

Supplementary Notes: (PJ Shlachtman, Miller book) Human Population: Growth, Demography, and Carrying Capacity

Factors Affecting Human Population Size

Pop. size is affected by birth rates, death rates, emigration and immigration

$$\text{Population change} = [\text{births} + \text{immigrations}] - [\text{deaths} + \text{emigration}]$$

Zero Population Growth (ZPG) – when births plus immigration equal deaths plus emigration

Crude Birth Rate (CBR) – number of live births per 1000 people in a pop. in a given year

Crude Death Rate (CDR) – number of deaths per 1000 people in a population in a given year

Rate of World's Population Change (%) = $(\text{Birth Rate} - \text{Death Rate})/1000 \text{ people} \times 100 = (\text{Birth Rate} - \text{Death Rate})/10$

China and India constitute 37% of world's population. U.S. – 4.5% of world's population.

Average Annual population growth rate – 1.35% (global)

Developing countries will constitute >95% of population growth between 1998 and 2025

Global Fertility Rates

There are two types of fertility rates

1. Replacement Level Fertility

This is the number of children a couple must bear to replace themselves. (2.1 in developed countries and 2.5 in developing countries). These numbers are greater than 2 because some female children die before reaching their reproductive years.

Population Momentum – The population increase resulting from a large number of people entering their childbearing years. It will continue even though future parents only have an average of 2.1 children.

2. Total Fertility Rate (TFR)

- The most useful measure of fertility for projecting future population change. TFR is an estimate of the average number of children a woman will have during her childbearing years under current age-specific birth rates. In 2000, TFR was 2.9 (1.3 in developed countries; 3.2 in developing countries).
- Highest TFR: Africa = 5.3 children per woman.
- If the world's TFR remained at 2.9, the human population would reach 694 billion by the year 2150.
- TFR = 2.3; World population = 8 billion (2025)

U.S. Fertility Rates

- U.S. pop.: 76 million (1900); 288 million (2002)
- TFR (US) has oscillated wildly (see p.243) TFR (2000) = 2.1
- US has the highest fertility rate and highest immigration rate of any industrialized country. The rate of pop. growth has declined, but population is still growing faster than most developed countries. Population growth in 2000 was ~1% (double the rate of other industrialized countries).
- Growth added 2.76 million people; 1.66 million more births than deaths; 800,000 legal immigrants; 300,000 illegal immigrants.
- Moderate Projection: US pop. of 404 million by 2050 (41% increase).
Less Conservative Projection: pop. = 507 million (86% increase)
- ***Because of the high per capita rate of resource use in the US, each addition to the US pop. has an enormous environmental impact.
- In Pacific Northwest population growth is higher than that of India.

Reasons for Projected Growth:

1. Large number of baby-boom women still in child-bearing years
2. Increase in number of unmarried mothers (incl. teenagers)
3. Continued higher fertility rates for women in some racial and ethnic groups than for Caucasian women.
4. High levels of legal and illegal immigrants (43% of US pop. growth).
5. Inadequate family-planning services.

Case Study: Increasing Fertility Rates and Environmental Problems in California

What Factors Affect Birth and Fertility Rates?

1. Average level of education and affluence
2. Importance of children as part of the labor force
3. Urbanization
4. Cost of raising and educating children
5. Educational and employment opportunities for women
6. Infant mortality rate

7. Average age at marriage
8. Availability of private and public pension systems
9. Availability of legal abortions
10. Availability of reliable methods of birth control
11. Religious beliefs, traditions and cultural norms

What Factors Affect Death Rates?

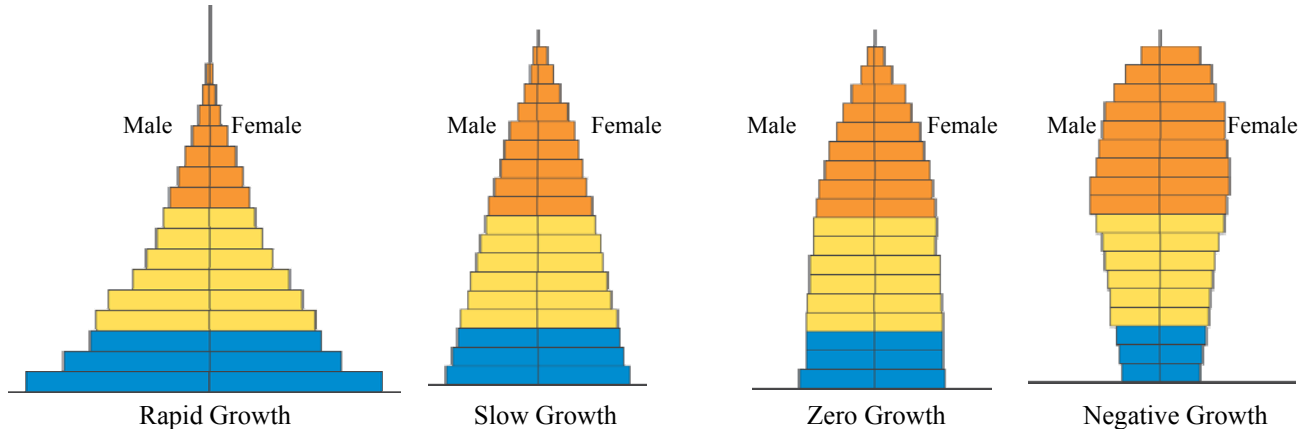
- Decline in the CDR (crude death rate) has led to the rapid incr. in world's pop. People started living longer:
- “It's not that people stopped breeding like rabbits; it's just that they stopped dying like flies” (UN)
- Two useful indicators of overall health in a country:
 1. **Life expectancy** (the avg. number of years a newborn infant can expect to live)
 - Life Expectancy: 75 years (developed countries); 64 years (developing countries)
 - Globally, life expectancy = 48 years (1955), 66 years (1998), 73 years (2025, projected)
 - Life expectancy in Africa is less 50 years
 2. **Infant mortality rate** (the number of babies out of every 1000 born each year that die within 1 year)
 - Infant mortality is the single most important measure of a society's quality of life – because it reflects the general level of nutrition and health care.
 - U.S. infant mortality rate = 7.0/1000 (1998); 32 other countries had lower rates;
 - These rates are high because inadequate health care (poor women), drug addiction (among pregnant women) and high birth rate among teenage women.
 - Babies born to teenage women are more likely to have low birth weights – the most important factor in infant deaths.
 - US – highest teenage pregnancy of any industrialized country

Population Age Structure

Age Structure Diagrams – show the proportion of the population at each age level.

Three main age categories:

- Prereproductive (ages 0-14)
- Reproductive (15-44)
- Postreproductive (45+)



How Does Age Structure Affect Population Growth?

A wide base (0-14 years) has a strong built-in momentum to increase pop.

1998: Half of world's women were in the reproductive age group;

- World: 31% of people <15 years.
- In developing countries: 34% <15 years; (19% in developed countries)
- Africa: 44% <15 years

How can Age Structure Diagrams be used to make population and economic projections?

- Baby-Boom vs. Baby-Bust Generations. Any boom or bust in the age structure of a population can create social and economic changes that ripple through a society for decades. Competition for jobs; political clout; retirement benefits and needs.

What are some of the effects of population decline?

- Gradual population decline: negative effects are manageable.

- Rapid pop. decline can lead to severe economic and social problems.
- A sharp rise in proportion of elderly will lead to a large share of medical care, social security and other costly social services. Labor shortages (unless you can utilize increase automation, immigration of foreign workers or both).

Case Study: The Graying of Japan.

- 1949: TFR = 4.5
1998: TFR = 1.4 (one of the world's lowest)
- Declining workforce: encourage automation and women working outside the home.
- Japan resists increasing immigration – fearing a breakdown in its social cohesiveness.

Solutions: Influencing Population Size.

How is Migration Related to Environmental Degradation?

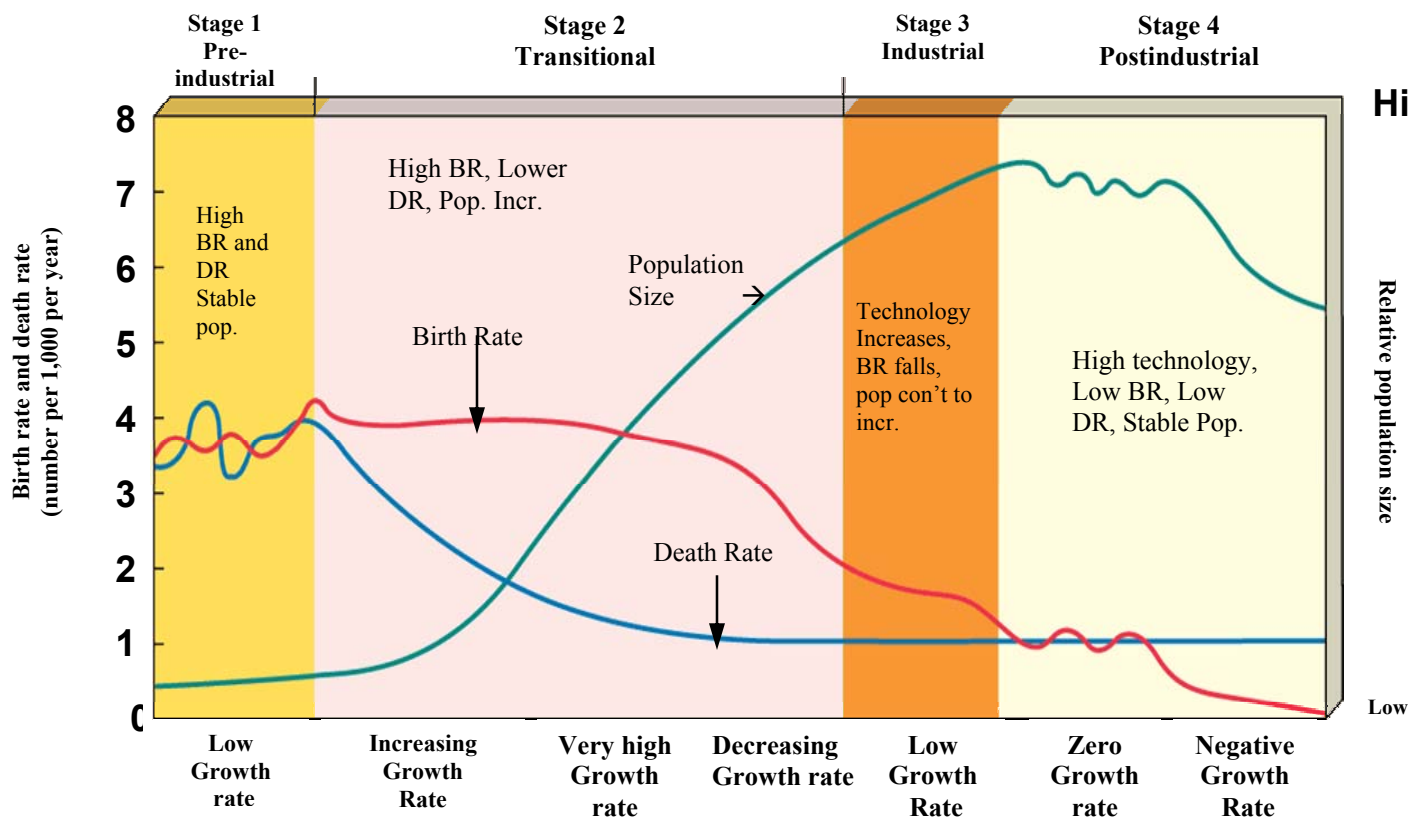
- People voluntarily move from less affluent areas to more affluent areas both within countries and between countries.
- 1995 – 27 million international environmental refugees moved from one country to another because of drought, desertification, deforestation, soil erosion, and resource shortages. (23 million traditional refugees in 1995)
- 1988-1998: 50 million people left homeless by natural disasters (earthquakes, hurricanes, floods and landslides)
- Most countries restrict immigration. Only a few accept large numbers of immigrants or refugees (U.S., Canada and Australia).
- U.S. Immigration – 1999
 - 800,000 legal immigrants and refugees
 - 300,000 illegal immigrants (constituting 40% of pop. growth)
 - 75% of legal immigrants live in CA, FL, IL, NY, NJ and TX. (90% with illegal immigrants)
- Immigrants
 - provide labor for jobs many Americans refuse to do.
 - Immigrants pay taxes
 - Immigrants increase the need for goods and services
 - Immigrants increase the need for social services (incl. schools)
 - Immigrants have children who are automatically US citizens (?)

What are the Pros and Cons about Reducing Births?

- Can we provide enough food, energy, water, sanitation, education, health care, and housing for twice as many people if the world pop. continues to grow?
- Can we provide adequate standard of living for twice as many people without causing massive environmental damage?
- Some say the Earth is already overpopulated.
- Others say the Earth could support 20-48 million people if everyone existed at a minimal survival level (grain diet only, cultivate all arable land, mine the Earth's crust to a depth of 1 mile).

Computer Models

- **System dynamics computer modeling**
 - mimics the behavior of complex systems and makes projections.
 - Uses mathematical equations to represent interactions of key variables: feedback loops, time delays, synergistic interactions and other properties of complex systems.
- Models are
 - no better than the assumptions built into them and the accuracy of the data used.
 - very useful for evaluating possible implications of current trends and proposed changes in environmental and economic policies.
- *The Limits of Growth* (1972) by Forrester *et al.*: projected economic and ecological collapse if pop. trends and resource use continued unchanged from 1970s.
- *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future.* Forrester *et al.*: updated their projections saying the world already overshoot some limits. We face global economic and environmental collapse during the 21st century.



How Can Economic Development Help Reduce Births?

- **Demographic Transition** (a hypothesis of population change): As countries become more industrialized, first their death rates and then their birth rates decline. (see above diagram)
- This Transition takes place in four stages:
 1. **Pre-industrial stage** – harsh living conditions, high infant mortality rates, high death rate; need a high birth rate .. pop. growth is small (or zero)
 2. **Transitional stage** – industrialization begins, rise in food production, improved health care, reduction in death rate, birth rate remains high .. pop. grows rapidly (2.5-3%/year)
 3. **Industrial stage** – industrialization is widespread. Birth rate drops and approaches the death rate. Better access to birth control, reduced infant mortality, incr. job opportunities for women, high cost of raising children, HS and college educations. Pop. grows but at a slower rate.
 4. **Post-industrial stage** – Birth rate declines further, equals death rate ==> ZPG. 37 countries (mostly western Europe, 12% of world's pop.) are in this stage.
- Developing countries are still in the transitional stage. Pop. growth in many developing countries will still outstrip economic growth leading to a demographic trap (this is happening esp. in Africa).
- A poor country with a pop. growth rate of 2.5% /year needs an economic growth rate of 5%/year to achieve the 2.5% per capita economic growth regarded as the minimum req'd to make the demographic transition.
- Developing countries do not have enough skilled workers to produce high-tech products. Many low- to middle-income countries lack the capital and resources for rapid economic development. The amount of economic assistance from developed countries has been on the decrease since 1980.

Family Planning

- Family planning provides educational and clinical services to help couples choose how many children to have and when to have them.
- 600,000 women die from pregnancy-related causes each year
- Modern contraception: 52% worldwide (2000) in developing nations.
- Responsible for 55% of the drop in TFR in developing countries from 6 (1960) to 3.2 (2000).
- Two major factors for this reduced TFR:
 1. a six-fold increase in contraceptive use by married women in past 20 years.
 2. couples seeking fewer benefits of large families
- Moderate to poor results in the more populous developing countries of India, Egypt, Pakistan and Nigeria (and in 79 less populous developing countries – Africa, Latin America).

How can Economic Rewards and Penalties be used to Help Reduce Births?

- Family planning alone cannot curb pop. growth enough in developing countries. Economic Rewards and Penalties are needed.
- **Penalties** (China): higher taxes, other fees, elimination of tax deductions for a third child, lose health care benefits, food allotments and job options.
- Economic rewards and penalties designed to lower birth rates work best if they encourage (rather than mandate) people to have fewer children, reinforce existing customs and trends toward smaller families, or increase a poor family's economic status.
- A population out of control may be forced to use coercive methods to prevent mass starvation and hardship.

Empowering Women to Help Reduce Births

- Education
- Jobs outside the home
- Societies where individual rights are not suppressed

Cutting Global Population Growth and Sustainability

- We are exceeding the carrying capacity for humans in parts of the world and eventually for the entire world. Our goals should be to reduce the current rate of population growth in all countries and stabilize it.
- Replacement-level fertility can be reached in 15-30 years. And the best way to achieve that goal is through family planning, reducing poverty and elevating the status of women. Devise government policies to minimize environmental impact of population growth in efforts to achieve sustainability.

How are Governments Planning to Reduce Population Growth?

1. Provide universal access to family planning services and reproductive health care.
2. Improve health care for infants, children and pregnant women
3. Encourage pop. policies as part of social and economic development policies
4. More equitable relationships between men and women.
5. Increase access to education, esp. for girls
6. Increase involvement of men in child-rearing responsibilities and family planning
7. Take steps to eradicate poverty
8. Reduce or eliminate unsustainable patterns of production and consumption