ECON 202 - MACROECONOMIC PRINCIPLES

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Chapter 5 - Measuring National Production

Measuring National Production - Topics

- What is an economy in macro?
- Definitions of GDP
- How to calculate GDP - 3 approaches
- Real vs. nominal GDP
- GDP deflator
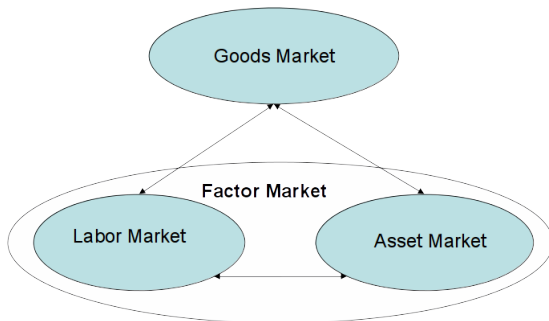- Consumer price index

The Economy

Starring:

- The Firm
- The Household (HH)
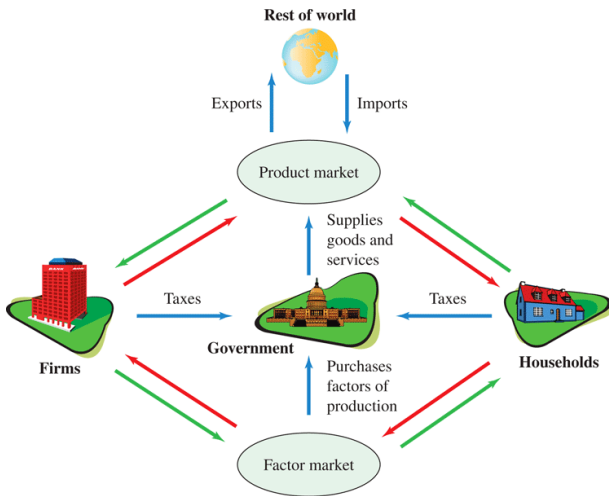- The Government (G)
- The Foreign Sector

The Economy

Actors:

- The Firm
- The Household (HH)
- The Government (G)
- The Foreign Sector

Figure 1: The Locations

Figure 2: Circular Flow

Mechanism

- Production generates income!
- HH supply labor and capital to firms via factor markets
- Firms produce "stuff" and pay wages and interest (or rent or dividends) to HH
- Firms sell "stuff" to HH hopefully making a profit
- HH consume "stuff"
- (The Government sleeps and the Foreign Sector is too far away for the moment!)

Measuring GDP

How do we measure production?

- Answer: Gross Domestic Product (GDP)
- Definition of GDP
    - The total market value of
    - all the final goods and services
    - produced within an economy
    - in a given year
- It is a measure of total value added to the economy over the given period
- Beware of intermediate goods and stuff produced by Americans outside the states

Three Approaches

- In the United States (US) measured quarterly as part of **National Income and Product Accounts** (NIPA).
- Three approaches:

1. Product - sum of all the value-added in the economy (do not count intermediate goods).
2. Expenditure - total spending on all final goods and services in the economy (do not count intermediate goods).
3. Income - add up all incomes received by economic agents contribution to production.

- All three approaches will yield the same answer:
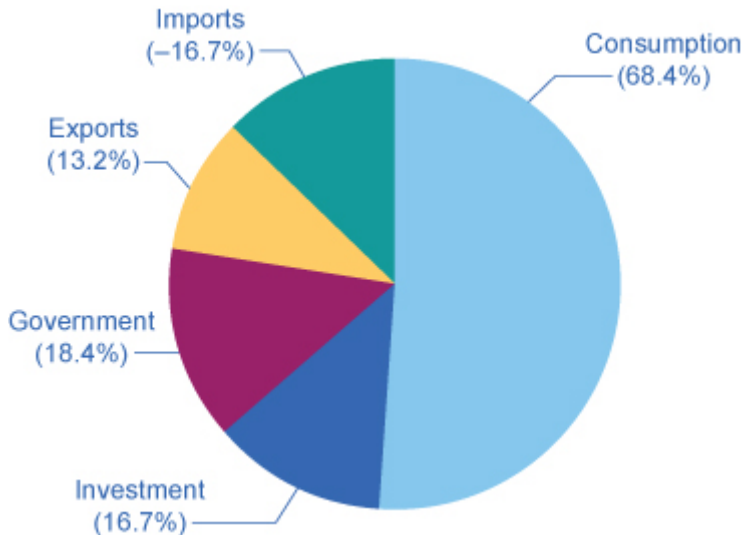
$$Y = C + I + G + NX.$$

Components of GDP - Expenditure Approach (II)

- Economists divide GDP into four broad expenditure categories:
  - Consumption expenditures: purchases by consumers
  - Private investment expenditures: purchases by firms.
  - Government purchases: purchases by federal, state, and local governments.
  - Net exports: net purchases by the foreign sector (domestic exports minus domestic imports)

TABLE 5.1	Composition of U.S. GDP, Third Quarter 2011 (Billions of Dollars Expressed at Annual Rates)			
GDP	Consumption Expenditures	Private Investment Expenditures	Government Purchases	Net Exports
$15,176	$10,784	$1,906	$3,047	–$562

Components of GDP (2014)

The GDP Equation

- Letting the symbol "Y" stand for GDP and
- C, I, G, NX stand for consumption, investment, government purchases, and net exports

$$Y = C + I + G + NX$$

- Or in words:
    - GDP = consumption + investment + government purchases + net exports

Components of GDP: Consumption C

- C is defined as purchases of
    - currently produced goods and services,
    - either domestic or foreign

- Durable goods: e.g. cars, TVs,. . .
- Nondurable goods: e.g. food,. . .
- Services: e.g. medical services, haircuts,. . .

Components of GDP: Investment I

- New plants and equipment during the year
- Newly produced housing
- Increase in inventories during the current year
- net Inv = gross Inv. − depreciation
- In GDP accounting, investment is the purchase of new capital

Components of GDP: Government Purchases G

- Government Purchases of newly produced goods and services by federal state, and local governments
- Excludes transfer payments (e.g. social security, welfare, interest)
- Therefore, a large part of the federal government budget is not part of GDP

Components of GDP: Net exports (X)

- Net exports=exports-imports

- If net exports < 0, trade deficit!

- If net exports > 0, trade surplus!

US Trade Balance as Share of GDP

- As a Share of GDP 1960-2011 Prior to the mid-1970s, the United States usually ran a trade surplus with other nations
- However, in recent years, the trade deficits are now the norm for the United States
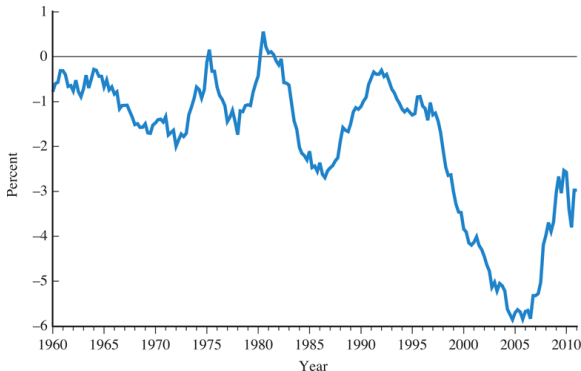
Gross National Product (GNP)

- GNP = GDP + net income earned abroad
- GNP =
    - GDP
    - + income earned abroad by US firms and citizens
    - − income earned in the US by foreign firms or citizens
- Difference between GDP and GNP in U.S. is roughly 0.2%

Net National Product (NNP) and National Income

- NNP=GNP-depreciation

- National income = NNP- indirect taxes

- Indirect taxes are sales taxes on products.

The Income Approach (III): Measuring a Nation's Macroeconomic Activity Using National Income

- The third and last adjustment we make to reach national income is to subtract indirect taxes, which are sales taxes or excise taxes on products

TABLE 5.2 From GDP to National Income, Third Quarter 2011 (Billions of Dollars)	
Gross domestic product	$15,176
Gross national product	15,443
Net national product	13,480
National income	13,431

Calculating GDP - 3 Approaches

GDP can be calculated three ways:

1. Add up the value added of all producers
2. Add up all spending on domestically produced final goods and services
   - This results in the equation: $GDP = C + I + G + X - IM$
3. Add up all income paid to factors of production

GDP: What's In and What's Out

- Included
  - domestically produced final goods and services (including capital goods)
  - new construction of structures
  - changes to inventories

- Not Included
  - intermediate goods and services
  - inputs

- used goods
- financial assets like stocks and bonds
- foreign-produced goods and services

Keep in Mind

- Goods used as inputs for production during the current period are not counted in that period's GDP
- However, investment in equipment for future production is included in GDP
- Only goods and services produced in the current period are counted in this period's GDP
    - "Raw" land, stocks and bonds are not in GDP
    - Sales of old houses are not in GDP

Calculating GDP

- Take all final goods satisfying the definition
- value them at their current market prices and
- add up the total:

$$GDP = P_1 \times Q_1 + ... + P_n \times Q_n$$

Example 1: Simple GDP Calculation

- Imagine that, during the year, only three goods are produced:
  - 10,000 computers at $1000 a piece
  - 2,000 automobiles at $5000 a piece
  - 1,000,000 haircuts at $10 a cut

$$
\begin{aligned}
GDP &= 10,000 \times \$1,000 + 2,000 \times \$5,000 + 1,000,000 \times \$10 \\
&= \$30,000,000
\end{aligned}
$$

Example 2: Calculating GDP

Economy 2:

- iron ore producer
    - steel producer
    - car producer
- Iron is an input into steel production
- Steel is an input in car production

Total spending on domestically produced final goods and services = $21,500

	American Ore, Inc.	American Steel, Inc.	American Motors, Inc.	Total factor income	
Value of sales	$4,200 (ore)	$9,000 (steel)	$21,500 (car)		
Intermediate goods	0	4,200 (iron ore)	9,000 (steel)		
Wages	2,000	3,700	10,000	$15,700	Total payments to factors = $21,500
Interest payments	1,000	600	1,000	2,600	
Rent	200	300	500	1,000	
Profit	1,000	200	1,000	2,200	
Total expenditure by firm	4,200	9,000	21,500		
Value added per firm = Value of sales − cost of intermediate goods	4,200	4,800	12,500		

Sum of value added = $21,500

Example 3: Calculating GDP with 3 Approaches

Economy 3:

- Coconut producer produces 10 million coconuts
- Sell for $2.00 each
- Producer pays wages and taxes
- Of the 10 million coconuts, 6 million go to restaurant and 4 million are consumed directly by consumers
- Restaurant pays wages and taxes and sells $30 million in restaurant meals
- Government collects taxes and provides national defense

Example 3: Calculating GDP with 3 Approaches (cont.)

Table 2.1 Coconut Producer

Total Revenue	$20 million
Wages	$5 million
Interest on Loan	$0.5 million
Taxes	$1.5 million

Table 2.2 Restaurant

Total Revenue	$30 million
Cost of Coconuts	$12 million
Wages	$4 million
Taxes	$3 million

Table 2.3 After-Tax Profits

Coconut Producer	$13 million
Restaurant	$11 million

Table 2.4 Government

Tax Revenue	$5.5 million
Wages	$5.5 million

Table 2.5 Consumers

Wage Income	$14.5 million
Interest Income	$0.5 million
Taxes	$1 million
Profits Distributed to Producers	$24 million

GDP Using the Value Added Approach (I)

- Products:
    - Private: coconut (goods) and restaurant (services)
    - Public : defense
- Value added
- Coconut producer: TR - TC of (intermed.good i.e. coconuts) $= 20 mil$
- Restaurant: TR - TC of coconut product $= (30 - 12) mil$
- Government: TR - TC $= 5.5 mil$. Cost of defense has no market price

Table 2.6 GDP Using the Product Approach

Value added - coconuts	$20 million
Value added - restaurant food	$18 million
Value added - government	$5.5 million
GDP	$43.5 million

GDP Using the Expenditure Approach (II)

- Total expenditures on all final goods and services
- Total expenditure = C + I + G + NX
- In our example, I = 0 and NX = 0

Table 2.7 GDP Using the Expenditure Approach

Consumption	$38 million
Investment	0
Government Expenditures	$5.5 million
Net Exports	0
GDP	$43.5 million

GDP Using the Income Approach (III)

- Households
- work for firms and government and earn wages
- own firms and earn after-tax profits
- provide loan to coconut producers and collect interests
- pay income tax to government

Table 2.8 GDP Using the Income Approach

Wage Income	$14.5 million
After-tax profits	$24 million
Interest Income	$0.5 million
Taxes	$4.5 million
GDP	$43.5 million

Extensions

- Production of 13 million coconuts (instead of 10) and storing the additional 3 million Distribution of wealth/income is also not considered

- Restaurant imports 2 million coconuts from other islands for $2.00 each and all of the coconuts are used in the Restaurant

Problems with Measuring GDP

Problems with measuring GDP

- Economic activity in the underground economy cannot be measured directly
- It might be measured indirectly by accounting for the use of currency

TABLE 5.6 The World Underground Economy, 2002–2003	
Region of the World	Underground Economy as Percent of Reported GDP
Africa	41%
Central and South America	41
Asia	30
Transition Economies	38
Europe, United States, and Japan	17
Unweighted Average over 145 Countries	35

Problems with measuring GDP

- Government production is difficult to measure, as the output (for example defense services) is typically not sold in the market
- Leisure
- Home production is typically not sold in the market
- Pollution
- Distribution of wealth/income is also not considered

GDP and Welfare of a Society

- Both the US and the UK have experienced very large increases in per capita income over the last 30 years
- But, reported levels of happiness have declined slightly in the United States and remained relatively flat in the United Kingdom.
- Could it be the increased stress of everyday life has taken its toll on our happiness despite the increase in income?
- Trends in the relative happiness of different groups in our society:
    - While whites report higher levels of happiness than African Americans, the gap has decreased over the last 30 years, as the happiness of African Americans has risen faster than that of whites
    - Men's happiness has risen relative to that of women over the last 30 years
    - Controlling for income, education, and other personal factors, in the United States, happiness among men and women reaches a minimum at the ages of 49 and 45 respectively

Real vs Nominal GDP

Nominal versus Real variables

- Compare a variable like GDP dollar value over time
- However, price levels change (inflation) so must make adjustments
- GDP dollar value change is due to two components:
    - real growth in resources (real change)
    - inflation of the price level (norminal change)
- How to separate out these two components?
    - Construct a price index as a measure of the (average) price level.
    - Calculate inflation rate of this price index
- Use inflation rate to back out real changes in GDP
- Real GDP uses the prices of a base year

Inflation

- A general rise in nominal prices is called inflation

- Define the GDP Deflator as follows:
    - GDP Deflator = Nominal GDP/Real GDP

- If we have the deflator, we can calculate real GDP from nominal GDP
    - Real GDP = Nominal GDP/GDP Deflator

- In general:
    - Real Value = Nominal Value/ Price Index

Alternative Inflation Measures

- Often, we are interested in a measure of inflation that tracks the "cost of living"
- The GDP Deflator may not be precisely suited for this task
- Why?

Example of Real GDP Calculation

2014 (Base year)				
	Current Price	**Quantity**	**Nominal**	
Automobiles	$5,000	2,000	$10,000,000	
Computers	$1,000	10,000	$10,000,000	
Haircuts	$10	1,000,000	$10,000,000	
			$30,000,000	
2015				
	Current Price	**Quantity**	**Nominal**	**Real-Base year**
Automobiles	$10,000	1,000		
Computers	$2,000	5,000		
Haircuts	$20	500,000		

Example of Real GDP Calculation

2014 (Base year)				
	Current Price	**Quantity**	**Nominal**	
Automobiles	$5,000	2,000	$10,000,000	
Computers	$1,000	10,000	$10,000,000	
Haircuts	$10	1,000,000	$10,000,000	
			$30,000,000	
2015				
	Current Price	**Quantity**	**Nominal**	**Real(Base Year)**
Automobiles	$10,000	1,000	$10,000,000	$5,000,000
Computers	$2,000	5,000	$10,000,000	$5,000,000
Haircuts	$20	500,000	$10,000,000	$5,000,000
			$30,000,000	$15,000,000

GDP over Time

Measuring Real Versus Nominal GDP

	Quantity Produced		Price		Nominal GDP
Year	Cars	Computers	Cars	Computers	
2014	4	1	$10,000	$5,000	$45,000
2015	5	3	$12,000	$5,000	$75,000

To calculate real GDP we use constant prices!

	Quantity Produced		Price		Real GDP
Year	Cars	Computers	Cars	Computers	
2014	4	1	$10,000	$5,000	$45,000
2015	5	3	$10,000	$5,000	$65,000

Real GDP Growth

- Nominal GDP Growth

$$g_{\text{nom-GDP}} = \frac{\$75,000 - \$45,000}{\$45,000} = 0.667 = 66.7\%$$

- Real GDP Growth

$$g_{\text{real-GDP}} = \frac{\$65,000 - \$45,000}{\$45,000} = 0.444 = 44.4\%$$

Real vs Nominal GDP

- We can measure the change in prices over time using an index number called the GDP deflator
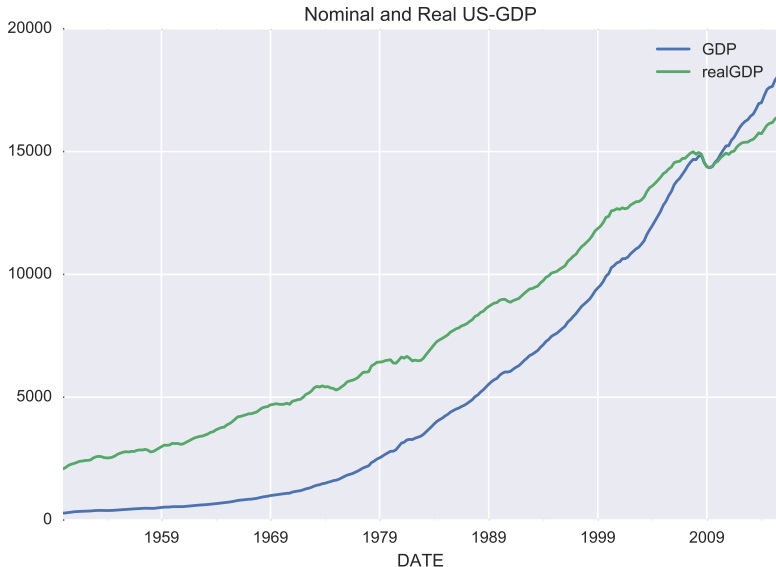- GDP deflator for 2015:

$$\text{GDP-Deflator} = 100 \times \frac{\text{Nominal-GDP in 2015}}{\text{Real-GDP in 2015}}$$
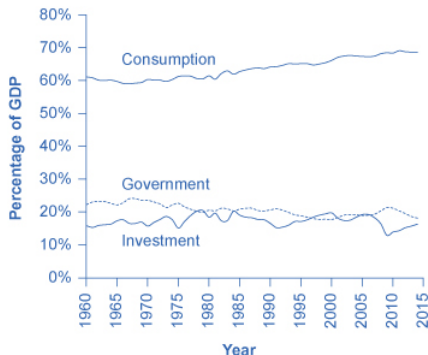
- GDP deflator in example

$$\text{GDP-Deflator} - 2015 = 100 \times \frac{\$75,000}{\$65,000} = 115$$

- This means that prices rose by 15% between the two years
- A chain index is a method for calculating price changes based on taking an average of price changes using base years from neighboring years
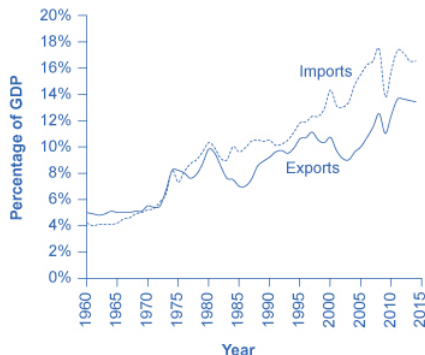
Nominal and Real US-GDP
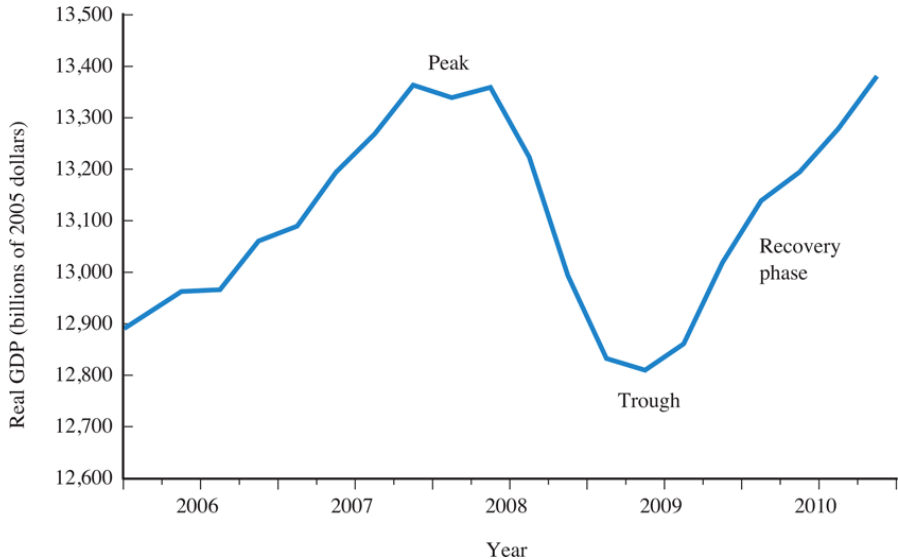
Components of GDP over Time

(a) Demand from consumption, investment, and government

(b) Imports and exports

Fluctuations in GDP

Fluctuations of GDP

- Recessions can be illustrated by peaks, troughs, and an expansion phase

- The date at which the recession starts and output begins to fall is called the peak

- The date at which the recession ends and output begins to rise is called the trough

- The expansion phase begins after the trough

- The 2007-2009 recession began in December 2007 and ended in June 2009

Definitions

- Recession
    - Six consecutive months of declining real GDP
- Peak
    - Date at which recession starts
- Trough
    - Date at which output stops falling in a recession
- Expansion
    - The period after a trough in the business cycle during which the economy recovers

GDP: Growth versus Cycles

- Gross Domestic Product (GDP) - measure of aggregate activity of an economy.
- Time-series data
- What is a trend/cycles?
- Growth = Trend
- Fluctuations about trend in real GDP
- Cycles = Deviations from trend
- Peaks are booms while Troughs are recessions
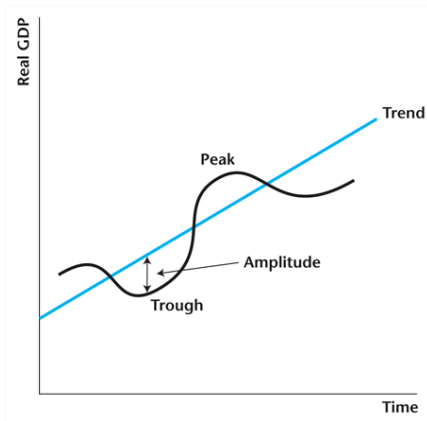
Persistence

- Deviations from trend in real GDP is persistent
- That is, if it is up, it stays up for a few periods; vice-versa
- Three features of deviations from trend:
  1. Choppy
  2. Amplitude (size) of deviations from trend is not regular
  3. No regularity in frequency
- Forecasting?
- WSJ Semiannual Economic Forecasting Survey (about 50 participants)

Percentage Deviations from (Long-Run Growth) Trend
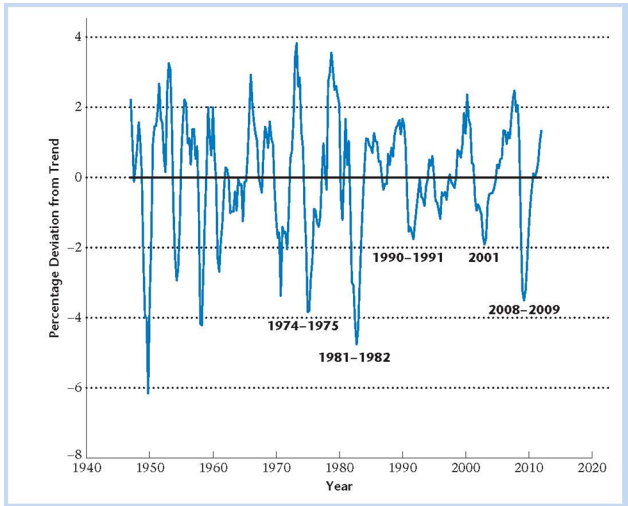
Historical Recessions

1. $1974 - 1975$: Oil price shock caused by OPEC restrictions

2. $1981 - 1982$: Fight inflation using monetary policy i.e. high interest rates (Volcker rule)

3. $1990 - 1991$: Gulf War, oil price high again

4. 2001: Burst of Dot.com bubble and loss of optimism $\rightarrow$ start of housing bubble (Greenspan rule)

5. $2008 - 2009$: Burst of Housing bubble and financial crisis

$1982 - 2008$: The Great Moderation $\rightarrow$ macro aggregates become less volatile

Historical Fluctuations in GDP

TABLE 5.5 Eleven Postwar Recessions

Peak	Trough	Percent Decline in Real GDP	Length of Recession (months)
November 1948	October 1949	−1.5	11
July 1953	May 1954	−3.2	10
August 1957	April 1958	−3.3	8
April 1960	February 1961	−1.2	10
December 1969	November 1970	−1.0	11
November 1973	March 1975	−4.1	16
January 1980	July 1980	−2.5	6
July 1981	November 1982	−3.0	16
July 1990	March 1991	−1.4	8
March 2001	November 2001	−0.6	8
December 2007	June 2009	−4.1	18