of the terms is given.

Where does all this leave the welfare basis for population control programmes? A firmer basis than whether or not there are diminishing or increasing returns to population growth is to consider the divergences between the private and social benefits that arise from large numbers of children. For example, individual families may prefer to have fewer children if they know that all other families will have fewer children, but, in isolation, they are not willing to limit the number of children they have. This is an example of what is known in welfare economics as the **isolation paradox**, and it establishes a case for public intervention. It is the young who suffer from there being more children because most of the costs arise in the future. Present parents may enjoy their children, but their children may wish their parents had had fewer, and they probably would have had fewer if they could have been sure that everybody else would have had fewer too. A further reason for public intervention in the field of population control may be market failure, if it can be shown that families have more children than they actually want and that there is an unmet need for family planning services.

It is interesting to note that surveys of desired family size in developing countries consistently put the figure at one or two lower than the actual family size. Apart from this, it could be argued that it is a basic human right to be able to choose freely and responsibly the number of children to have and how far apart to have them. This indeed was the resolution endorsed by the first UN World Population Conference in Bucharest in 1974, which laid the foundation for the World Bank's increased support for population control programmes throughout developing countries, and was reiterated by the last UN Conference on Population and Development in Cairo in 1994. The Cairo conference emphasized the right of women to control the number and timing of their children and urged countries to provide universal access to family planning services. It is estimated that only 50% of married women in developing countries use any form of birth control. As we saw earlier, however, the education of women is the major determinant of fertility, and a necessary condition for a reduction in fertility is the expansion of educational and work opportunities for women.

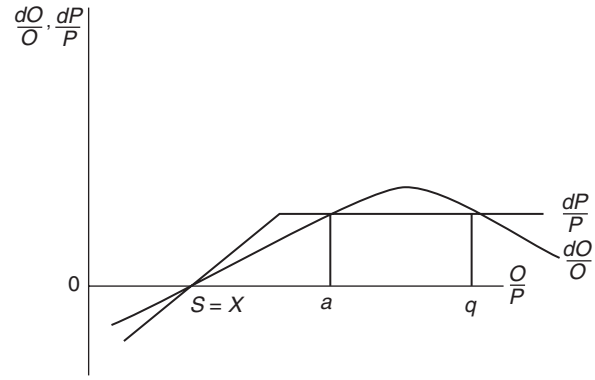
A model of the low-level equilibrium trap

To repeat, there are two main interrelated reasons why rapid population growth may be regarded as a retarding influence on development:

1. Rapid population growth may not permit a sufficiently large rise in per capita incomes to provide the savings necessary for the required amount of capital formation for growth.
2. If population growth outstrips the capacity of industry to absorb new labour, either urban unemployment will develop or rural underemployment will be exacerbated, depressing productivity in the agricultural sector.

It is not inconceivable, moreover, that rises in per capita income (PCY) in the early stages of development may be accompanied by, or even induce, population growth in excess of income growth, holding down PCY to a subsistence level. Today's falling death rates (associated with development) are contributing to population pressure; and presumably for centuries past the

Figure 11.7 Low-level equilibrium trap



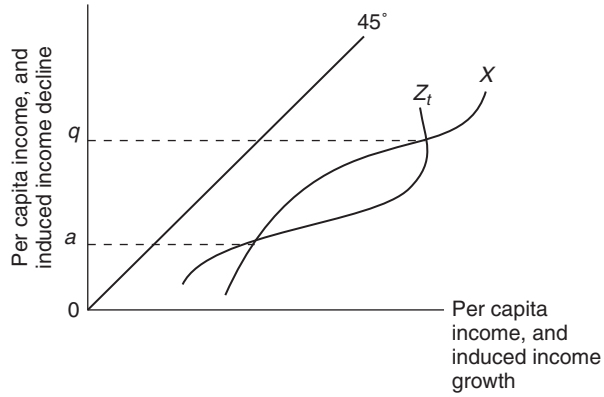
population of most countries has been oscillating around the subsistence level, with small gains in living standards (due to 'technical progress') being wiped out either by higher birth rates or factors such as disease, famine and war. This is the notion of a **low-level equilibrium trap**, illustrated in Figure 11.7.

Figure 11.7 shows the relationship between the growth of population (dP/P) and the growth of output (dO/O) on the one hand (measured on the vertical axis), against the level of per capita income (O/P) on the other (measured on the horizontal axis). $S = X$ represents the subsistence level of PCY at which population growth is zero and output growth is also zero because at the subsistence level there is no saving and investment. Population growth rises with PCY and then levels off at a biological maximum. Output growth rises with PCY because the savings ratio also rises with PCY, but then levels off (and even declines). Output growth eventually falls as the capital–labour ratio falls. If the output growth curve cuts the population growth curve from above at point $S = X$, it can be seen that any increase in PCY above the subsistence level up to a point a will lead to population growth in excess of output growth, pushing income per head back to the subsistence level. Conversely, any PCY level beyond a will mean a sustained rise in PCY until the two curves cut again at q. This would be a new stable equilibrium, with the output growth curve again cutting the population growth curve from above.

To escape from the low-level equilibrium trap, PCY must either be raised to a, or the dO/O and dP/P curves must be shifted favourably. The origin of **big push** theories of development (see Chapter 9), and the concept of a **critical minimum effort**, was the belief that to escape from the 'trap', it would be necessary to raise PCY to a in one go through a massive investment programme. If countries are in a trap situation, however, much greater hope probably lies in the dO/O curve drifting upwards over time, through technical progress, or in a sudden drop in the dP/P curve from a reduction in the birth rate. Capital from abroad, raising the dO/O curve, and emigration, lowering the dP/P curve, could also free an economy from such a trap.

To take account of factors other than population growth that may depress PCY, and factors other than increases in capital per head that may raise PCY, the low-level equilibrium trap model can be extended and generalized by adopting Leibenstein's terminology of 'income-depressing' forces and 'income-raising' forces (Leibenstein, 1957). Leibenstein's approach is illustrated in Figure 11.8. The curve representing income-depressing forces, Z, is measured horizontally from the 45^0 line, and the curve representing income-raising forces, X, is measured vertically from the 45^0 line. Per capita income level a is the only point of stable equilibrium. Between a and q, income-depressing

Figure 11.8 Leibenstein's approach



forces are greater than income-raising forces and PCY will slip back to *a*. Only beyond *q* are income-raising forces greater than income-depressing forces, such that a sustained increase in PCY becomes possible. *q* is the critical PCY level necessary to escape from the low-level equilibrium trap.

Most developing countries in the world today are experiencing income growth faster than population growth. Whether income growth would be faster if population growth was reduced is an open question. It is possible to conceive of a low-level equilibrium trap, but its level almost certainly rises over time owing largely to technical progress before a reduction in birth rates sets in (see Cassen (1976), Kelley (1988), Simon (1997), Dasgupta (1995) and Bloom (2016) for surveys of many of the issues discussed in this chapter).

Summary

- Since the 1950s, the world's population has grown at an unprecedented rate, more than doubling from just over 3 billion in 1950 to over 7 billion today. The pace of growth is slowing but population growth in developing countries is still three times faster than in developed countries (1.8% compared with 0.6% per annum). The world's population is forecast to stabilize at around 11 billion in 2050.
- The cause of this population explosion has been a dramatic fall in the death rate due to advances in medical knowledge and improved sanitation, without a commensurate fall in the birth rate (until recently).
- Fertility rates are high in poor countries, but decline with the level of per capita income. This is the theory of demographic transition. Fertility also declines with the years of education women receive and with female employment opportunities.
- The costs of rapid population growth include pressure on food supplies, urban congestion, environmental degradation, the depletion of non-renewable resources, and a reduction in the savings ratio of countries.
- The potential benefits of population growth include the stimulus to new agricultural methods to raise output (e.g. the Green Revolution of the 1960s and 1970s), demand-induced investment, scale economies, and the provision of social infrastructure, which confers positive externalities (e.g. transport).

- There is no statistically significant correlation (negative or positive) between the growth of population and the growth of living standards across countries.
- The term 'optimum' population is used in four different senses: maximizing income per head; maximizing total welfare; the maximum population that can be supported with existing resources; and the population level that maximizes total output. The terms 'overpopulation' and 'underpopulation' need to be treated with caution without knowing the precise basis of the calculations.
- It is possible for countries to get caught in a 'low-level equilibrium trap' with population growth exceeding income growth and income per head oscillating around subsistence level. A 'big push' or 'critical minimum effort' in terms of investment may be necessary to launch communities in this state on to a self-sustaining growth path.

Chapter 11 **Discussion questions**

1. What accounts for the population explosion in developing countries since the 1970s?
2. Why do poor people have large families?
3. What are the major determinants of fertility?
4. It has been said that 'affluence is its own prophylactic'. Does this mean that it is futile to attempt to control the size of the population before living standards rise?
5. Why will the population continue to grow rapidly even if fertility rates in developing countries fall rapidly?
6. In what ways may rapid population growth impair development?
7. What are the stimuli that rapid population growth might give to development?
8. How would you do a cost–benefit analysis of population growth?
9. What do you understand by the concept of the 'low-level equilibrium trap'?
10. Is it possible to define an 'optimum' population?

Note

1. For an extensive survey of the determinants of fertility relating to the microeconomic behaviour of households, see Dasgupta (1995).

Websites on population

World Bank, World Development Indicators http://data.worldbank.org/data-catalog/world-development-indicators
United Nations www.un.org/popin/wdtrends
UN Population Division www.un.org/en/development/desa/population/
UN Population Fund www.unfpa.org
UN Population Information Network www.un.org/popin/