Chapter 18

GROWTH AND SUSTAINABILITY IN THE 21ST CENTURY

Macroeconomics in Context (Goodwin et al.)

Chapter Overview

This chapter examines ecological challenges and their implications for macroeconomic growth. It considers the problems of population, resource depletion, climate change, and possible limits to economic growth, putting earlier analysis of aggregate demand and economic growth into a new framework emphasizing sustainability. The chapter discusses theories of the relationship between economic growth and the environment, such as the Environmental Kuznets Curve (EKC). It looks at possible alternatives to indefinite economic growth, including theories of the steady-state economy. Analyses of resource limits and environmental impacts raise serious challenges to the belief that economic growth and markets, on their own, will solve the social and environmental problems of the coming century. The chapter concludes with a discussion of institutions and policies to promote sustainable development. The appendix provides an in-depth analysis of population issues.

Chapter Objectives

After reading and reviewing this chapter, you should be able to:

1. Identify ecological sustainability as a major economic issue for the 21st century.
2. Identify major environmental challenges.
3. Understand the relationship of climate change to economic growth.
4. Be familiar with the Environmental Kuznets Curve and its limitations.
5. Understand the concepts of limits to growth and a steady-state economy
6. Describe several policies directed towards sustainable development.

Key Terms

throughput
social discount rate
steady-state economy

Appendix Key Terms:

birth rate	population momentum
fertility rate	demographic transition
death rate	net migration rate
mortality rate	old-age dependency ratio
replacement fertility rate	

Active Review

Fill in the Blank

1. Major environmental issues for the twenty-first century include _____, _____, and _____.

2. Emissions of _____lead to global warming and climate change.

3. The _____committed industrialized countries to reduce their greenhouse gas emissions by an average of 5% below 1990 emissions by 2008-12.

4. The _____ curve posits an inverted U-shaped relationship between economic development and environmental damages, suggesting that as nations develop their damage to the environment decreases.

5. Taxes that are used as a means to internalize the negative externalities from pollution are called _____.

6. A discount rate that reflects social rather than market valuation of future costs and benefits, and is usually lower than the market discount rate, is called a _____.

7. (Appendix) The annual number of births per 1,000 people is the _____rate, whereas the average number of births per woman of reproductive age in the population is the _____ rate.

8. (Appendix) The annual number of deaths per 1,000 people is the _____rate, whereas the average number of deaths among a specific group is the _____ rate.

9. (Appendix) The fertility rate required in order for each generation to be replaced by a next generation of the same size (which is an average of 2.1 children per woman in industrialized countries) is the _____.

10. (Appendix) The change over time from a combination of high birth and death rates to a combination of low birth and death rates is called the _____.

True or False

11. The world population exceeded 7 billion in 2011, and the United Nations medium range projections show global population of 9.2 billion people in 2050.

12. According to leading scientists, global emissions of greenhouse gases will eventually need to be reduced significantly—up to 50 percent lower than current levels by 2050—if we are to avoid the most dangerous effects of climate change.

13. Environmental damage per capita tends to decline with increasing income for all major pollutants.

14. One of the limitations of green taxes is that they are regressive, likely falling disproportionately on lower-income households.

15. Tradable permit systems allow overall pollution to increase since businesses can purchase permits to pollute.

16. (Appendix) A population can continue to grow, in spite of having a fertility rate at or below replacement, if a large proportion of its members are of childbearing age.

Short Answer

17. What kinds of problems have emerged in affluent societies in which having "too much" may itself be a problem?

18. Identify three environmental issues that are closely related to economic growth.

19. What kinds of environmental problems are associated with the increasing global human population?

20. What are some of the problems predicted to occur with rising levels of greenhouse gas emissions?

21. What is the Environmental Kuznets Curve (EKC) hypothesis? And what is the evidence for this hypothesis?

22. Identify at least four policies for sustainable development.

Problems

1. Go to http://www.myfootprint.org and take the quiz to determine your own "ecological footprint". In you are on-campus it is probably better to consider your family living situation, since the quiz is not set up to analyze dorm living. You might try taking the quiz several times, assuming the role of either a very environmentally conscious, low-consumption individual or a high-consuming, affluent suburbanite, and see how the results differ.

2. Go to http://www.footprintnetwork.org and locate the "Footprint for Nations" under Footprint basics. Look at the 2010 Data Tables to find the per capita footprint, biological capacity, and surplus/deficit for the United States (scroll right for the surplus/deficit). Compare this to other major nations, national income groups and regions. What do you conclude about the sustainability of current consumption patterns?

Self Test

1. According to United Nations median projections, global population is expected to:

   a. Increase to 8 billion by 2050
   b. Decrease to 6 billion by 2050
   c. Remain approximately constant
   d. Increase to over 9 billion by 2050
   e. Increase to 11 billion by 2050

2. Which of the following resources are currently being depleted or at risk of depletion?

   a. Fisheries
   b. Forests
   c. Clean water for drinking and agriculture
   d. Minerals and fossil fuels
   e. All of the above.

3. Which of the following are *not* among the adverse effects of greenhouse gas emissions?

   a. Rising temperatures.
   b. Rising sea-levels.
   c. Ecological disruptions such as species extinction.
   d. Increased frequency of severe weather events such as hurricanes, floods, and droughts.
   e. Depletion of mineral resources.

4. The Intergovernmental Panel on Climate Change (IPCC) in a 2001 report predicts a rise in global average temperatures by 2100 of:

   a. Between 1 degree Celsius (low estimate) and 3 degrees Celsius (high estimate).
   b. Between 1.1 degrees Celsius (low estimate) and 6.4 degrees Celsius (high estimate).
   c. Between 2.1 degrees Celsius (low estimate), to 10.5 degrees Celsius (high estimate).
   d. They claim the uncertainties of climate change make such predictions impossible.
   e. None of the above.

5. According to the IPCC in a 2001 report, which of the following are likely effects of a 2°Celsius increase in global average temperature?

   a. A 20–30 percent decrease in water supplies in already vulnerable regions such as Southern Africa and the Mediterranean.
   b. 15–40 percent of species possibly facing extinction
   c. 40–60 million more people exposed to malaria in Africa.
   d. Up to 10 million more people affected by coastal flooding each year, with major low-lying areas swamped and coastal cities endangered.
   e. All of the above.

6. Which of the following was the conclusion of the 2006 British government report written by former World Bank chief economist Nicholas Stern?

   a. The costs of climate change in the twenty-first century are estimated as equivalent to 5–20 percent of global GDP, while the most severe effects of climate change could be avoided at a cost of around only 1 percent of global GDP.
   b. The costs of climate change in the twenty-first century are estimated as equivalent to 1 percent of global GDP, while the most severe effects of climate change could only be avoided at a cost of around 5 - 20 percent of global GDP.
   c. It now appears that the costs of current actions to minimize climate change significantly exceed the benefits.
   d. (a) and (c)
   e. None of the above.

7. If nothing is done now to stem the effects of climate change, what group will face the most dangerous impacts from climate change?

   a. Current generations
   b. Future generations living several decades from now or later
   c. Developed countries
   d. Developing countries
   e. (b) and (d)

8. Why do some researchers suggest that when economic development increases, environmental damage (per capita) will decrease?

    a. Because the greater availability of wealth and technology allows nations to adopt cleaner production methods.
    b. Because as countries develop, they move to a service-based economy which does less harm to the environment.
    c. Because as people become wealthier, they demand higher environmental quality standards.
    d. All of the above.
    e. None of the above.

9. The Environmental Kuznets Curve (EKC) hypothesis posits that:

    a. Environmental damage per capita increases in the early stages of economic development, reaches a maximum, and then diminishes as a nation attains higher levels of income.
    b. Environmental damage per capita falls in the early stages of economic development, reaches a minimum, and then rises as a nation attains higher levels of income.
    c. Environmental damage per capita steadily rises during all stages of economic development.
    d. Environmental damage per capita steadily falls during all stages of economic development.
    e. There is no clear relationship between environmental damage per capita and economic development, as it depends on the country, the pollutant, and other contingencies.

10. The evidence for the Environmental Kuznets Curve (EKC) suggests that:

    a. The EKC relationship does seem to hold for all pollutants.
    b. The EKC relationship does not seem to hold for any pollutants.
    c. The EKC relationship does seem to hold for some pollutants, such as per capita sulfur dioxide emissions and other air pollutants, but not for the environmental impacts of municipal waste, energy use, and CO_2 emissions.
    d. The EKC relationship does seem to hold for the environmental impacts of municipal waste, energy use, and CO_2 emissions, but not for per capita sulfur dioxide emissions and other air pollutants.
    e. The EKC relationship does seem to hold for some countries, but not others.

For the following question, refer to the figure below.
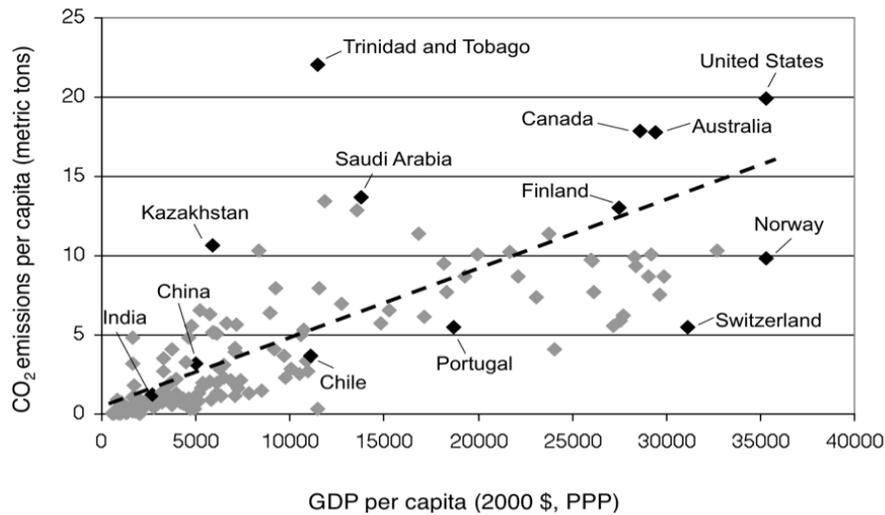
11. The figure above, showing the relationship between GDP per capita and CO_2 emissions:

    a. Indicates that developing countries typically have high per capita CO_2 emissions.
    b. Show that there is no relationship between GDP and CO_2 emissions.
    c. Provides evidence that confirms the Environmental Kuznets Curve hypothesis.
    d. Provides evidence that does not support the Environmental Kuznets Curve hypothesis.
    e. None of the above.

12. Which of the following is *not* a policy to promote environmental sustainability?

    a. Green taxes and tradable pollution permits.
    b. Grants, subsidies and tax breaks to support recycling, renewable energy, and efficient transportation systems.
    c. Tax cuts to stimulate consumption spending.
    d. Elimination of subsidies for environmental degrading activities.
    e. Debt for nature swaps.

13. Evidence on global income and environmental impacts (Table 18.1 in the text) suggests that:
    a. The impact on environmental problems of the global lower-income class is relatively minor.
    b. The global middle class leads a relatively environmentally sustainable lifestyle.
    c. The global upper income class leads the most environmentally unsustainable lifestyle.
    d. All of the above.
    e. None of the above

14. How can macroeconomic policy deal with environmental considerations?

   a. Seek to modify both the level and composition of consumption spending.
   b. Promote forms of investment that do not increase the "throughput" of natural resources and the creation of wastes.
   c. Direct government spending towards promoting environmental sustainability.
   d. Promote investments that are more future-oriented than those concerned with short-term considerations.
   e. All of the above.

15. (Appendix) Which of the following is *not* one of the 5 stages of the demographic transition?

   a. Both birth and death rates are high.
   b. Death rates are reduced, while birth rates stay high.
   c. Death rates start declining, but are still higher than birth rates.
   d. Birth rates and death rates equalize at a low rate.
   e. Birth rates are lower than death rates.

16. (Appendix) In what stage of the demographic transition are the industrialized countries of the world?

   a. In the first stage.
   b. In the second stage.
   c. In the third or fourth stage.
   d. In the fifth stage.
   e. They have passed through the fifth stage.

17. (Appendix) Which of the following statements about global population trends is false?

   a. Even though China has put downward pressure on population with its one-child policy and had a fertility rate estimated at 1.73 in 2006, its population is still growing due to population momentum (the large number of women in childbearing years).
   b. China is expected to displace India as the world's most populous country within the next fifty years.
   c. Some countries, such as Italy, German and Japan, are now experiencing population declines.
   d. Sub-Saharan Africa has had some of the world's highest fertility rates in modern times, but increased mortality rates due to the HIV/AIDS pandemic.
   e. World population is forecasted to rise from its current level of 7 billion to about 9 billion by 2050.

18. (Appendix) Which of the following characterizes the projected U.S. population pyramid for 2050?

    a. Triangular, due to the steady birth rates and steady death rates among older persons.
    b. Triangular, due to the baby boom of the post WWII years.
    c. House-shaped, due to the unusually high proportion of the population who are in their prime working years.
    d. Rectangular, due to the rising proportion of the population who are in their retirement years.
    e. An inverted triangle, due to the rising proportion of the population who are in their retirement years.

19. (Appendix) Which of the following are macroeconomic considerations arising from higher old-age dependency ratios in upcoming years?

    a. There will be a higher proportion of elderly relative to active workers.
    b. There may be a further sectoral shift toward service-sector employment.
    c. National savings may become depressed, limiting the funds available for investment spending.
    d. Strains on public finances may lead to higher taxes and/or lower benefits.
    e. All of the above.

Answers to Active Review Questions

1. population, resource depletion, and pollution and wastes
2. greenhouse gases including CO_2
3. Kyoto protocol
4. Environmental Kuznets (Curve)
5. green taxes
6. social discount rate
7. (Appendix) birth (rate), fertility (rate)
8. (Appendix) death (rate), mortality (rate)
9. (Appendix) replacement fertility rate
10. (Appendix) demographic transition
11. True.
12. False – scientific research indicates that the reduction in greenhouse gases needs to be in the 80 to 90 percent range by 2050 to avoid major destructive impacts.
13. False – a declining trend is noted for some pollutants above about $5,000 in per capita income, but other pollutants continue to increase as incomes rise.
14. True.
15. False. Tradable permit systems allow individual business to purchase permits for pollution, but set an overall limit on the total amount of pollution emitted.
16. (Appendix) True.
17. Problems include overconsumption and overstimulation, such as obesity, as well as spiritual malaise and dissatisfaction when not being able to "keep up with the Joneses".
18. Global population, resource depletion, and pollution and wastes.
19. The increasing global human population necessitates increasing food supplies, which has led to environmental problems such as: land degradation, pollution from fertilizers and pesticides, and overdraft of water supplies.
20. The problems include: Rising temperatures (between 1.4 – 5.8 degrees Celsius), rising sea-levels and coastal flooding, decrease in water supplies, declines in crop yields, ecological disruptions such as species extinction, spread of malaria and other tropical diseases, and increased frequency of severe weather events such as hurricanes, floods, and droughts.
21. The Environmental Kuznets Curve (EKC) Hypothesis says that environmental damage per capita increases in the early stages of economic development, reaches a maximum, and then diminishes as a nation attains higher levels of income. The EKC relationship does seem to hold for some pollutants, such as per capita sulfur dioxide emissions and other air pollutants, but not for the environmental impacts of municipal waste, energy use, and CO_2 emissions.
22. Green taxes and tradable pollution permits; Grants, subsidies and tax breaks to support recycling, renewable energy, and efficient transportation systems; Elimination of subsidies for environmental degrading activities; Debt for nature swaps.

Answers to Problems

1. If you are a resident of a developed country, your personal footprint probably indicates that it would take several "earths" to support the entire global population at your level of consumption. The results will vary depending on your living situation and food and transportation patterns, as well as specific efforts to save energy, recycle, etc. The footprint is also broken down by biome (ecological zone) into cropland, pastureland, forestland, and marine fisheries. Note that the "forestland" footprint includes hypothetical forest needed to absorb carbon emissions. The "reduce your footprint" button gives tips on reducing your individual footprint, but it should be evident that even if we all try to follow these guidelines, the problem of how to support planetary consumption and growth will require much more "macro" solutions in addition to individual effort.

2. The footprint, biocapacity, and surplus/deficit are measured in measured in "global hectares per capita", which is a measure representing the area of average global productivity needed to support consumption. For the United States, the footprint is 8.0 hectares/capita, and the biocapacity (area available within the country) is 3.9 hectares/capita, giving an ecological deficit of 4.1 hectares/capita. Thus the U.S. must consume planetary resources in excess of its own to support its consumption. Scrolling up and down the table indicates that only a couple of Middle Eastern oil producers—Qatar and the United Arab Emirates—have a higher footprint than the U.S. Most European countries have about half the U.S. footprint, and almost all developing nations have much lower footprints. Since the world as a whole is in "ecological deficit", with most of this deficit being due to the high-income countries, this clearly raises issues of macroeconomic growth – per capita environmental impacts will have to be drastically reduced to achieve a sustainable situation, and to accommodate population growth and economic growth (at least in the currently developed countries, even if higher-income countries were to move towards a steady-state economy.)

Note: The table indicates that the planet as a whole has an ecological deficit, consuming approximately 1 ½ "earths". How the entire planet be consuming more than we have? The answer is that the footprint calculation includes the theoretical forest area needed to absorb our carbon production, so our "ecological deficit" mostly takes the form of excess carbon stored in the atmosphere. The cropland, grazing, and forest footprints, taken alone, are not in deficit but indicate approximately full use of current capacities.

Answers to Self Test Questions

1.	D	8.	D
2.	E	9.	A
3.	E	10.	C
4.	B	11.	D
5.	E	12.	C
6.	B	13.	D
7.	E	14.	E

Appendix

15.	C	18.	D
16.	C	19.	E
17.	B		