

# Markets for Natural Resources

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March 2, 2017

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## Nations with Highest Per Capita GDP, 2015

	Dollars
Macau	111,497
Luxembourg	101,926
Singapore	85,382
Brunei	78,369
Kuwait	74,646
UAE	69,971
Ireland	65,144
Norway	61,197
Switzerland	61,086
Hong Kong	56,924
US	56,116
Saudi Arabia	53,539

# Problems of Markets for Natural Resources

Some natural resources, such as land, are in fixed supply

Supply is not dependent on price; price is “pure rent”

Henry George, *Progress and Poverty*, 1879

Diminishing returns to fixed factors may retard economic growth

Thomas Malthus, *An Essay on the Principle of Population*, 1798

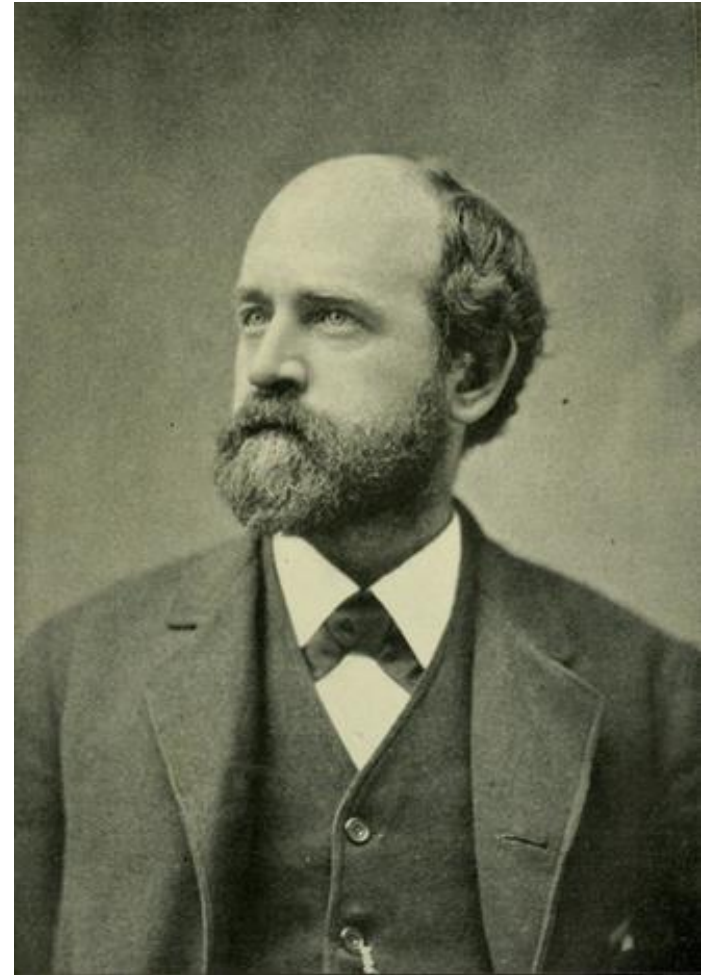
Paul Ehrlich, *Population Bomb*, 1968

Donella Meadows et al., *The Limits to Growth*, 1972

# Henry George and the Single-Tax Society

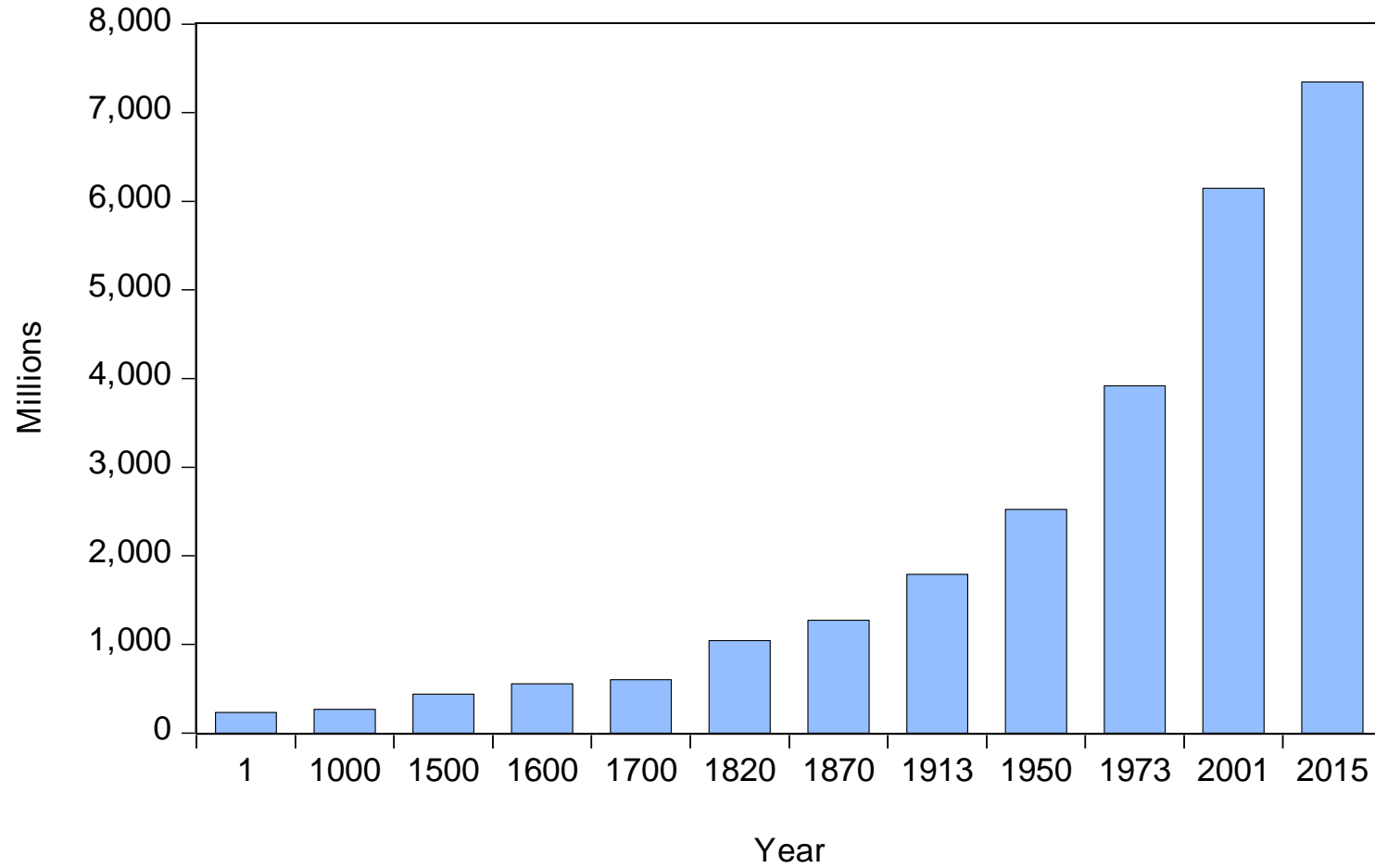
Henry George, 1839-1897

Decried concentration of wealth  
in unearned economic rents



# World Population, 1-2015

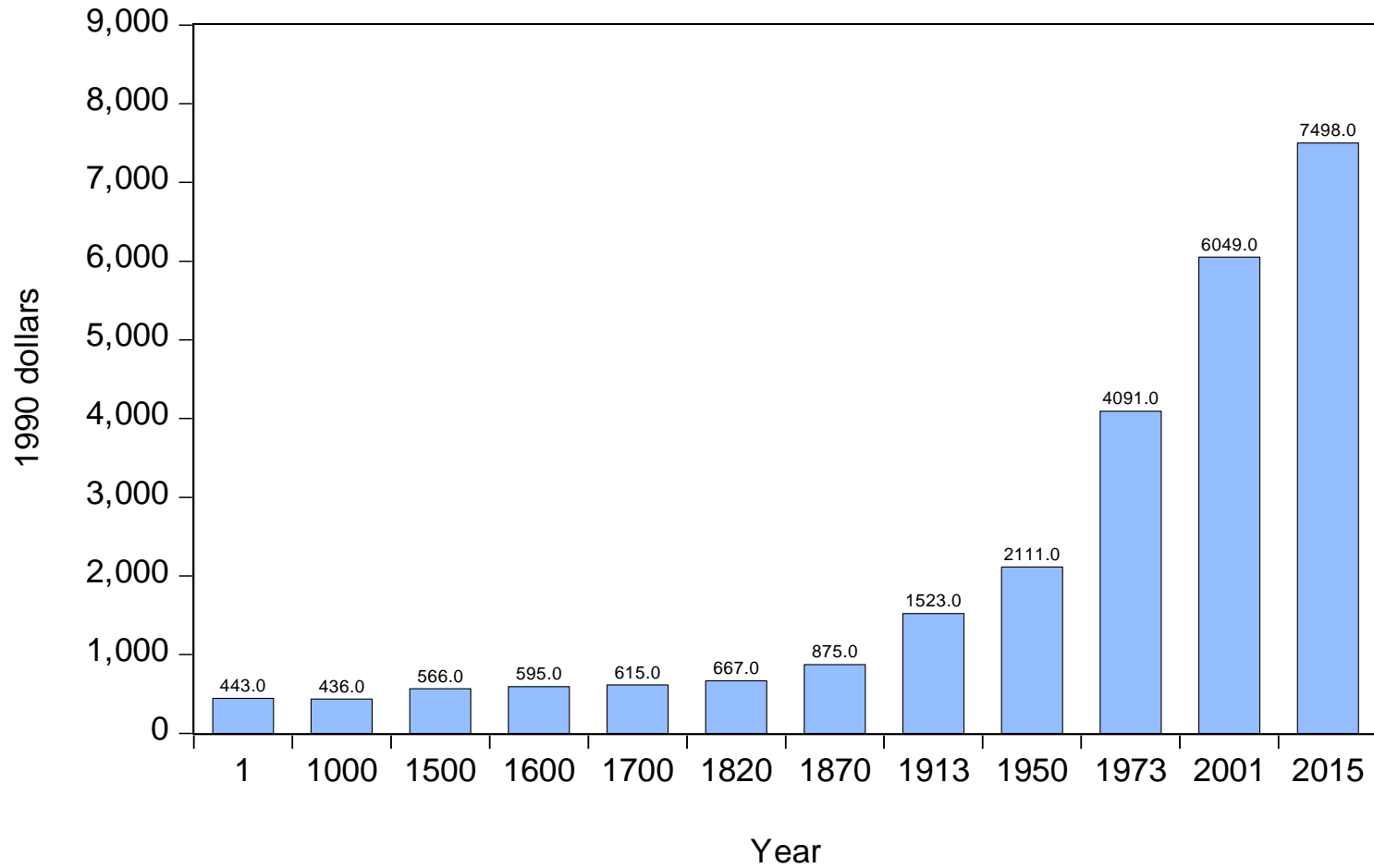
Millions



Source: A. Maddison, The World Economy: Historical Statistics, OECD, 2003

# World Per Capita GDP, 1-2015

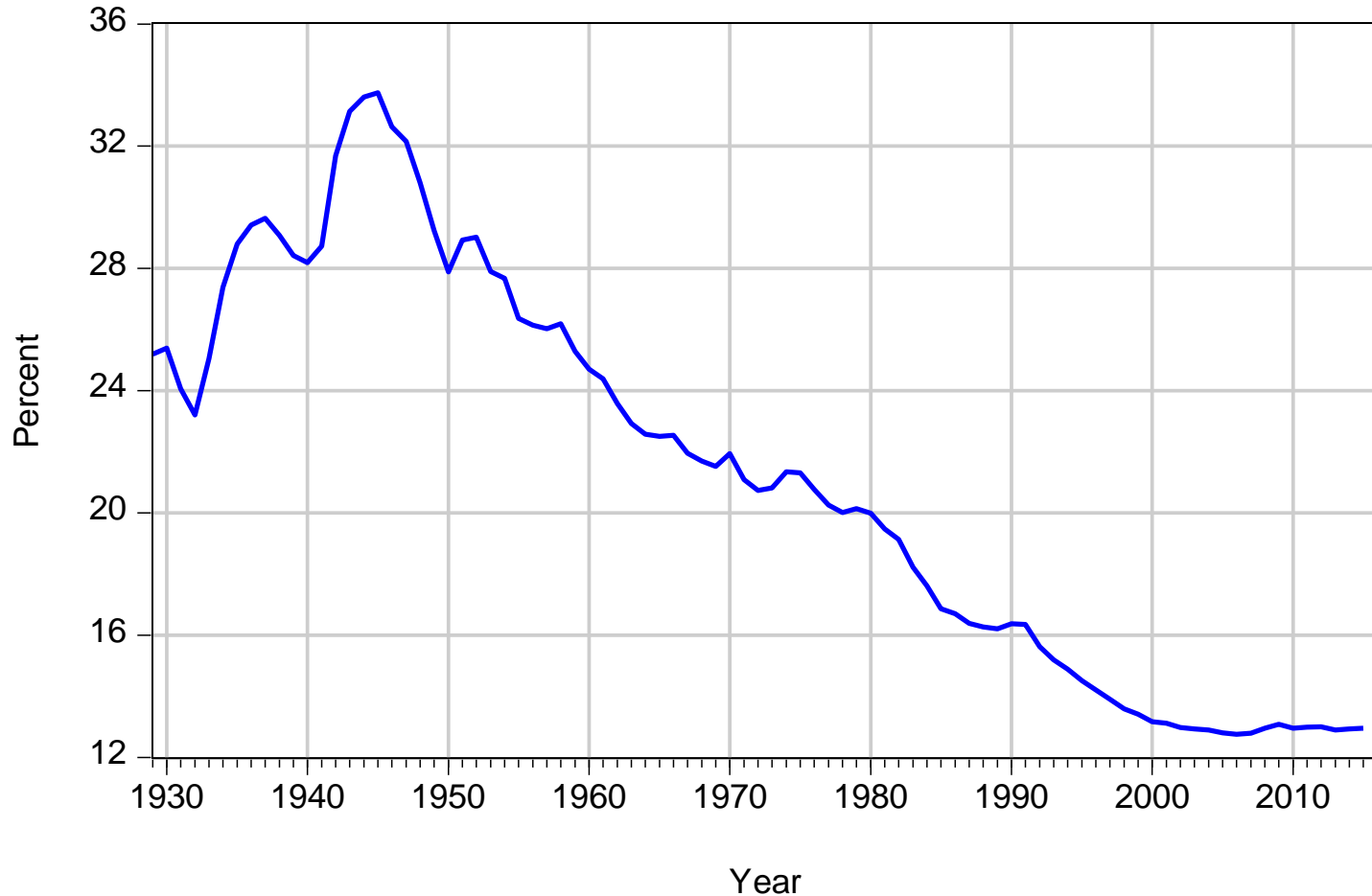
1990 dollars



Sources: A. Maddison, *The World Economy: Historical Statistics*, OECD, 2003;  
2015 estimated using World Bank data

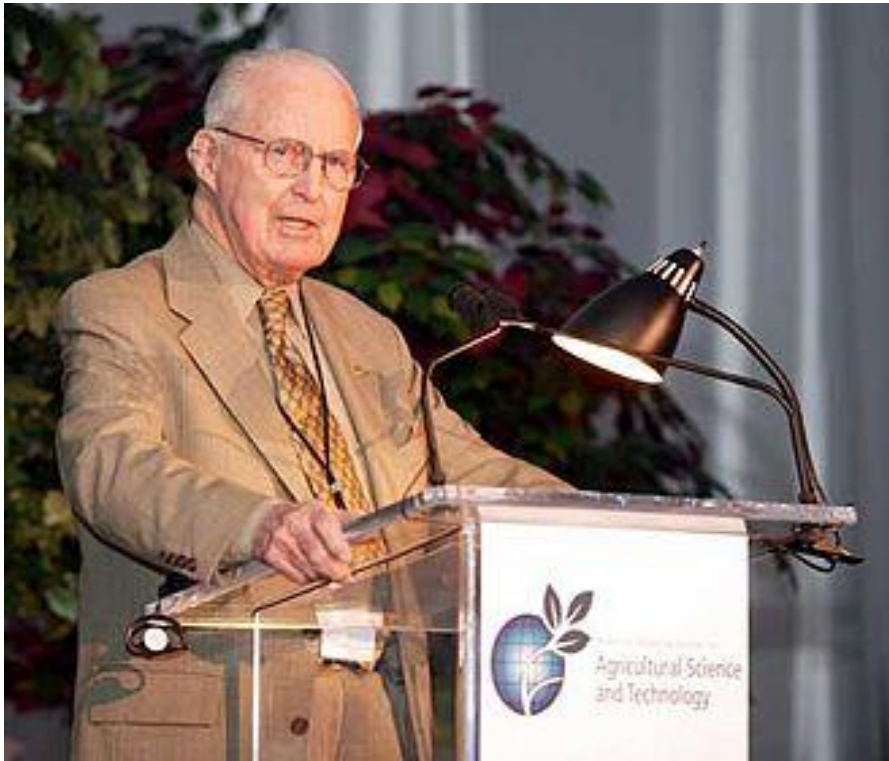
# Household Spending on Food Has Trended Downward Since World War II

Personal Consumption Expenditures on Food, 1929-2015  
Percent of Total Personal Consumption Expenditures



Source: U.S. National Income Accounts, Tables 2.3.5, 2.4.5; includes food consumed at home and away

# Father of the “Green Revolution”



Developed high-yield,  
disease-resistant wheat  
varieties

Introduced new seeds and  
methods in Mexico,  
Pakistan, India

Nobel Peace Prize, 1970

Norman Borlaug, 1914-2009



# Problems of Markets for Natural Resources

Some natural resources are renewable but exhaustible

Examples – grazing lands, fisheries, forests

Common resources create need for coordination

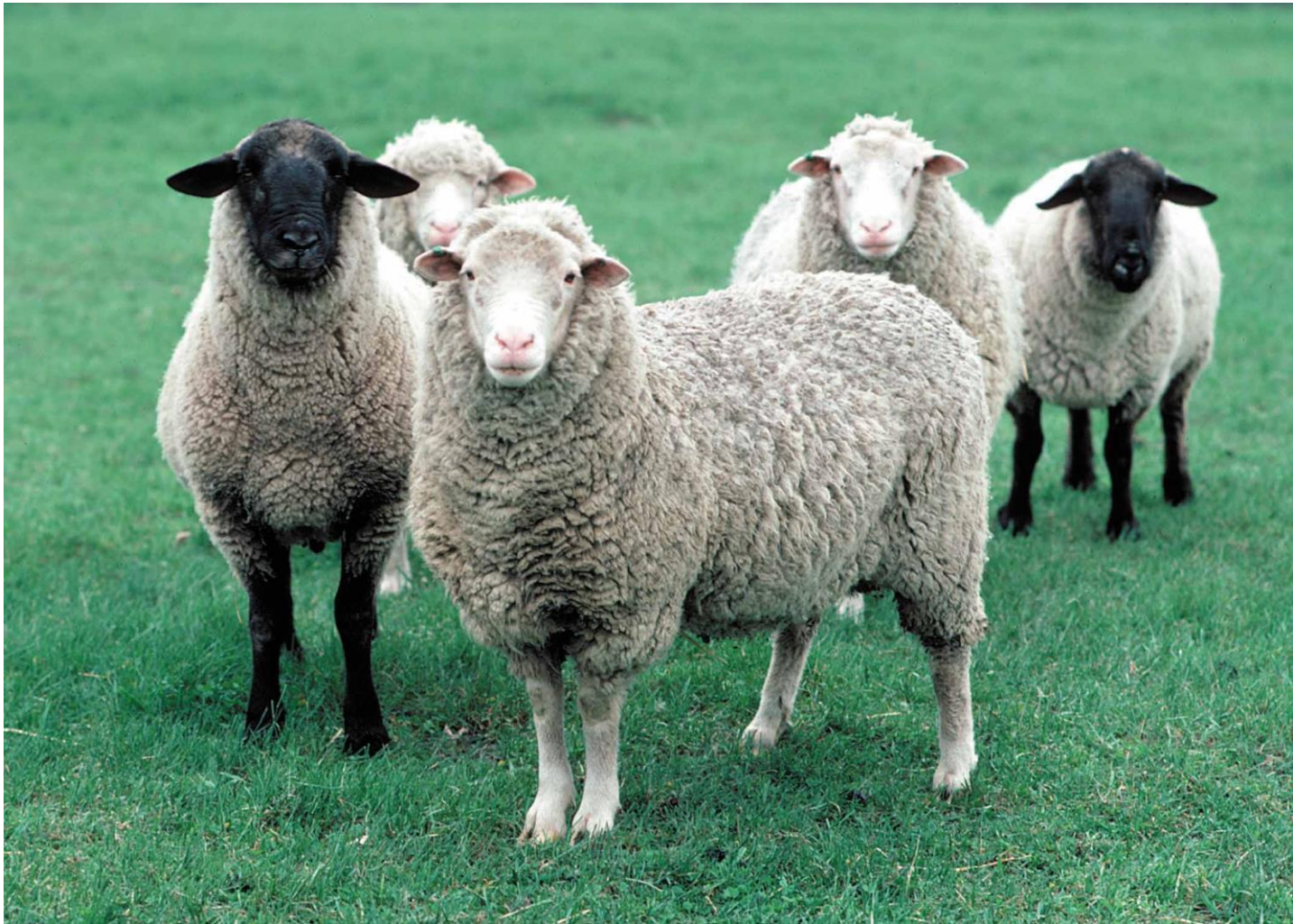
Government regulation vs. private arrangements

Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action*, 1990

Some natural resources are exhaustible and non-renewable – oil, coal

How rapidly should such resources be used up?

Economic growth may not be sustainable  
if critical resources are non-renewable



Ringleaders of the Enclosure Movement



Elinor Ostrom, 1933-2012

Indiana University faculty

Advocate of private solutions  
to common resource management

Nobel Prize in Economics, 2009

*Governing the Commons: The Evolution  
of Institutions for Collective Action, 1990*

# Externalities and Social Cost

External effects of production and consumption

Plants emit harmful substances into air or water

Smokers pollute air and create health hazard for others

Producers and consumers are degrading natural resources,  
but they are not paying for the damage done

Social costs of activities exceed private costs

Economic decisions need to be based on social cost

# Alternative Approaches to Limit Environmental Damage

## Non-market approach

Command and control: Set maximums for each emitter and enforce with penalties

## Market-based approaches

Facilitate private voluntary arrangements among affected parties

Clarify property rights, let parties bargain

Ronald Coase, "The Theory of Social Cost," 1960

Pigouvian taxes on emissions

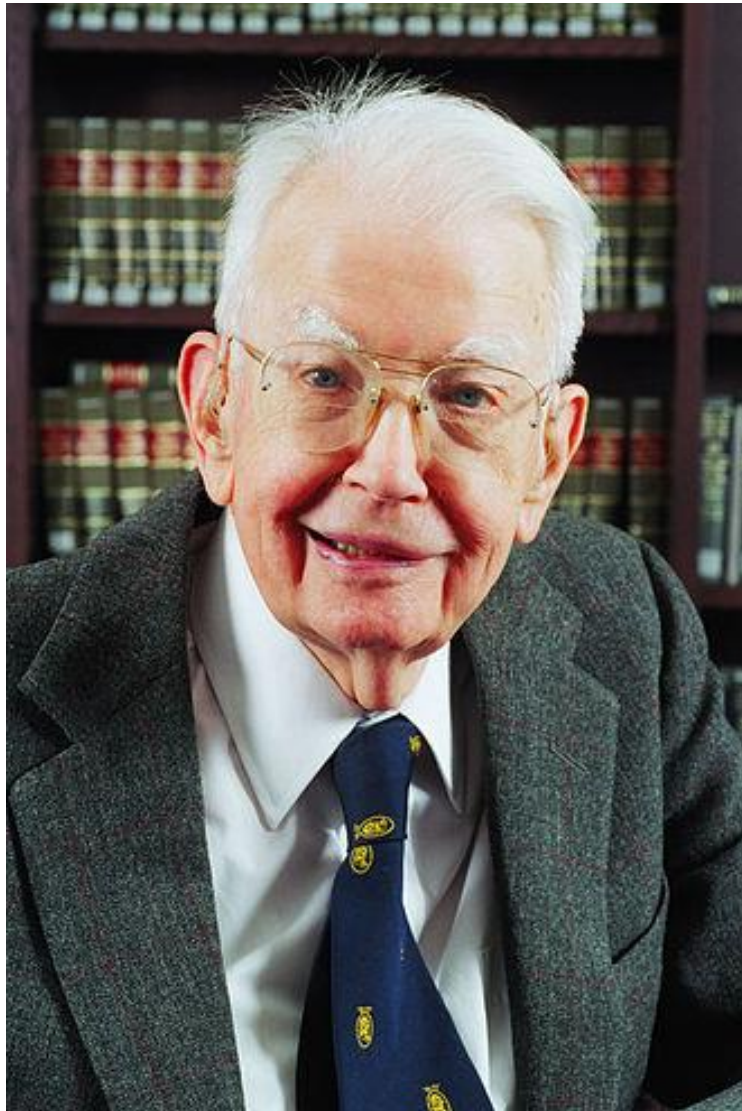
Tax activities to make price + tax signal social cost

A. C. Pigou, *The Economics of Welfare*, 1920

Cap-and-trade: set overall limits, issue permits, allow trading in permits

Example: EPA's SO<sub>2</sub> permit auctions to reduce acid rain





## Ronald Coase, 1910-2013

University of Chicago faculty

Nobel Prize in Economics, 1991

Coase Theorem: If there are no transactions costs and property rights are clear, markets can deal with externalities.

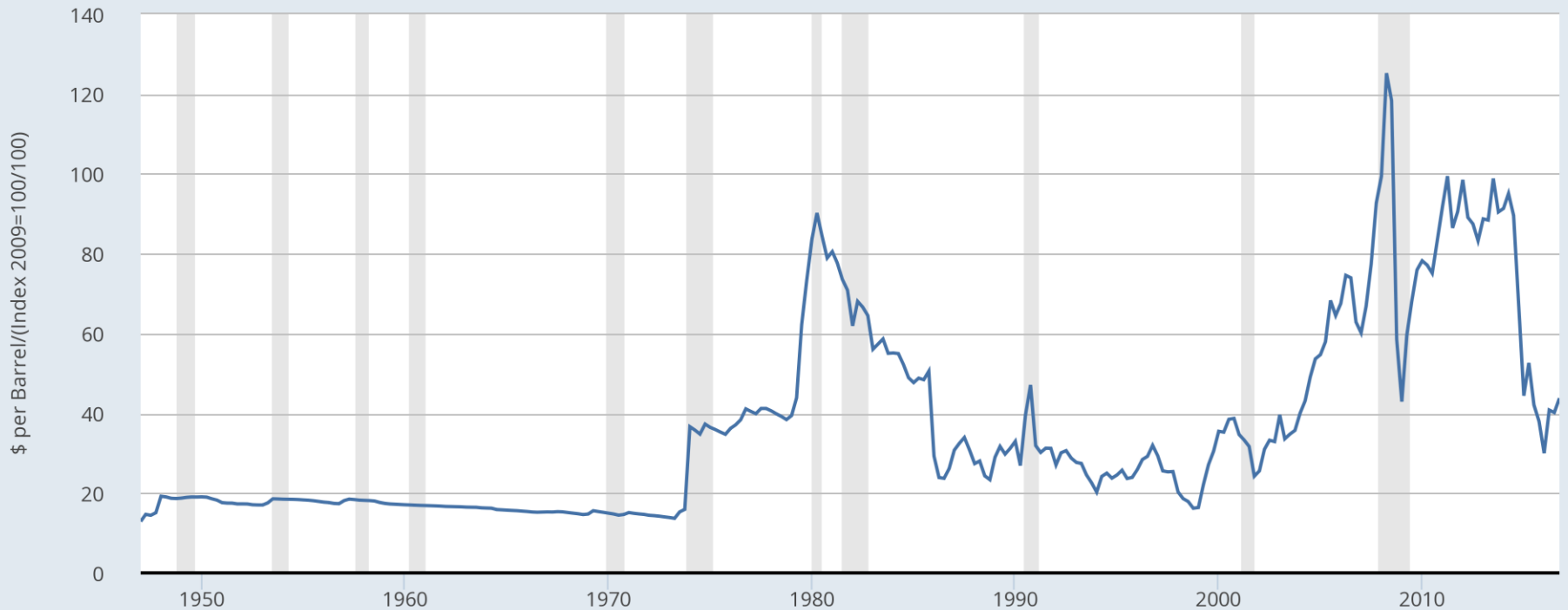
# Some Landmarks in Environmental Protection

- 1916 National Park Service
- 1933 Civilian Conservation Corps (closed 1942)
- 1962 Rachel Carson, *Silent Spring*
- 1963 Clean Air Act; major strengthening in 1970 and 1990
- 1970 Environmental Protection Agency established
- 1972 First modern Clean Water Act
- 1980 Environmental Superfund to remove toxic wastes
- 1997 Kyoto Protocol to reduce international greenhouse gas emissions
  - Became effective in 2005
  - US did not ratify; others such as Canada have dropped out
  - Doha Amendment to extend beyond 2012 not yet ratified
- 2005 EU establishes Emission Trading System
  - World's first mandatory cap-and-trade to reduce CO<sub>2</sub> emissions
- 2007 Energy Independence and Security Act – Bush's "20 in 10" challenge
- 2015 Paris Agreement follow-up to Kyoto Protocol - limit global warming to 2° C.

# The Real Price of Crude Oil Has Been Cyclical With Little Trend



— Spot Crude Oil Price: West Texas Intermediate (WTI)/(Gross Domestic Product: Implicit Price Deflator/100)





# The Hog Cycle

## Market Cycles Caused by Production Lags and Overshooting



Rise in price increases herd

Larger herd eventually reduces price

Lower price reduces herd

Smaller herd eventually raises price

And so on ...

Fall in gas price increases herd

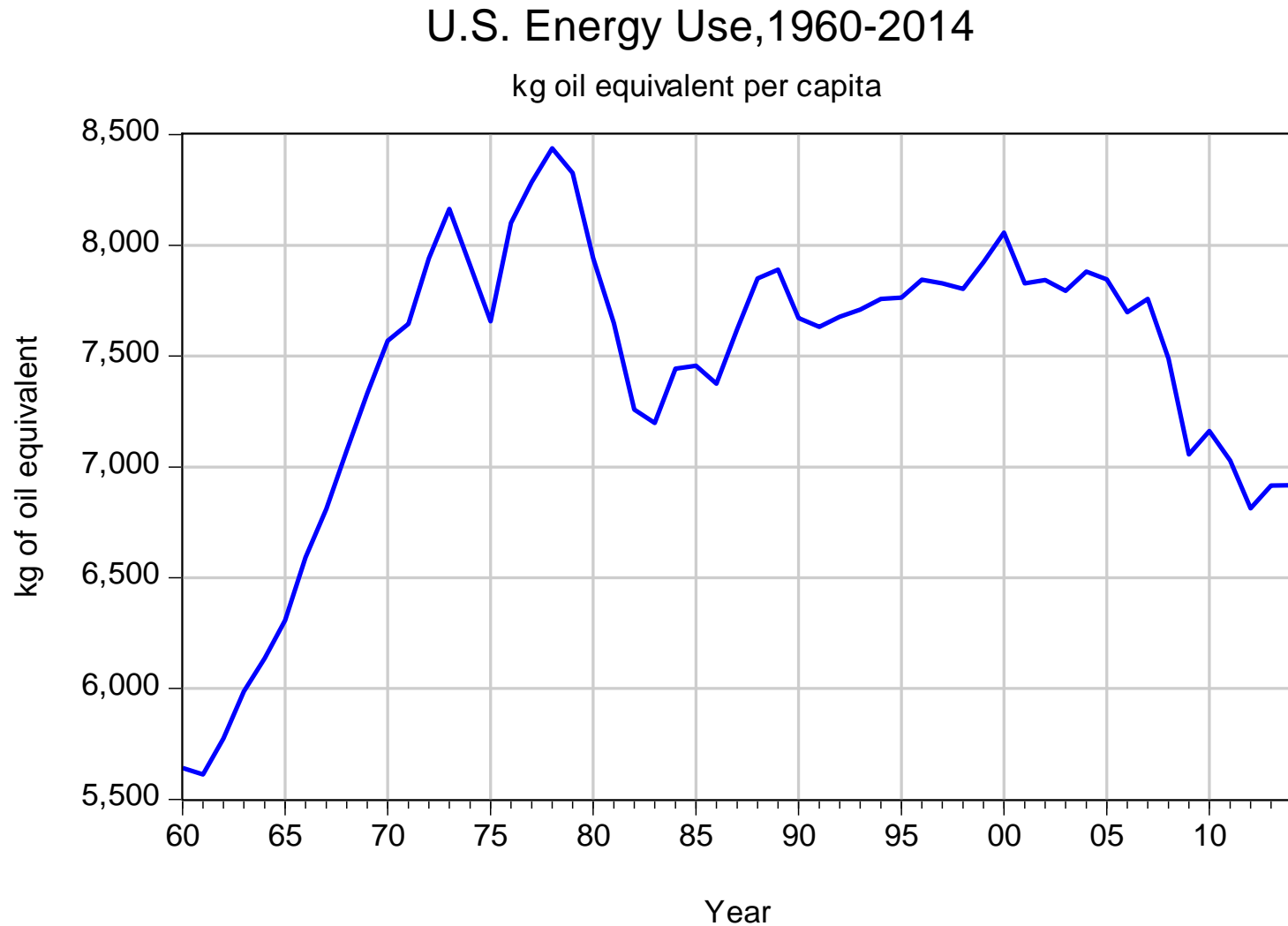
Larger herd eventually raises gas price

Higher gas price decreases herd

Smaller herd eventually lowers gas price

And so on ...

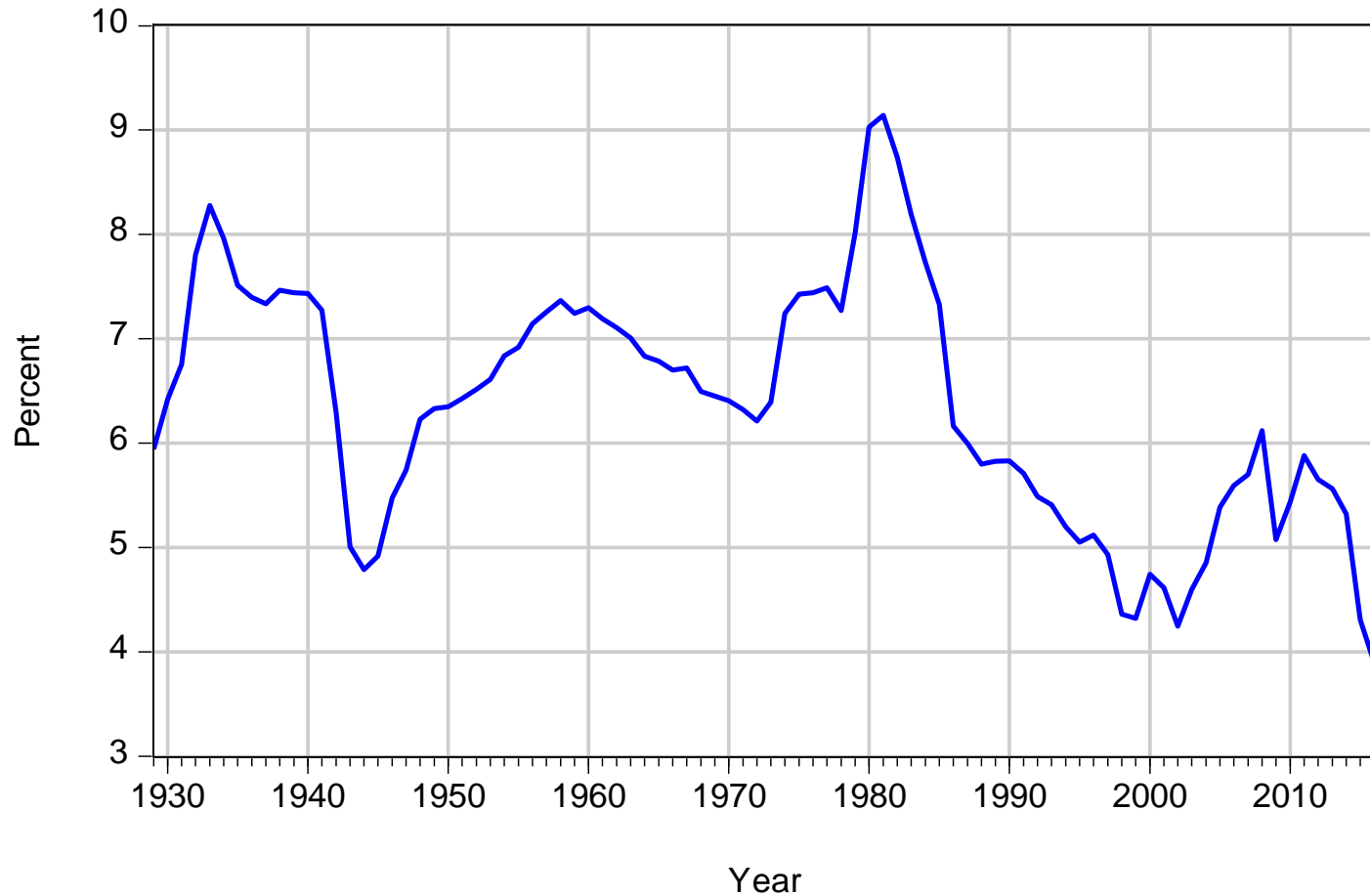
# U.S. Energy Use Stabilized Before Declining in the Great Recession



Source: World Development Indicators, World Bank

# Household Spending on Energy Is Low Compared to Past History

Personal Consumption Expenditures on Energy Goods and Services, 1929-2016  
Percent of Total Personal Consumption Expenditures

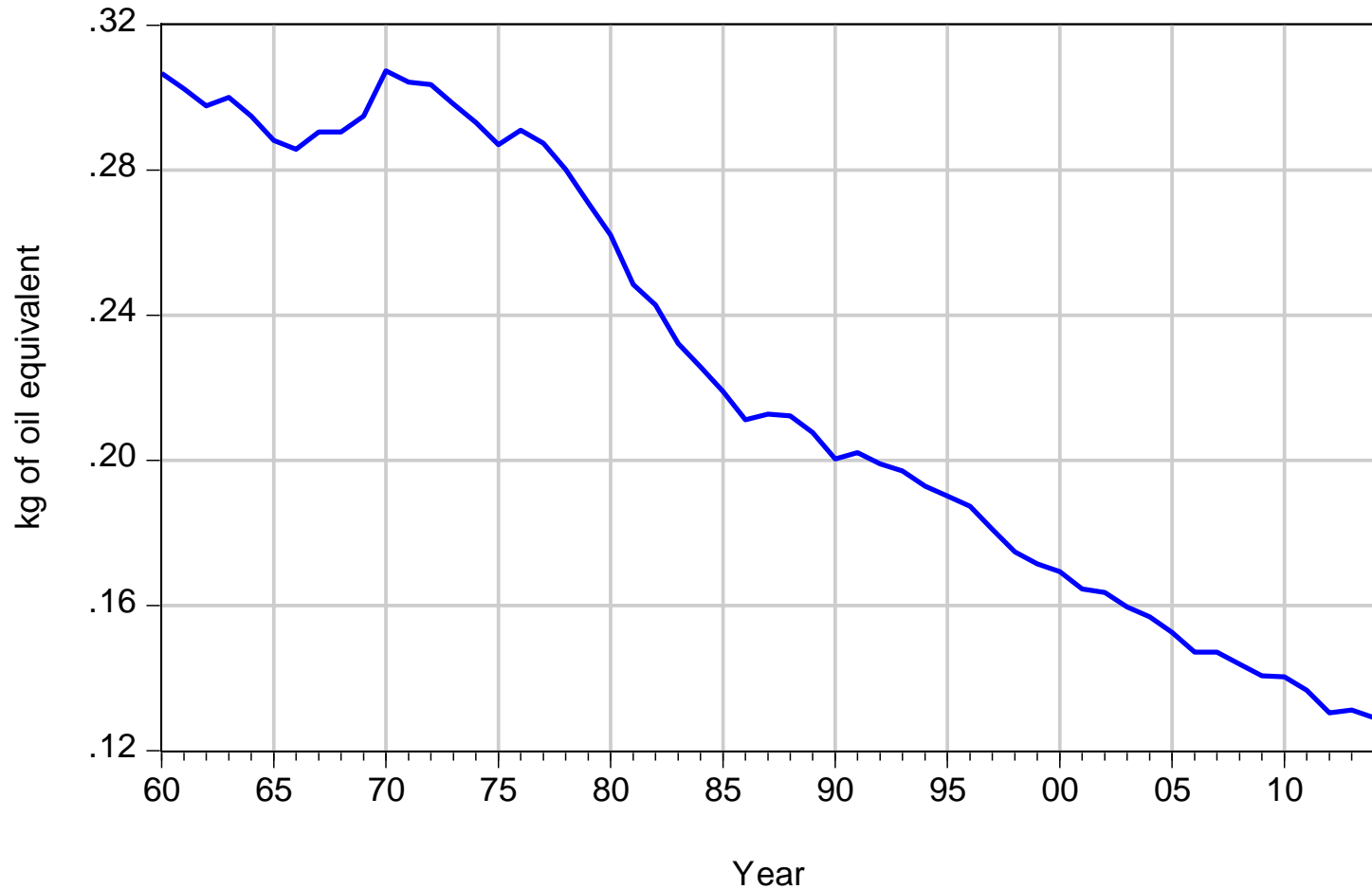


Source: Data from U.S. National Income Accounts, Table 2.3.5

# U.S. Energy Efficiency Has Greatly Improved Since 1976

## Energy Use per Dollar of Real GDP, 1960-2014

kg of oil equivalent per dollar of GDP in 2013 dollars



# Energy Use in Selected Nations, 2013

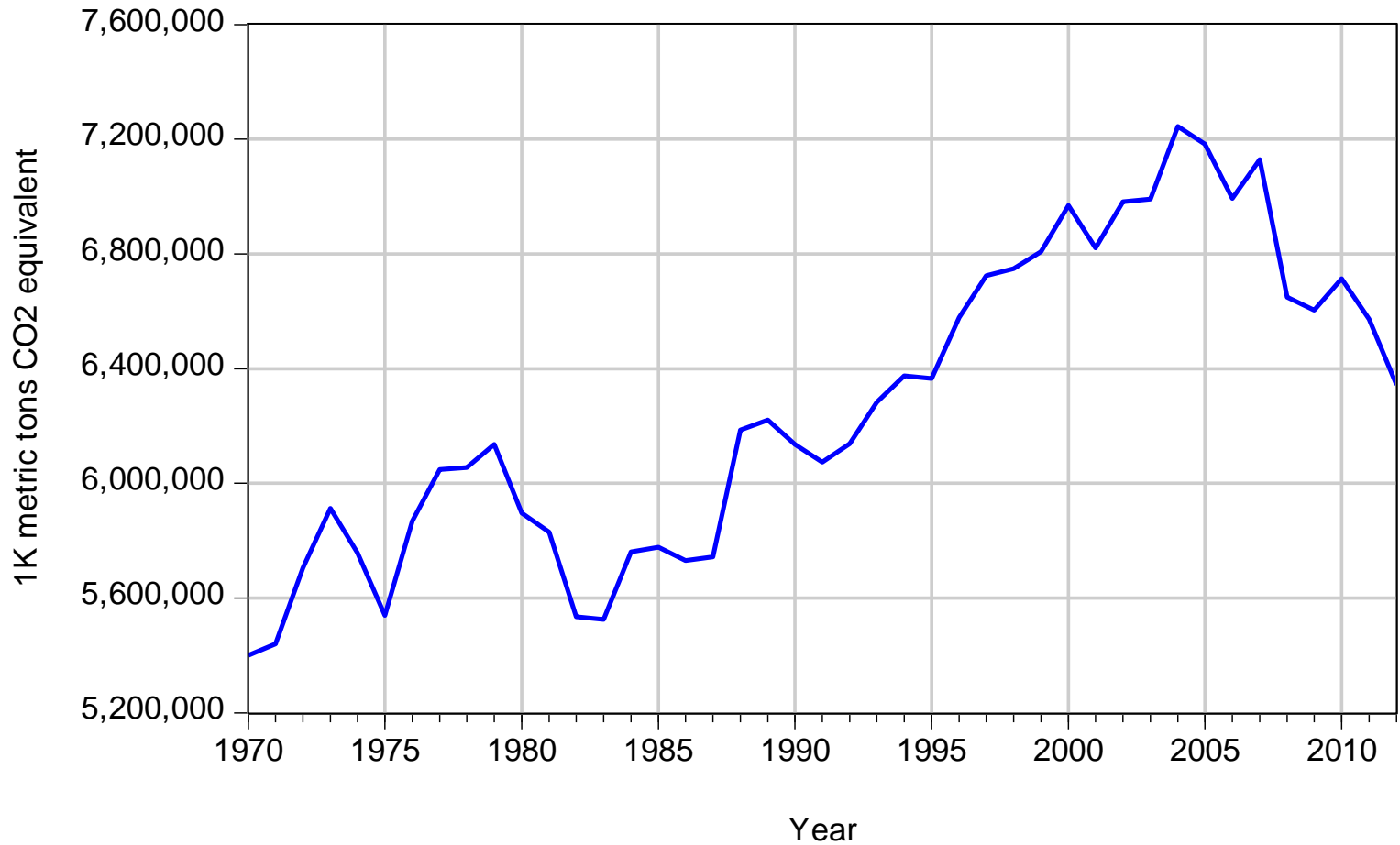
Kilograms of oil equivalent

	Per capita		Per \$1K GDP
Qatar	19,120	China	180
Canada	7,202	Canada	164
US	6,916	Qatar	141
Norway	6,439	US	131
Australia	5,586	Australia	123
Sweden	5,132	Sweden	112
Germany	3,868	France	97
France	3,840	Norway	96
Japan	3,570	Japan	91
UK	2,978	Germany	85
Spain	2,504	Spain	76
China	2,226	UK	76

# U.S. Greenhouse Gas Emissions Have Declined 12% Since 2004 Peak

## Greenhouse Gas Emissions, 1970-2012

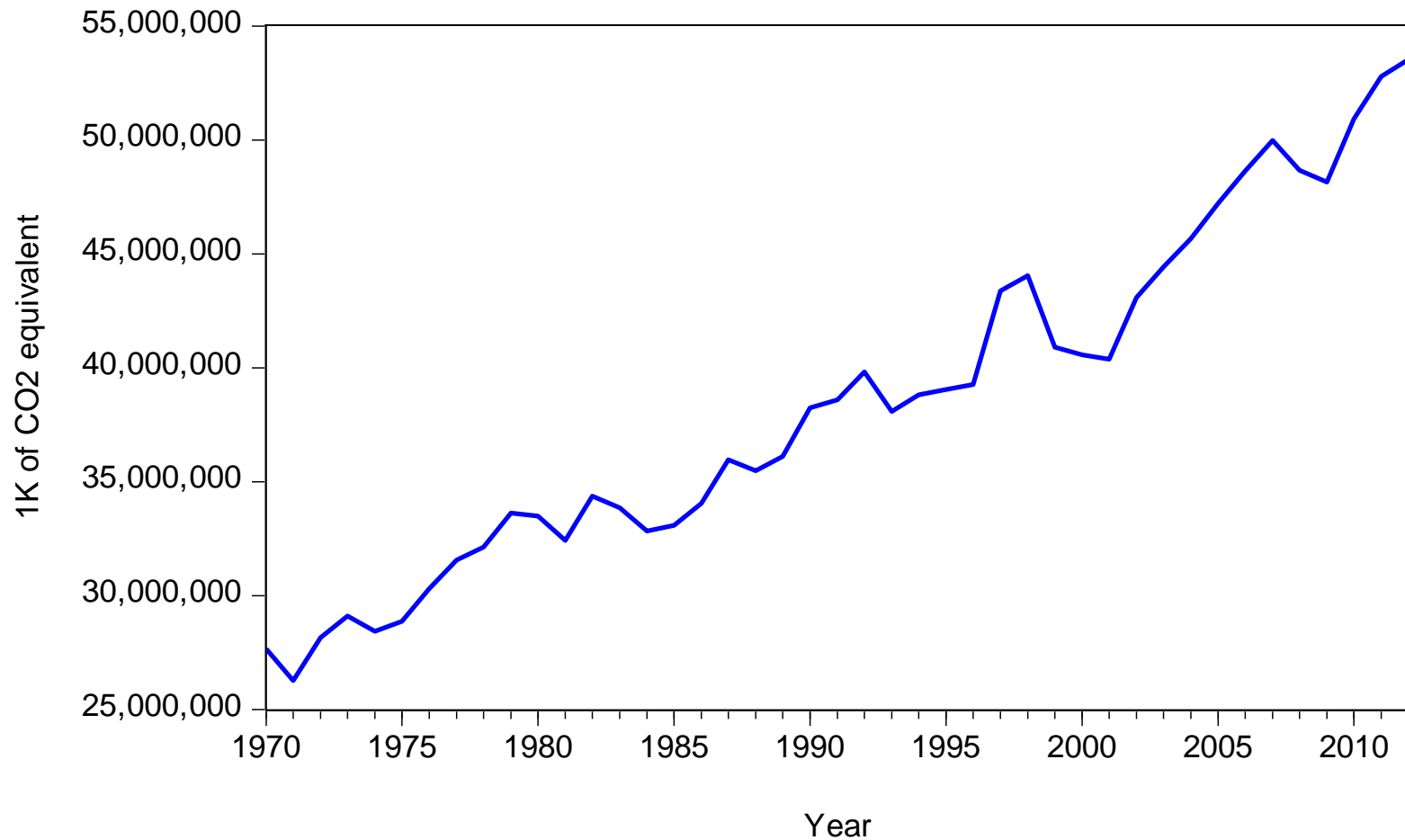
Thousands of metric tons of CO2 equivalent



# World Greenhouse Gas Emissions Have Risen Steadily

## Greenhouse Gas Emissions, 1970-2012

Thousand of metric tons of CO2 equivalent



# Greenhouse Gas Emissions in Selected Nations, 2012

Thousand metric tons of CO2 equivalent

	Total		Per \$1M GDP
World	53,526,303	World	536
China	12,454,711	China	812
US	6,343,841	Australia	787
Japan	1,478,859	Canada	701
Canada	1,027,063	US	393
Germany	951,717	Qatar	383
Australia	761,686	Japan	312
UK	585,780	Germany	272
France	499,147	UK	245
Spain	348,257	Spain	232
Qatar	103,155	France	202
Sweden	65,768	Norway	194
Norway	63,537	Sweden	154



# 12 Largest Emitters of Greenhouse Gases, 2012

Thousand metric tons of CO2 equivalent

World	53,526,303
China	12,454,711
US	6,343,841
India	3,002,895
Brazil	2,989,418
Russia	2,803,398
Japan	1,478,859
Canada	1,027,063
Germany	951,717
Congo	802,271
Indonesia	780,551
Australia	761,686
Korea	668,990

# Recent Republican Proposal for a Carbon Tax

Impose gradually increasing carbon tax at point of entry, e.g., mine or wellhead

Return tax receipts to all citizens in equal quarterly “dividend” checks (tax free)

Impose compensating fees on imports from nations with no carbon taxes

Rebate carbon taxes on exports to nations with no carbon taxes

Eliminate EPA regulations of carbon emissions; repeal Obama’s Clean Power Plan

See “The Conservative Case for Carbon Dividends,” Climate Leadership Council, February 2017. Also appeared as op-ed in the NY Times, Feb. 8, 2017.

Authors include James Baker, Henry Paulson, George Shultz, Martin Feldstein, Gregory Mankiw

# The Outlook: Gradual Warming with Possibility of Disaster

CO2 concentrations estimated to double by 2050,  
compared to pre-industrial levels; ~ 4° temp increase

Some progress in emissions reductions,  
but expect reruns of the Hog Cycle

Economics of wind and solar still shaky; need storage capacity

If world greenhouse gas emissions per capita were at US level,  
world emissions would be 3X higher

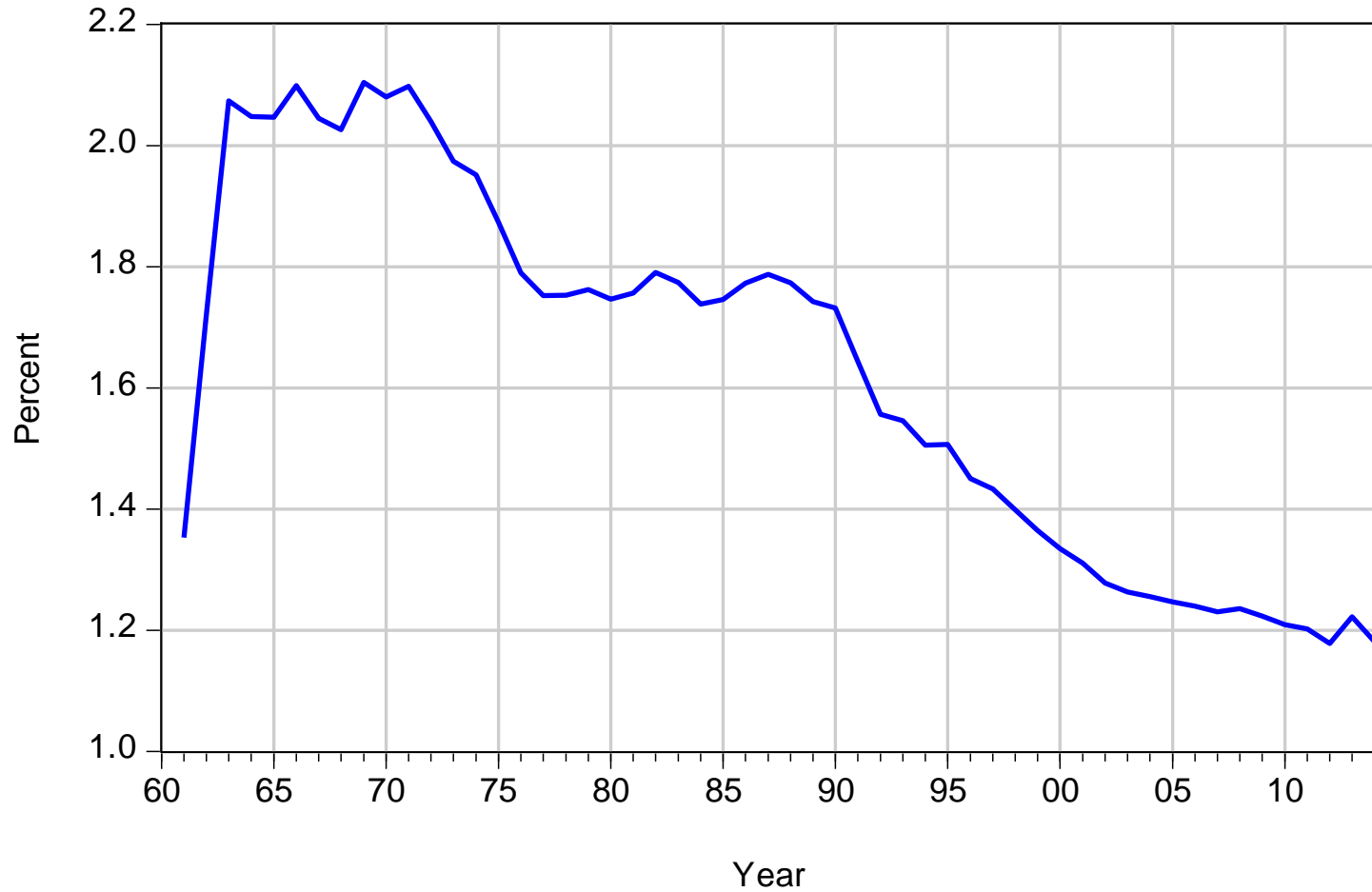
If they were at Swedish level,  
world emissions would be just 10% lower

Even at today's 1.2% growth rate,  
world population will double in 58 years

International protocols are in trouble

Will markets signal need for adjustments before it is too late?

# Annual Growth Rate of World Population, 1961-2015



Source: World Development Indicators, World Bank

**END**