2

MACROECONOMICS

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The Data of Macroeconomics

IN THIS CHAPTER, YOU WILL LEARN:

. . . the meaning and measurement of the most important macroeconomic statistics:

- gross domestic product (GDP)
- the consumer price index (CPI)
- the unemployment rate

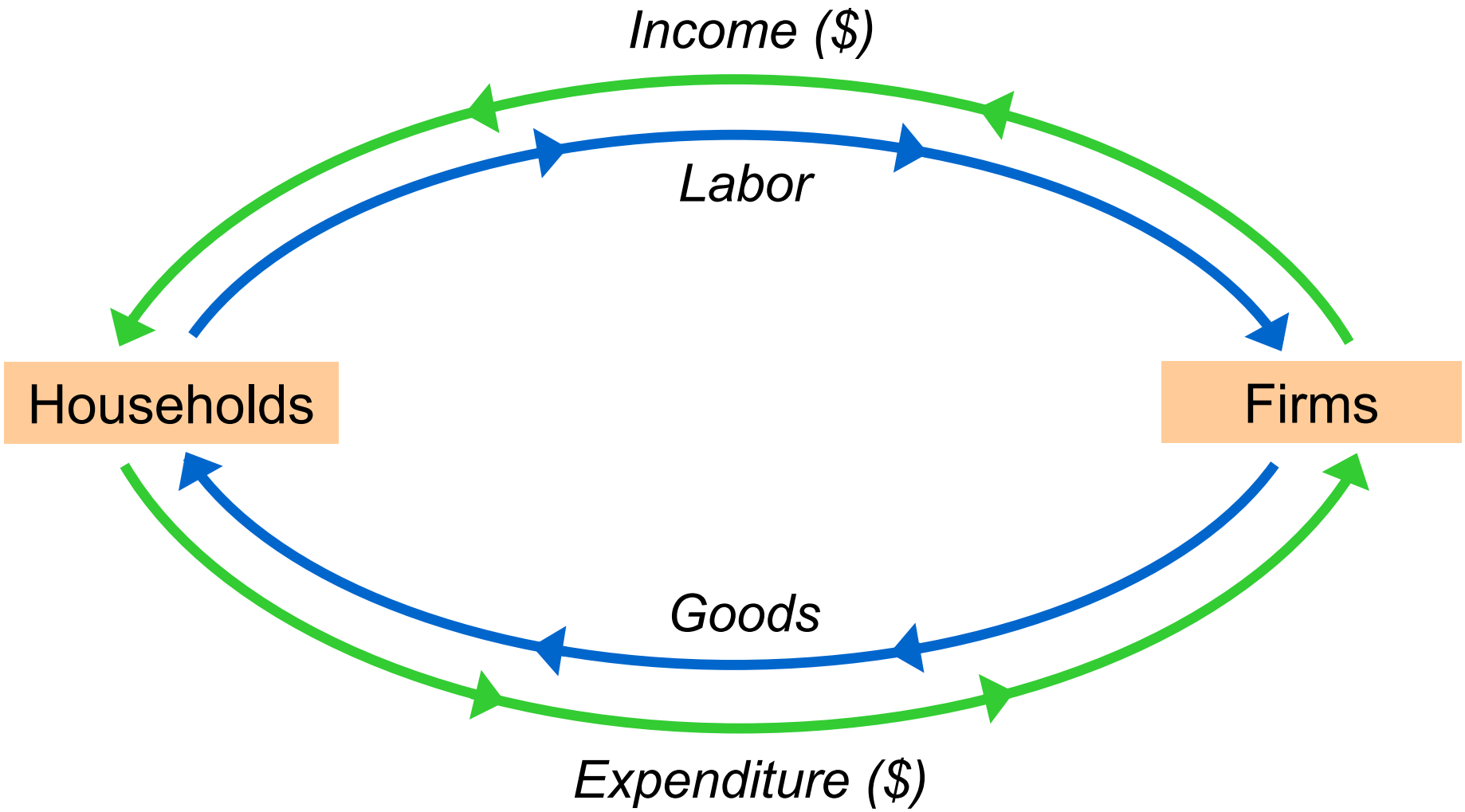
Gross Domestic Product: Expenditure and Income

Two definitions:

- Total expenditure on domestically produced final goods and services.
- Total income earned by domestically located factors of production.

Expenditure equals income because every dollar a buyer spends becomes income to the seller.

The Circular Flow



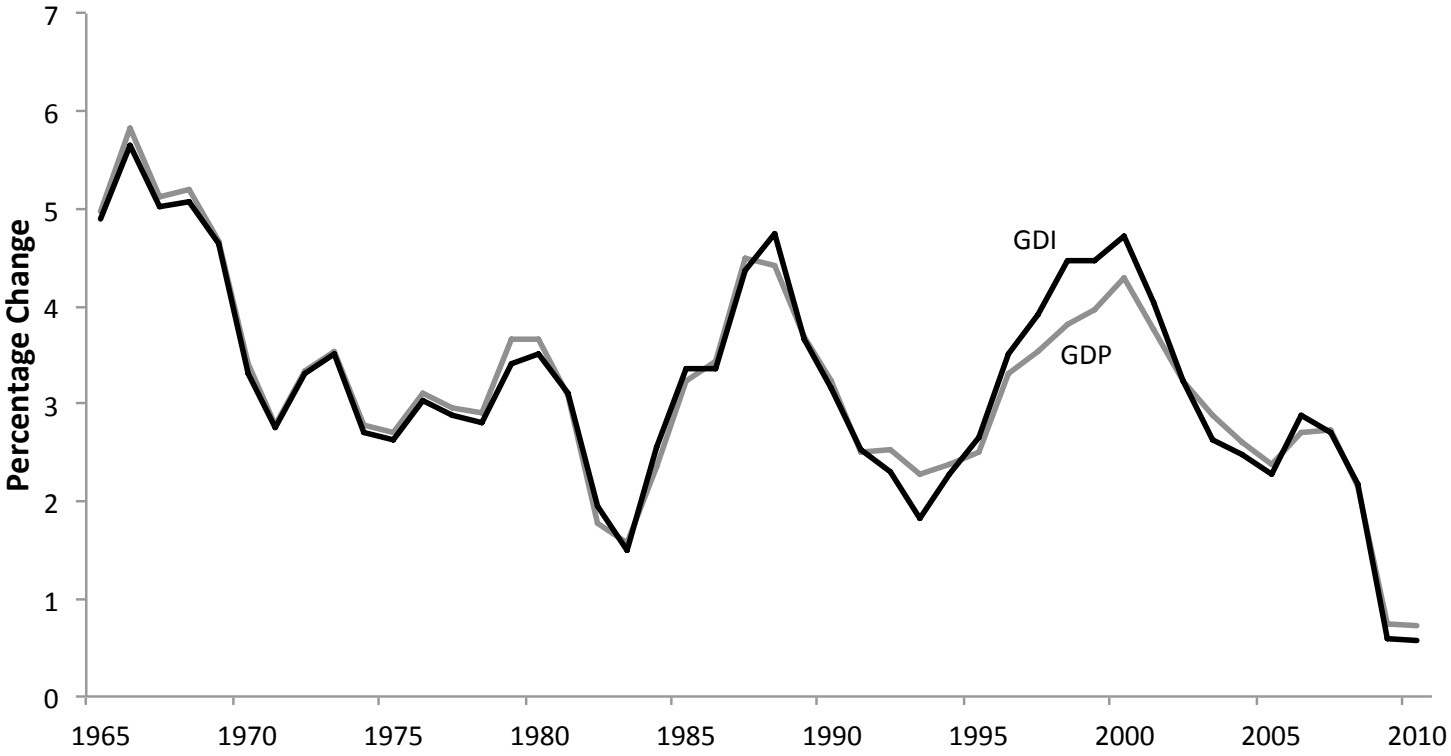
Gross Domestic Product: Expenditure and Income

- One caveat:
- Measurement of income and expenditure is imperfect.
- Difference in GDP and Gross Domestic Income (GDI) is called the "Statistical Discrepancy."

See Supplement 2-1

Gross Domestic Product: Expenditure and Income

Figure 1 Comparing Measures of Economic Growth



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Note: Data are average annual percentage change over previous five years.

Value added

Value added: The value of output minus the value of the intermediate goods used to produce that output

NOW YOU TRY

Identifying value added

- A farmer grows a bushel of wheat and sells it to a miller for $1.00.
- The miller turns the wheat into flour and sells it to a baker for $3.00.
- The baker uses the flour to make a loaf of bread and sells it to an engineer for $6.00.
- The engineer eats the bread.

Compute value added at each stage of production and GDP.

Final goods, value added, and GDP

- GDP = value of final goods produced
  = sum of value added at all stages of production.
- The value of the final goods already includes the value of the intermediate goods, so including intermediate *and* final goods in GDP would be double counting.

The expenditure components of GDP

- consumption, ***C***
- investment, ***I***
- government spending, ***G***
- net exports, ***NX***

An important identity:

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

value of total output

aggregate expenditure

Consumption (C)

Definition: The value of all goods and services bought by households. Includes:

- ***Durable goods***
  last a long time.
  E.g., cars, home appliances
- ***Nondurable goods***
  last a short time.
  E.g., food, clothing
- ***Services***
  are intangible items purchased by consumers.
  E.g., dry cleaning, air travel

U.S. Consumption, 2014

	$ billions	*% of GDP*
Consumption	12,002	68.2
Durables	1,320	7.5
Nondurables	2,691	15.3
Services	7,990	45.4

Investment (I)

- Spending on capital, a physical asset used in future production
- Includes:
  - ***Business fixed investment***
    Spending on plant and equipment
  - ***Residential fixed investment***
    Spending by consumers and landlords on housing units
  - ***Inventory investment***
    The change in the value of all firms' inventories

U.S. Investment, 2014

	$ billions	*% of GDP*
Investment	2,905	16.5
Business fixed	2,244	12.8
Residential	566	3.2
Inventory	94	0.5

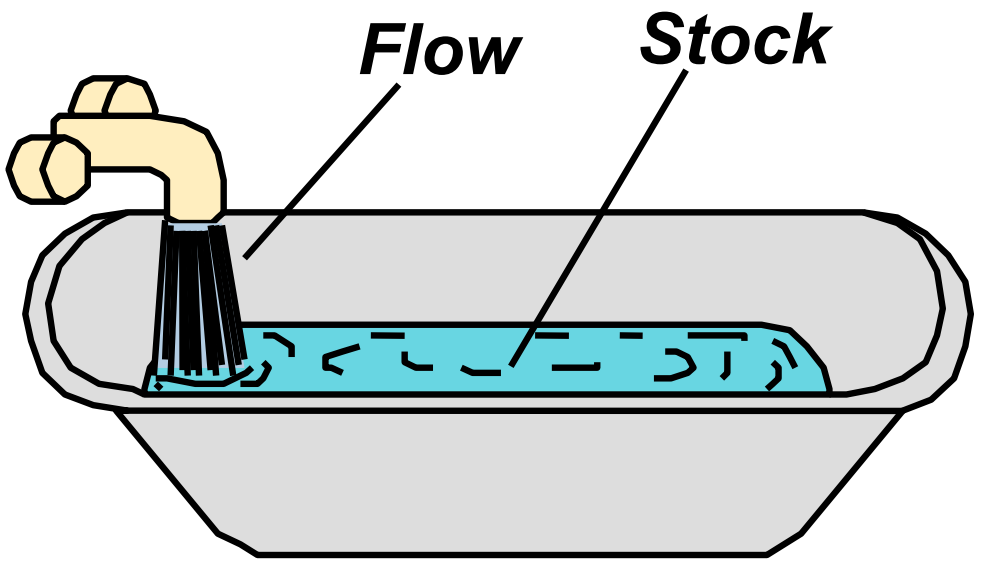
Investment vs. capital

Note: Investment is spending on new capital.

Example *(assumes no depreciation)*:

- 1/1/2016:
  Economy has $10 trillion worth of capital
- During 2016:
  Investment = $2 trillion
- 1/1/2017:
  Economy will have $12 trillion worth of capital

Stocks vs. Flows



A **stock** is a quantity measured at a point in time.

E.g.,
"The U.S. capital stock was $10 trillion on January 1, 2016."

A **flow** is a quantity measured per unit of time.

E.g., "U.S. investment was $2 trillion during 2016."

Stocks vs. Flows: Examples

Stock	*Flow*
a person's wealth	a person's annual savings
# of people with college degrees	# of new college graduates this year
the govt debt	the govt budget deficit

NOW YOU TRY
Stock or Flow?

- The balance on your credit card statement
- National Income
- The size of your iTunes collection
- The inflation rate
- The unemployment rate

Government spending (G)

- **G** includes all government spending on goods and services.
- **G** excludes transfer payments (e.g., unemployment insurance payments) because they do not represent spending on goods and services.

U.S. Government Spending, 2014

	$ billions	% of GDP
Govt spending	3,209	18.2
- Federal	1,241	7.1
Nondefense	457	2.6
Defense	784	4.5
- State & local	1,968	11.2

Net exports (NX)

- **NX** = exports – imports
  - **Exports**: the value of goods and services sold to other countries
  - **Imports**: the value of goods and services purchased from other countries
- Hence, NX equals net spending from abroad on our goods and services

U.S. Net Exports, 2014

	$ billions	% of GDP
Net Exports of Goods and Services	–517	–2.9
Exports	2,367	13.4
Goods	1,645	9.3
Services	721	4.1
Imports	2,883	16.4
Goods	2,394	13.6
Services	489	2.8

NOW YOU TRY

An expenditure-output puzzle?

Suppose a firm:

- produces $10 million worth of final goods
- only sells $9 million worth

- Does this violate the
  expenditure = output identity?

Why output = expenditure

- Unsold output goes into inventory,
  and is counted as “inventory investment” . . .
  whether or not the inventory buildup was intentional.
- In effect, we are assuming that
  firms purchase their unsold output.

GDP:
An important and versatile concept

We have now seen that GDP measures:

- total income
- total output
- total expenditure
- the sum of value added at all stages
  in the production of final goods and services

GNP vs. GDP

- Gross **national** product (GNP):
  Total income earned by the nation's factors of production, regardless of where located.

- Gross **domestic** product (GDP):
  Total income earned by domestically-located factors of production, regardless of nationality.

  GNP – GDP = factor payments from abroad
  minus factor payments to abroad

- Examples of factor payments: wages, profits, rent, interest & dividends on assets

NOW YOU TRY

Discussion Question

In your country, which would you want to be bigger, GDP or GNP?

Why?

GNP vs. GDP in Select Countries, 2012

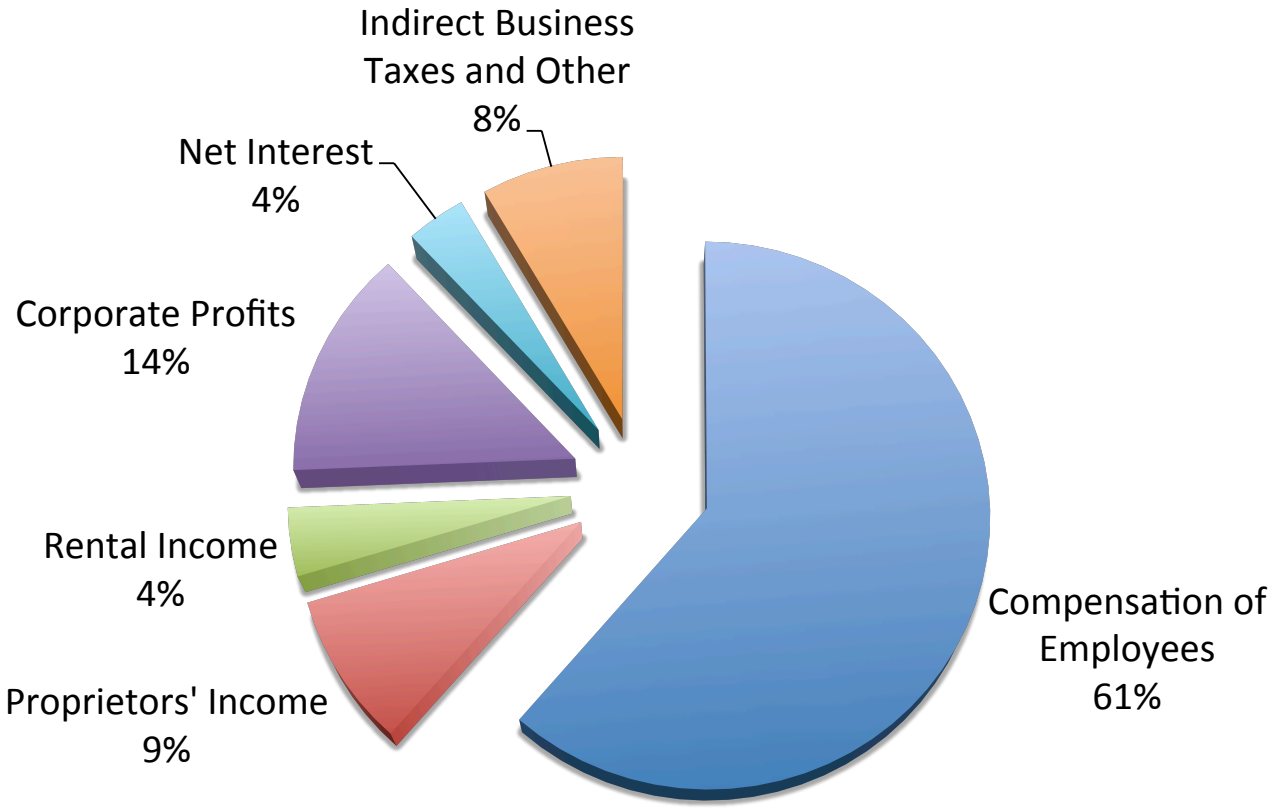
Country	*GNP*	*GDP*	*GNP – GDP (% of GDP)*
Bangladesh	127,672	116,355	9.7
Japan	6,150,132	5,961,066	3.2
China	8,184,963	8,227,103	-0.5
United States	16,514,500	16,244,600	1.7
India	1,837,279	1,858,740	-1.2
Canada	1,821,424	1,779,635	2.3
Greece	250,167	248,939	0.5
Iraq	216,453	215,838	0.3
Ireland	171,996	210,636	-18.3

GNP and GDP in millions of current U.S. dollars.

Other Measures of Income

- *Net National Product* = GNP – Depreciation
- *National Income* = NNP – Statistical Discrepancy
- *National Income* = Compensation of Employees + Proprietors' Income + Rental Income + Corporate Profits + Net Interest + Indirect Business Taxes
- Note: *Supplement 2-5* describes a change in definition of National Income to include Indirect Business Taxes.

Components of National Income, 2014



Other Measures of Income

- *Personal Income* = National Income - Indirect Business Taxes - Corporate Profits - Social Insurance Contributions - Net Interest + Dividends + Government Transfers to Individuals + Personal Interest Income
- *Disposable Personal Income* = Personal Income - Personal Tax and Nontax Payments
- *Disposable Personal Income* is what households and noncorporate businesses have to spend (or save).

Real vs. nominal GDP

- GDP is the *value* of all final goods and services produced.
- **Nominal GDP** measures these values using current prices.
- **Real GDP** measures these values using the prices of a base year.

Real vs. Nominal GDP: Fixed Base-Year Prices

$$GDP_t = \sum_{i=1}^{n} P_{it} Q_{it}$$

$$RGDP_t = \sum_{i=1}^{n} P_{iB} Q_{it}$$

Real GDP controls for inflation

- Changes in nominal GDP can be due to:
  - changes in prices
  - changes in quantities of output produced
- Changes in real GDP can only be due to changes in quantities.
- **One way to calculate changes in real GDP is by using fixed base-year prices.

Measuring Economic Growth: Fixed Base-Year Prices

$$RGDP_t / RGDP_{t-1} = \sum_{i=1}^{n} P_{iB} Q_{it} \Big/ \sum_{i=1}^{n} P_{iB} Q_{it-1}$$

$$= \frac{\sum_{i=1}^{n} P_{iB} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^{n} P_{iB} Q_{it-1}}$$

Measuring Economic Growth: Fixed Base-Year Prices

$$RGDP_t / RGDP_{t-1} = \frac{\sum_{i=1}^{n} P_{iB} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^{n} P_{iB} Q_{it-1}}$$

$$\left[1 + g_t \right] = \sum_{i=1}^{n} \omega_{iB} \left[Q_{it} / Q_{it-1} \right]$$

Measuring Economic Growth: Fixed Base-Year Prices

$$\left[1+g_t\right]=\sum_{i=1}^{n}\omega_{iB}\left[Q_{it}/Q_{it-1}\right]$$

$$\text{where}\quad \omega_{iB}=\frac{P_{iB}Q_{it-1}}{\sum_{i=1}^{n}P_{iB}Q_{it-1}}$$

Measuring Economic Growth

A problem arises when using fixed base-year weights: *Growth will vary depending on base year chosen.*

Rapidly growing sectors with declining relative prices will be weighted *"too much"* as base year becomes further and further in the past. Opposite for slowly growing sectors.

Chain-Weighted Real GDP

- Over time, relative prices change, so the base year should be updated periodically--which BEA used to do.
- In essence, chain-weighted real GDP updates the base year every year, using an average of last year's and this year's prices, so it is more accurate than fixed base-year GDP.
- Official measure of GDP now produced by BEA.
- *See Supplement 2-3.*

Chain-Weighted Real GDP

Step 1:

$$[1+g_t]_{t-1} = \frac{\sum_{i=1}^{n} P_{i\,t-1} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^{n} P_{i\,t-1} Q_{it-1}}$$

Rewrite as:

$$\left[1+g_t\right]_{t-1} = \sum_{i=1}^{n} \omega_{i\,t-1} \left[Q_{it} / Q_{it-1} \right]$$

Chain-Weighted Real GDP

Step 2:

$$[1+g_t]_t = \frac{\sum_{i=1}^{n} P_{it} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^{n} P_{it} Q_{it-1}}$$

Rewrite as:

$$\left[1+g_t\right]_t = \sum_{i=1}^{n} \omega_{it} \left[Q_{it} / Q_{it-1} \right]$$

Chain-Weighted Real GDP

Step 3:

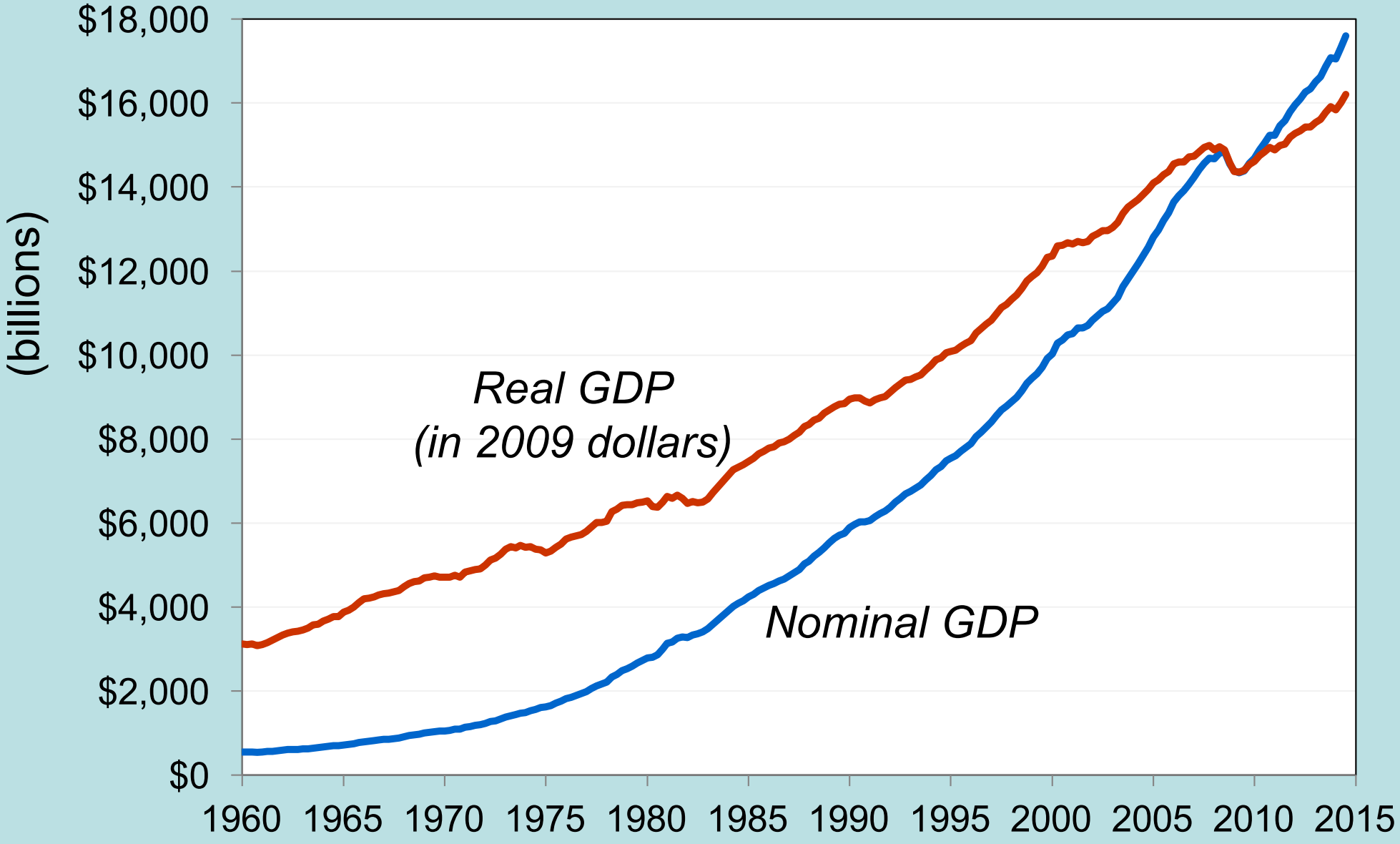
$$[1+g_t] = \{[1+g_t]_t \times [1+g_t]_{t-1}\}^{0.5}$$

To get level of real GDP, use nominal GDP for a given year and apply growth rate:

$$RGDP_t = \left[1+g_t\right]\left[1+g_{t-1}\right]\left[1+g_{t-2}\right]\left[1+g_{t-3}\right]GDP_{t-4}$$

Real GDP is measured here in year t-4 dollars.

U.S. Nominal and Real GDP, 1960-2014



GDP deflator

- **Inflation rate**: the percentage increase in the overall level of prices.
- One measure of the price level: **GDP deflator**

  Definition:

$$\text{GDP deflator} = 100 \times \frac{\text{Nominal GDP}}{\text{Real GDP}}$$

Deflator: Fixed-Weight Growth Measures

$$\text{GDP Deflator}_t = \text{GDP}_t / \text{RGDP}_t$$

$$= \sum_{i=1}^{n} P_{it} Q_{it} \Big/ \sum_{i=1}^{n} P_{iB} Q_{it}$$

$$= \frac{\sum_{i=1}^{n} P_{iB} Q_{it} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^{n} P_{iB} Q_{it}}$$

GDP deflator

- GDP Deflator is a Paasche (current-weighted) index when real GDP is computed as a Laspeyres (fixed-weighted) index:

$$\text{GDP Deflator}_t = \frac{\sum_{i=1}^{n} P_{iB} Q_{it} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^{n} P_{iB} Q_{it}}$$

GDP deflator

- Rewriting this expression gives:

$$\text{GDP Deflator}_t = \sum_{i=1}^{n} \gamma_i \left[P_{it} / P_{iB} \right]$$

$$\text{where } \gamma_i = \frac{P_{iB} Q_{it}}{\sum_{i=1}^{n} P_{iB} Q_{it}}$$

Chain-Weighted Real GDP

- We can compute a deflator for chain-weighted GDP in same manner used for the fixed-weight measure.
- This price measure is a chain-weighted index with quantity weights updated each year, but using an average of this year's and last year's quantities.
- As with the real GDP measure, the price measure updates the base year every year, ensuring the measure is never too far out of date.
- *See Supplement 2-3.*

NOW YOU TRY

GDP deflator and the inflation rate

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2010	$46,200	$46,200		*n.a.*
2011	51,400	50,000		
2012	58,300	52,000		

- Use your previous answers to compute the GDP deflator in each year.
- Use GDP deflator to compute the inflation rate from 2010 to 2011 and from 2011 to 2012.

NOW YOU TRY
Answers

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2010	$46,200	$46,200	100.0	*n.a.*
2011	51,400	50,000	102.8	2.8%
2012	58,300	52,000	112.1	9.1%

Two arithmetic tricks for working with percentage changes

1. For any variables ***X*** and ***Y***,

percentage change in (***X*** × ***Y***)

≈ percentage change in ***X***

+ percentage change in ***Y***

Ex.: If your hourly wage rises 5% and you work 7% more hours, then your wage income rises approximately 12%.

Two arithmetic tricks for working with percentage changes

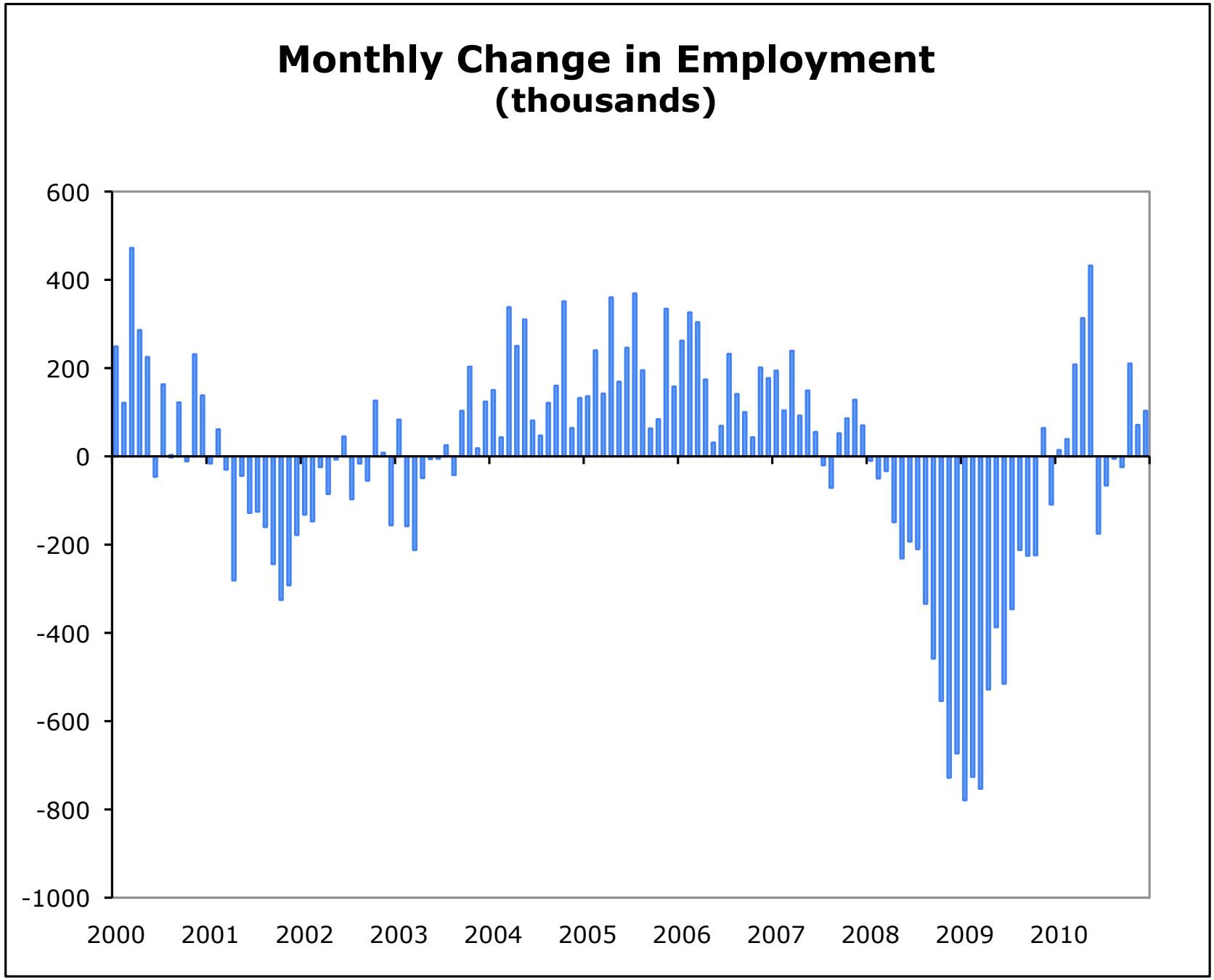
2. Percentage change in (***X/Y***)
≈ percentage change in ***X***
− percentage change in ***Y***

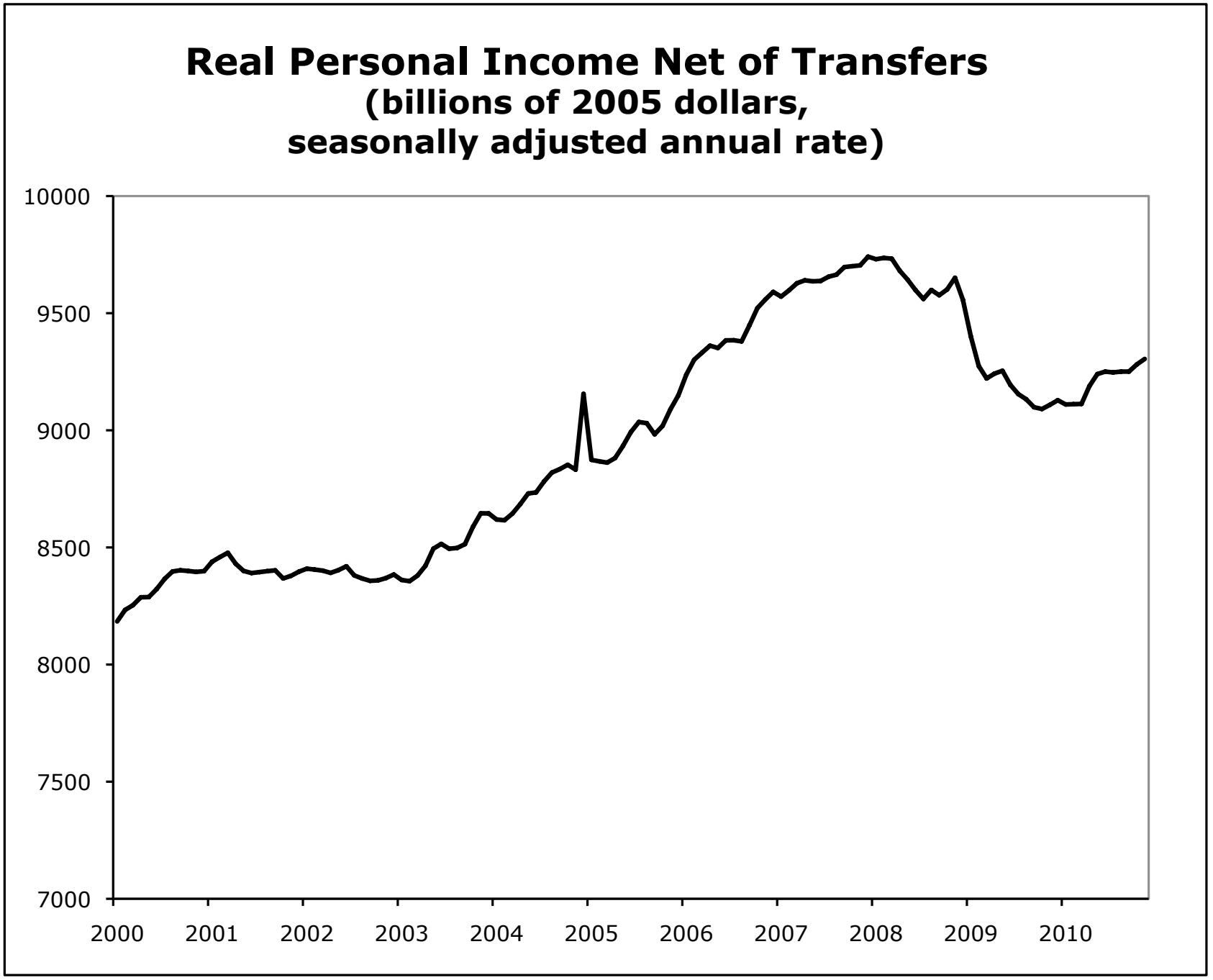
Ex.: GDP deflator = 100 × NGDP/RGDP.

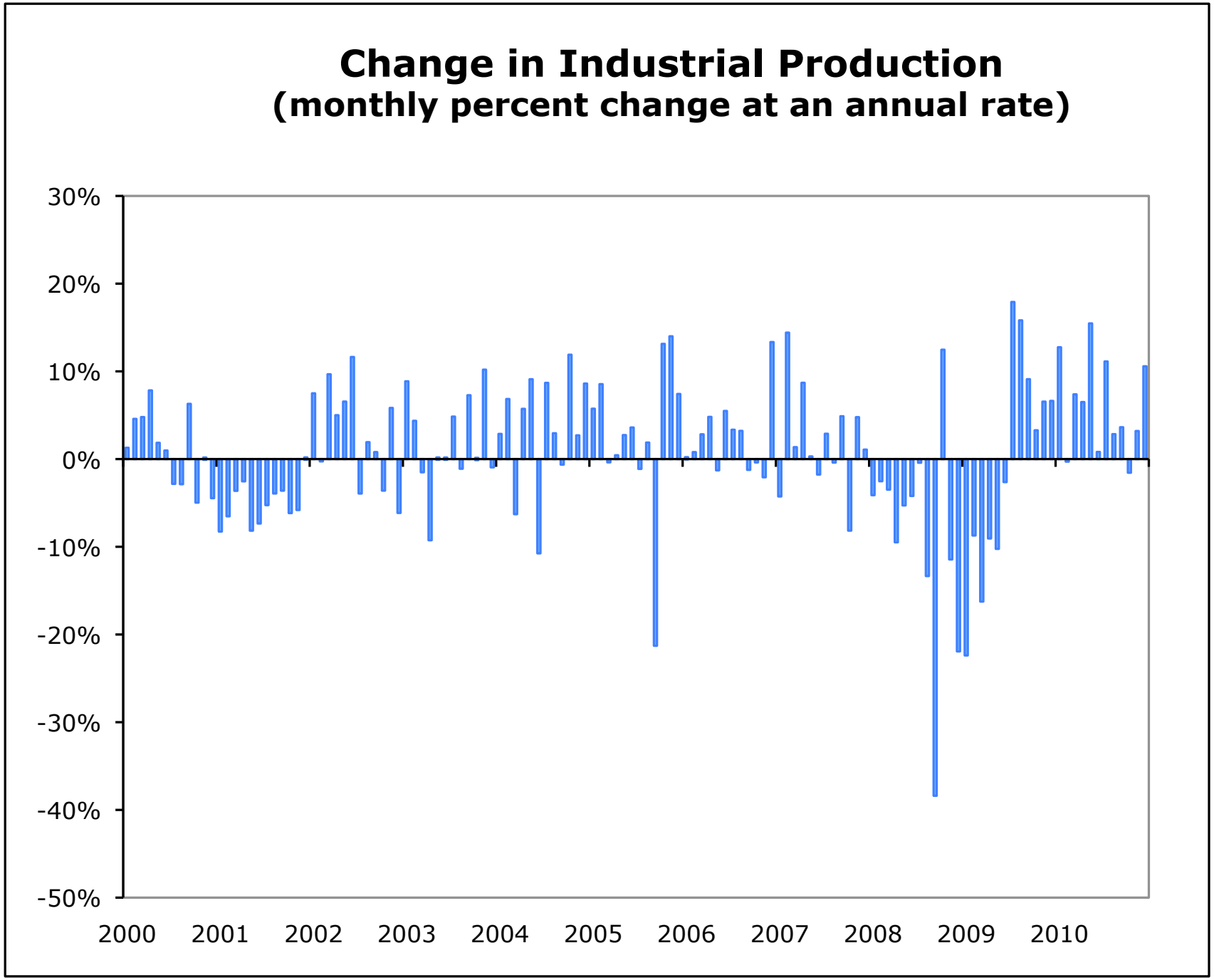
If NGDP rises 9% and RGDP rises 4%,
then the inflation rate is approximately 5%.

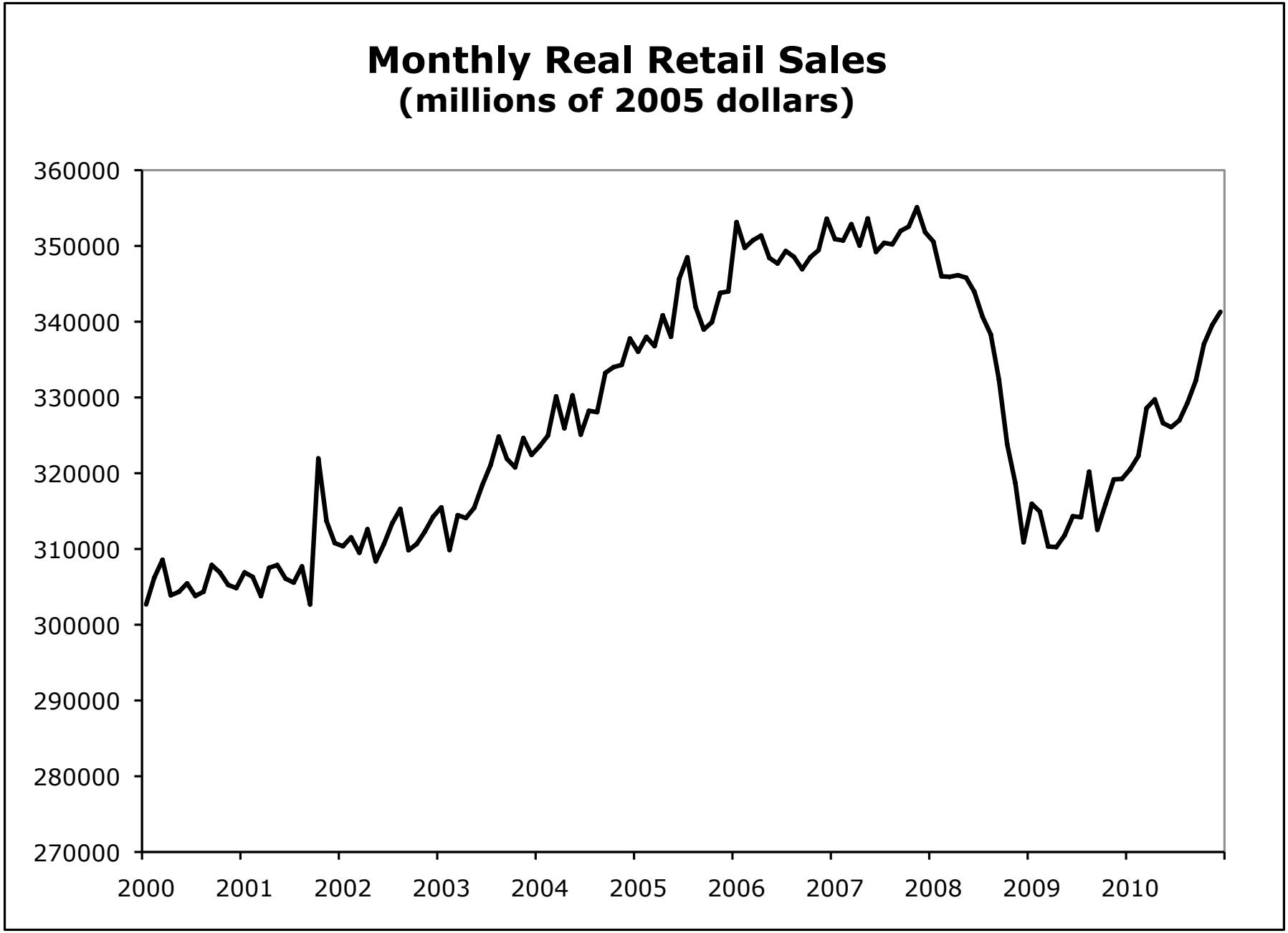
When is the Economy in a Recession?

- Rule of Thumb: Two quarters of decline in Real GDP
- National Bureau of Economic Research uses more nuanced approach (see **Supplement 1-3**):
  - Monthly Indicators rather than Quarterly.
  - "A significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade."


Monthly Change in Employment
(thousands)
600
400
200
0
-200
-400
-600
-800
-1000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


Real Personal Income Net of Transfers
(billions of 2005 dollars,
seasonally adjusted annual rate)
10000
9500
9000
8500
8000
7500
7000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


Change in Industrial Production
(monthly percent change at an annual rate)
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


Monthly Real Retail Sales
(millions of 2005 dollars)
360000
350000
340000
330000
320000
310000
300000
290000
280000
270000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

Consumer price index (CPI)

- A measure of the overall level of prices
- Published by the Bureau of Labor Statistics (BLS)
- Uses:
  - tracks changes in the typical household's cost of living
  - adjusts many contracts for inflation ("COLAs")
  - allows comparisons of dollar amounts over time

How the BLS constructs the CPI

1. Survey consumers to determine composition of the typical consumer's "basket" of goods
2. Every month, collect data on prices of all items in the basket; compute cost of basket
3. CPI in any month equals

$$100 \times \frac{\text{Cost of basket in that month}}{\text{Cost of basket in base period}}$$

NOW YOU TRY

Compute the CPI

Basket: 20 pizzas, 10 compact discs

Prices:

	pizza	CDs
2012	$10	$15
2013	11	15
2014	12	16
2015	13	15

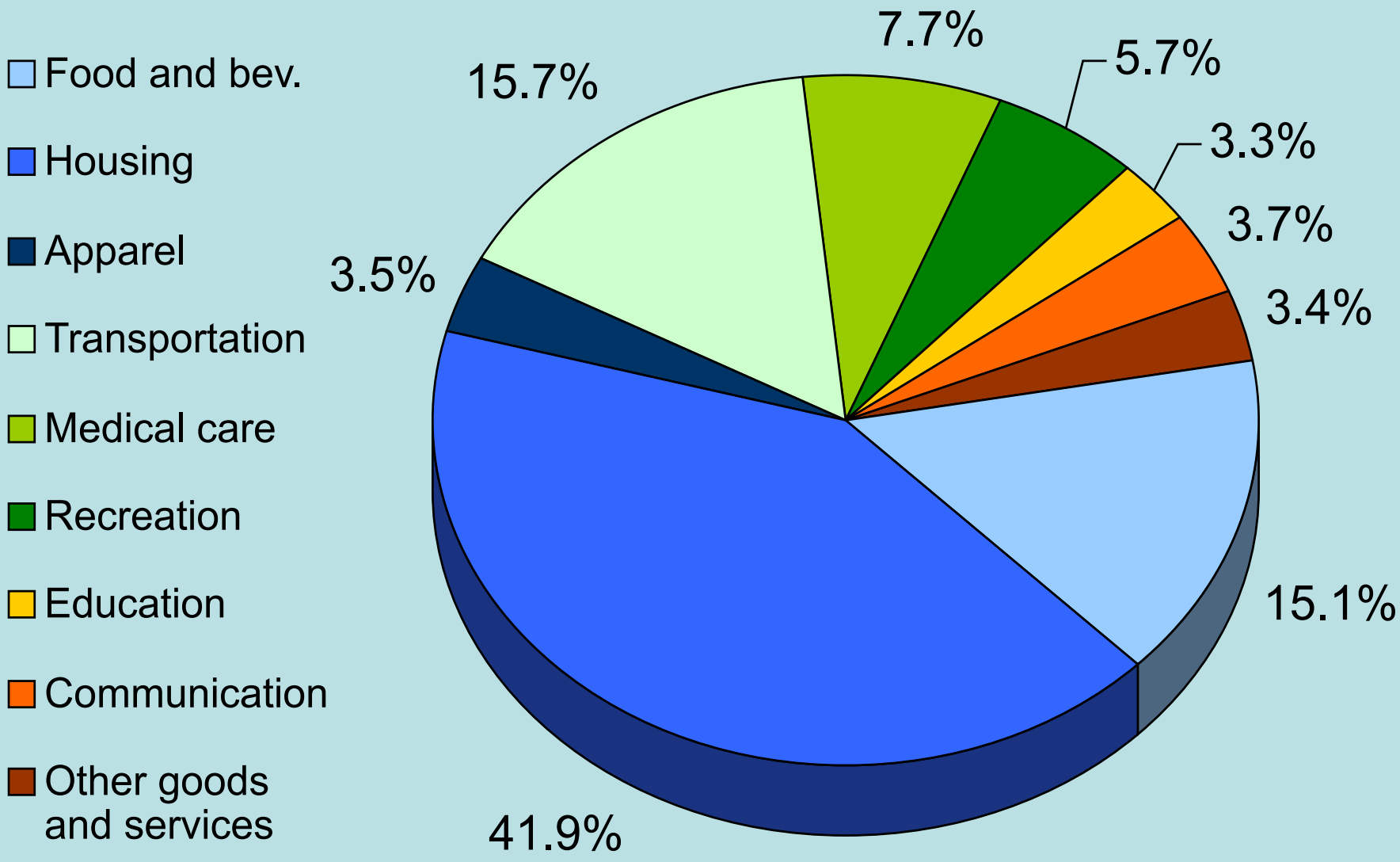
For each year, compute:

- the cost of the basket
- the CPI (use 2012 as the base year)
- the inflation rate from the preceding year

NOW YOU TRY
Answers

	Cost of basket	CPI	Inflation rate
2012	$350	100.0	*n.a.*
2013	370	105.7	5.7%
2014	400	114.3	8.1%
2015	410	117.1	2.5%

The composition of the CPI's "basket"



Understanding the CPI

For good i = 1,…,n

C_i = amount of good i in the CPI's basket

P_{it} = price of good i in month t

E_t = cost of the CPI basket in month t

E_B = cost of the basket in the base period

Understanding the CPI

$$CPI = \frac{E_t}{E_B} = \frac{\sum_{i=1}^{n} Q_{iB} P_{it}}{\sum_{i=1}^{n} Q_{iB} P_{iB}}$$

$$= \frac{\sum_{i=1}^{n} Q_{iB} P_{iB} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^{n} Q_{iB} P_{iB}}$$

Understanding the CPI

$$CPI = \frac{E_t}{E_B} = \sum_{i=1}^{n} \gamma_{iB} \left[P_{it} / P_{iB} \right]$$

where the weights are given by:

$$\gamma_{iB} = \frac{Q_{iB} P_{iB}}{\sum_{i=1}^{n} Q_{iB} P_{iB}}$$

Understanding the CPI

The CPI is a weighted average of prices relative to their value in the base period.

The weight on each "price relative" reflects that good's relative importance in the CPI's basket.

Note that the weights remain fixed over time—the CPI is a Laspeyres Index.

Why the CPI may overstate inflation

- **Substitution bias**:
  The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.
- **Introduction of new goods**:
  The introduction of new goods makes consumers better off and, in effect, increases the real value of the dollar. But it does not reduce the CPI, because the CPI uses fixed weights.
- **Unmeasured changes in quality**:
  Quality improvements increase the value of the dollar but are often not fully measured.

The size of the CPI's bias

- In 1995, a Senate-appointed panel of experts estimated that the CPI overstates inflation by about 1.1% per year.
- So the BLS made adjustments to reduce the bias.
- Now, the CPI's bias is probably under 1% per year.
- *See Supplements 2-8 and 2-9.*

NOW YOU TRY

Discussion Questions

1. If your grandmother receives Social Security, how is she affected by the CPI's bias?
2. Where does the government get the money to pay COLAs to Social Security recipients?
3. If you pay income and Social Security taxes, how does the CPI's bias affect you?
4. Is the government giving your grandmother too much of a COLA?
5. How does your grandmother's "basket" differ from the CPI's? Does this affect your answer to Q4?

CPI vs. GDP deflator

Prices of capital goods:

- included in GDP deflator (if produced domestically)
- excluded from CPI

Prices of imported consumer goods:

- included in CPI
- excluded from GDP deflator

The basket of goods:

- CPI: fixed
- GDP deflator: changes every year

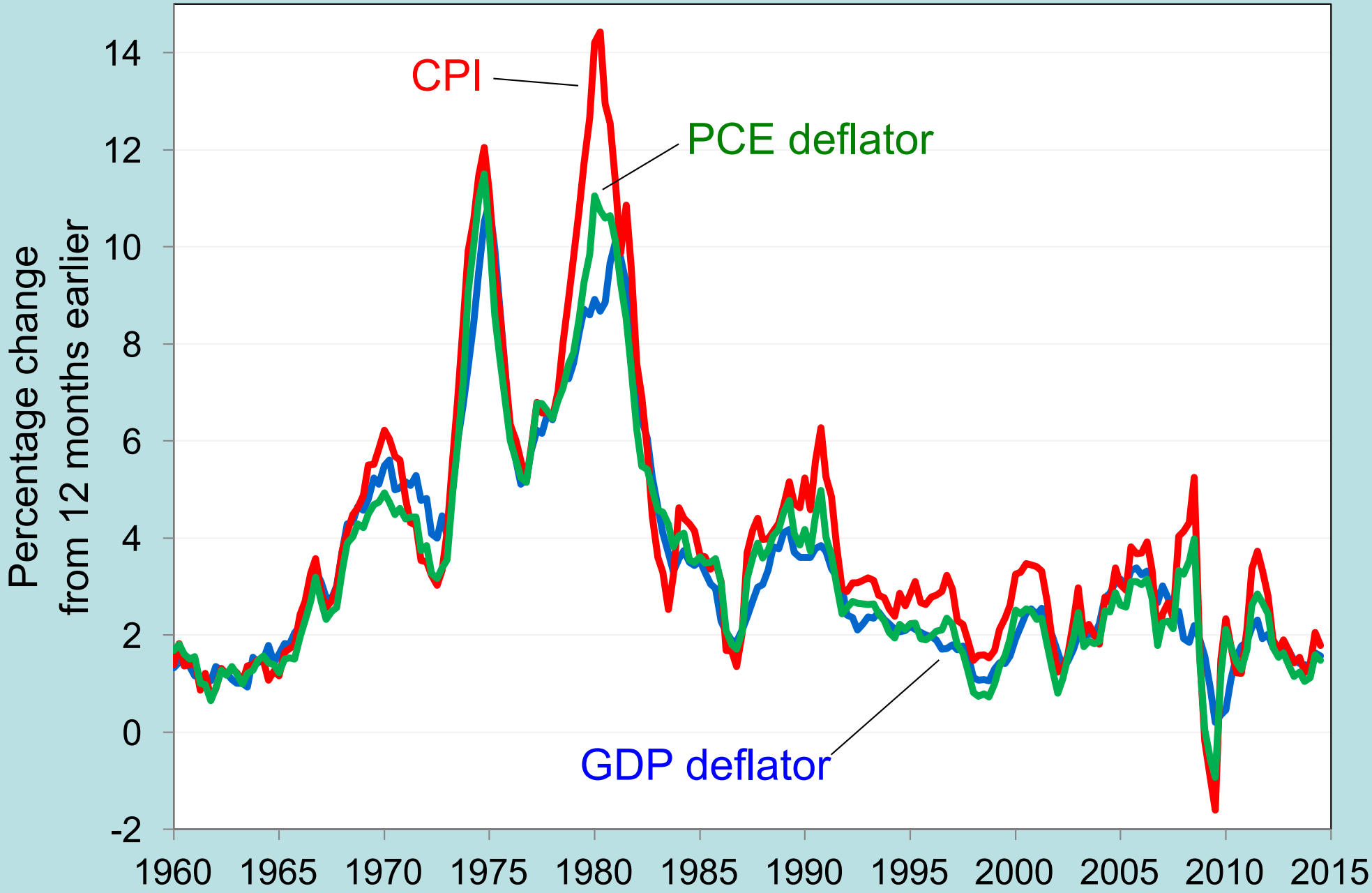
The PCE deflator

- Another measure of the price level:
  Personal Consumption Expenditures Price Index,
  the ratio of nominal to real consumer spending
- How the PCE is like the CPI:
  - only includes consumer spending
  - includes imported consumer goods
- How the PCE is like the GDP deflator:
  - the “basket” changes over time
- The Federal Reserve prefers PCE.

Core Measures of Inflation

- BLS and BEA produce measures of inflation that exclude food and energy sectors.
- These are known as “Core” inflation measures.
- Produced for both the CPI and the PCE Price Index.
- Federal Reserve often focuses on core inflation as a better measure of underlying trends in prices.

The GDP deflator, CPI, and PCE deflator



Categories of the population

- **Employed**
  working at a paid job
- **Unemployed**
  not employed but looking for a job
- **Labor force**
  the amount of labor available for producing goods and services; all employed plus unemployed persons
- **Not in the labor force**
  not employed, not looking for work

Two important labor force concepts

- **Unemployment rate**
  percentage of the labor force that is unemployed
- **Labor force participation rate**
  the fraction of the adult population that "participates" in the labor force, *i.e.* is working or looking for work
- **Household (Current Population) Survey**
  used to measure these concepts

NOW YOU TRY

Computing labor statistics

U.S. adult population by group, Dec 2014		
Number employed	=	147.4 million
Number unemployed	=	8.7 million
Adult population	=	249.0 million

Calculate

- the labor force
- the unemployment rate
- the labor force participation rate

NOW YOU TRY
Answers

Data: ***E*** = 147.4, ***U*** = 8.7, ***POP*** = 249.0

- Labor force
  L = ***E*** + ***U*** = 147.4 + 8.7 = 156.1
- Unemployment rate
  U/L x 100% = (8.7/156.1) x 100% = 5.6%
- Labor force participation rate
  L/POP x 100% = (156.1/249.0) x 100% = 62.7%

NOW YOU TRY

Computing percentage changes

Suppose

- population increases by 1%
- labor force increases by 3%
- number of unemployed persons increases by 2%

Compute the percentage changes in the labor force participation and unemployment rates.

NOW YOU TRY
Answers

LFPR = L/POP

L increases 3%, POP increases 1%,
so LFPR increases 3% – 1% = 2%.

U rate = U/L

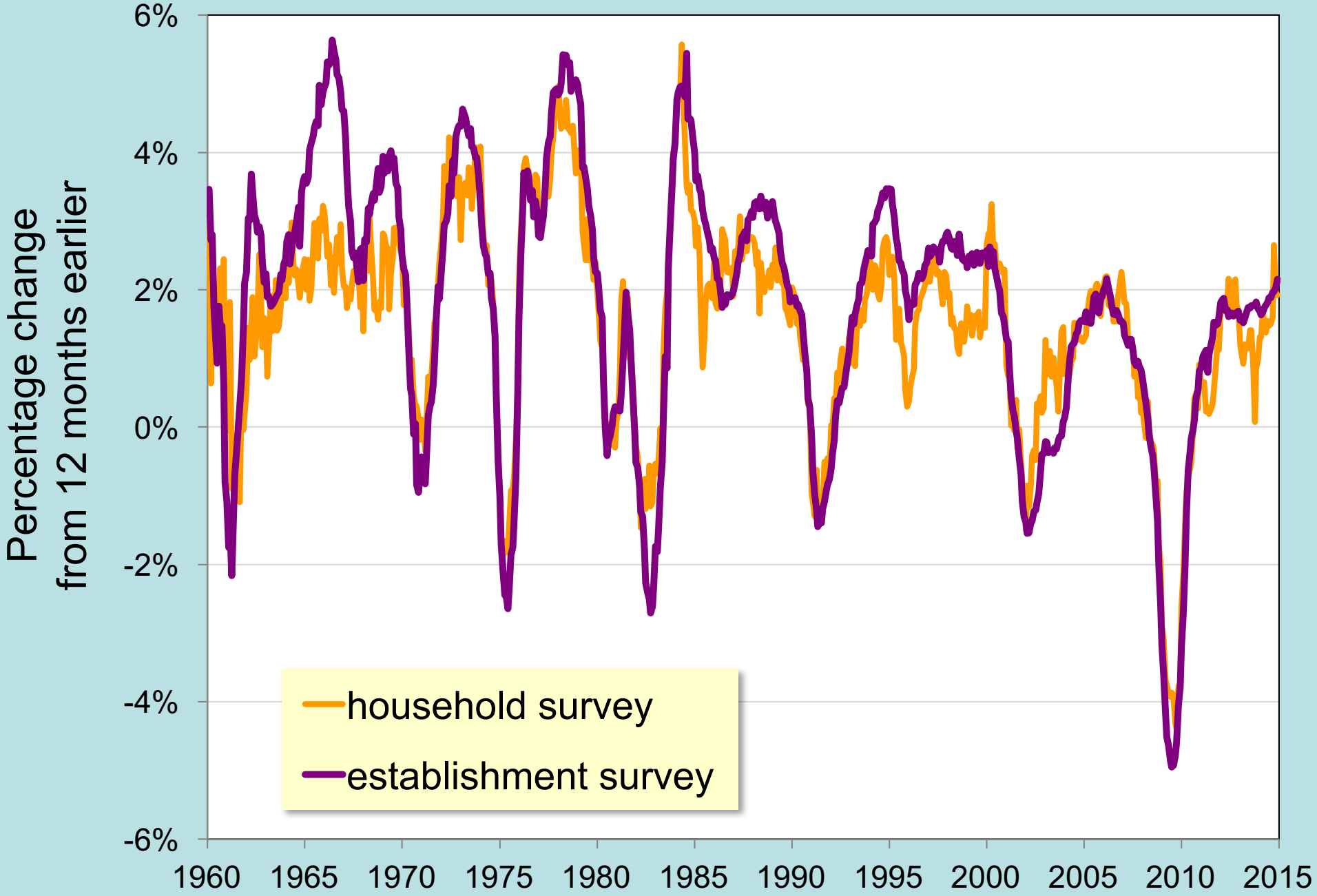
U increases 2%, L increases 3%,
so U-rate increases 2% – 3% = –1%.

Note: the changes in LFPR and U-rate are shown as a percent of their initial values, not in percentage points!
E.g., *if initial value of LFPR is 60.0%, a 2% increase would bring it to 61.2%, because 2% of 60 equals 1.2.*

The establishment survey

- The BLS obtains a second measure of employment by surveying businesses, asking how many workers are on their payrolls.
- Neither measure is perfect, and they occasionally diverge due to:
  - treatment of self-employed persons
  - new firms not counted in establishment survey
  - technical issues involving population inferences from sample data

Two measures of employment growth



CHAPTER SUMMARY

- Gross domestic product (GDP) measures both total income and total expenditure on the economy's output of goods & services.
- Nominal GDP values output at current prices; real GDP values output at constant prices. Changes in output affect both measures, but changes in prices only affect nominal GDP.
- GDP is the sum of consumption, investment, government purchases, and net exports.

CHAPTER SUMMARY

- The overall level of prices can be measured by either:
  - the consumer price index (CPI), the price of a fixed basket of goods purchased by the typical consumer, or
  - the GDP deflator, the ratio of nominal to real GDP.
- The unemployment rate is the fraction of the labor force that is not employed.