Measuring Macroeconomic Activity

— Week 2 —

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Summary

1. Measuring the State of the Economy
2. Measuring Changes over Time
3. Comparing Economic Performance across Countries (we will not cover this section)
4. Required reading

I – Measuring the State of the Economy

What is GDP?

1. Gross domestic product (GDP) is:
    1. The market value of the final goods and services produced in an economy over a certain period of time
2. United States GDP
    1. $12.5 trillion in 2005
    2. $14.4 trillion in 2008 ($47,000 per person)

The 3 ways to measure GDP

1. Production measure of GDP
   1. The number of goods produced in the economy.
2. Expenditure measure
   1. The total purchases in the economy.
3. Income measure
   1. All the income earned in the economy.
4. All three approaches give identical measures of GDP.

$$Production = Expenditure = Income$$

The Expenditure Approach to GDP

The national income accounting identity states:

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

Y = GDP (in dollars)
C = consumption
I = investment
G = government purchases
NX = net exports = exports – imports

The Expenditure Approach to GDP: 2008

TABLE 2.1

The Expenditure Approach to U.S. GDP in 2012

	Total (billions of dollars)	Share of GDP (percent)	Per person (dollars)
Gross domestic product	15,680	100.0	50,140
Personal consumption expenditures	11,120	70.9	35,560
Motor vehicles and parts	410	2.6	1,300
Food	830	5.3	2,650
Housing	1,970	12.6	6,290
Medical care	1,820	11.6	5,810
Gross private domestic investment	2,060	13.1	6,580
Structures (nonresidential)	460	2.9	1,470
Equipment and software	1,160	7.4	3,700
Residential	380	2.4	1,220
Government purchases	3,060	19.5	9,790
National defense	810	5.2	2,590
Net exports of goods and services	−560	−3.6	−1,790
Exports	2,180	13.9	6,980
Imports	2,740	17.5	8,770

Some major points

1. Net exports (trade balance) for the United States is negative.
2. The recent trade deficit indicates that the United States is borrowing goods from the rest of the world.
3. As the trade balance has turned negative, consumption has increased as a share of GDP recently.
4. This deficit must be repaid in the form of trade surpluses in the future.

The composition of GDP has been relatively stable

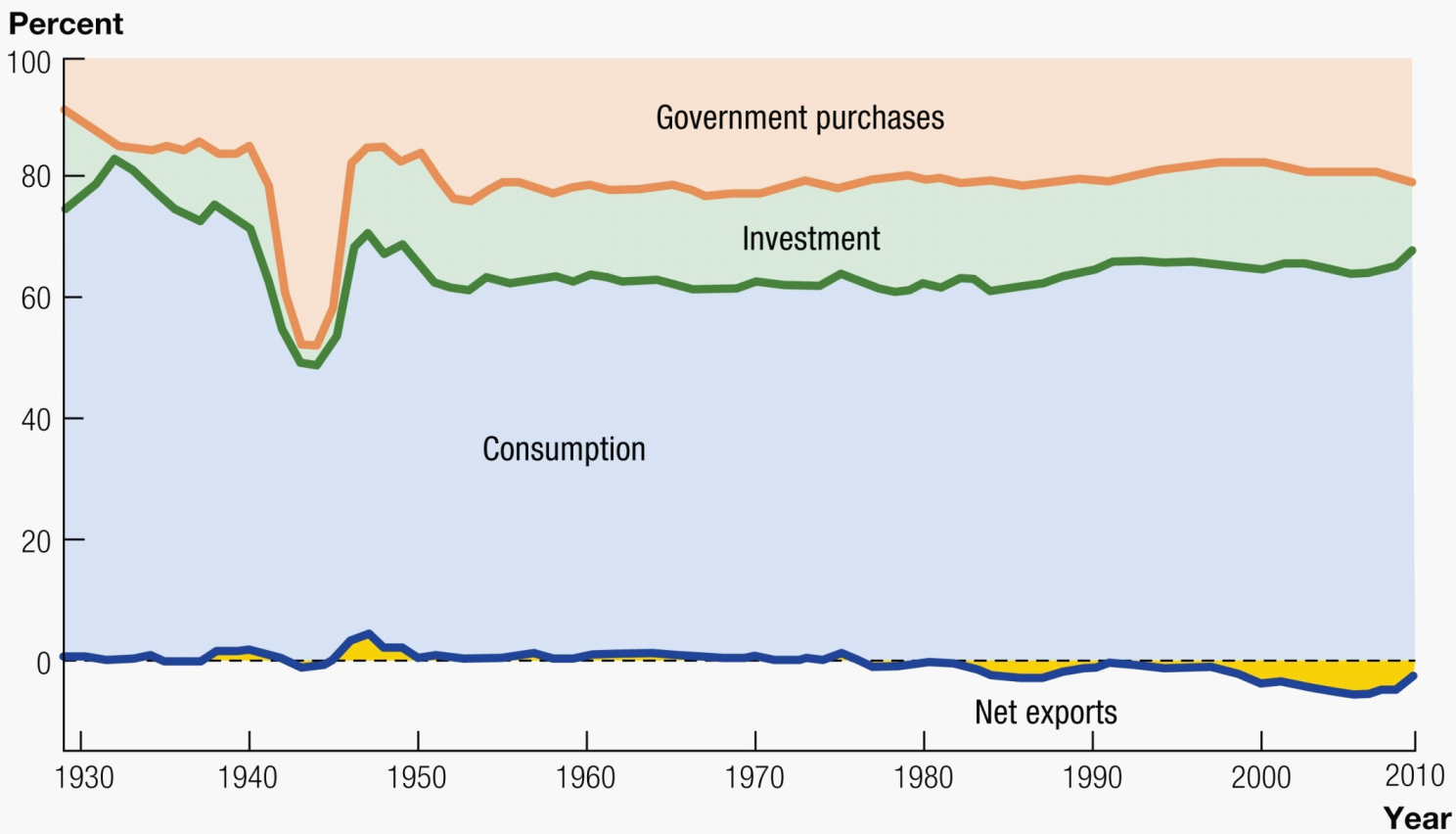

FIGURE 2.1 Composition of U.S. GDP, 1929–2009

Macroeconomics, 2nd Ed
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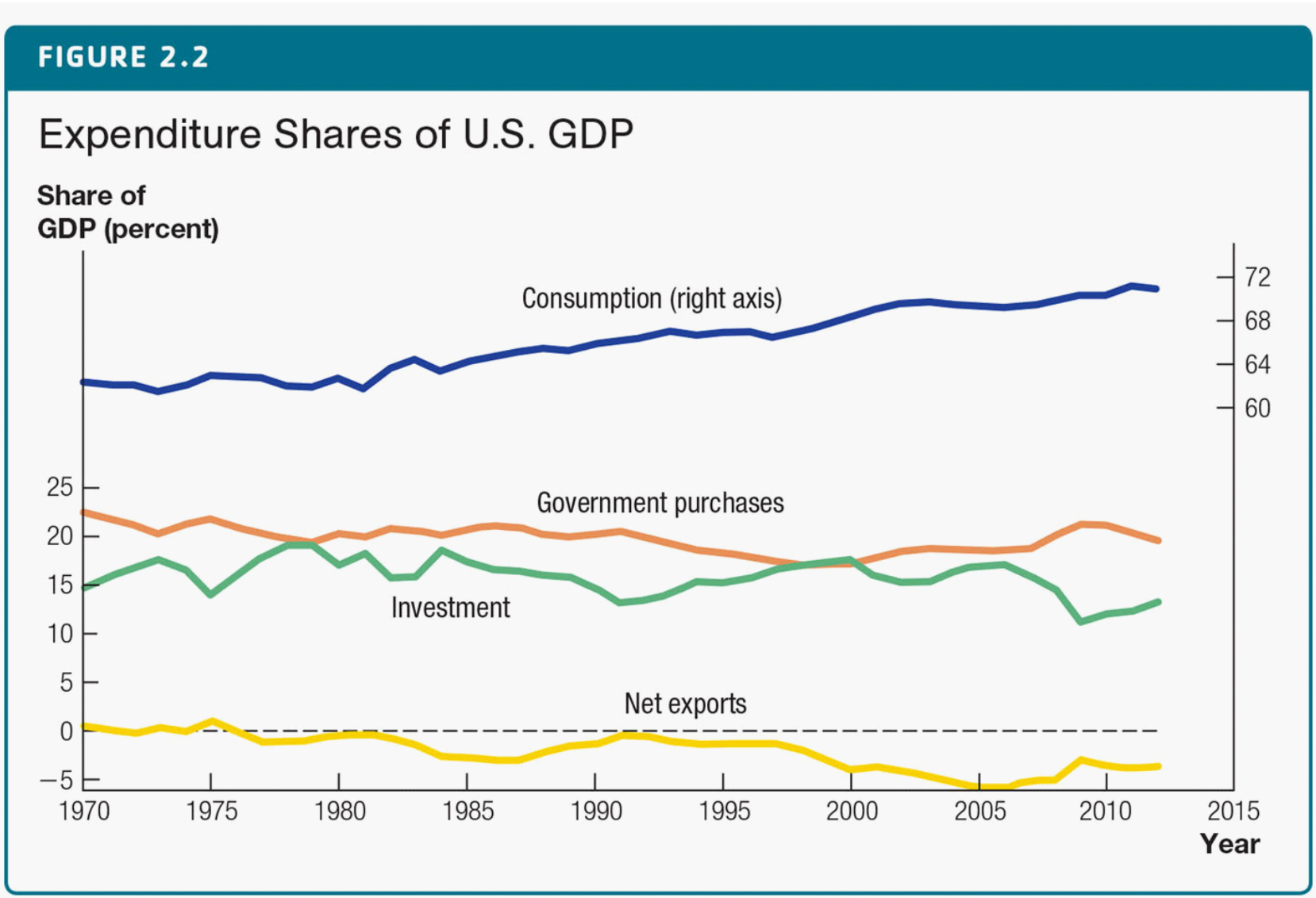
Consumption as % of GDP has been rising since the 1980's



The Income Approach to GDP

1. **Three groups of agents**: receive income from their participation in the production process:
   1. Wages (W)
   2. Profits (Π)
      1. profits before taxes
      2. interest
      3. rents
   3. Income taxes (T)
2. Therefore

$$GDP = TotalIncome = Y = W + \Pi + T$$

The product approach

1. This approach is calculated through the **production side** of economic activity
2. **Value Added**: value of total production **less** the value of intermediate goods purchased from other producers.
3. GDP is the *sum* of value added across all sectors.

A simple example

1. Economy produces \$400 of wheat and \$800 of bread.
2. Bakers buy all the wheat for bread.
3. Final goods: \$800
4. Intermediate goods: \$400
5. Total sales: \$1200
6. Value-added: \$400 by farmer + \$400 by baker = \$800

The 3 methods: an example

- Apart from small measurement errors ...

$$GDP = Income = Expenditure = Value\ Added$$

- Example: Williamson (2011), cap. 2

The expenditure approach

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

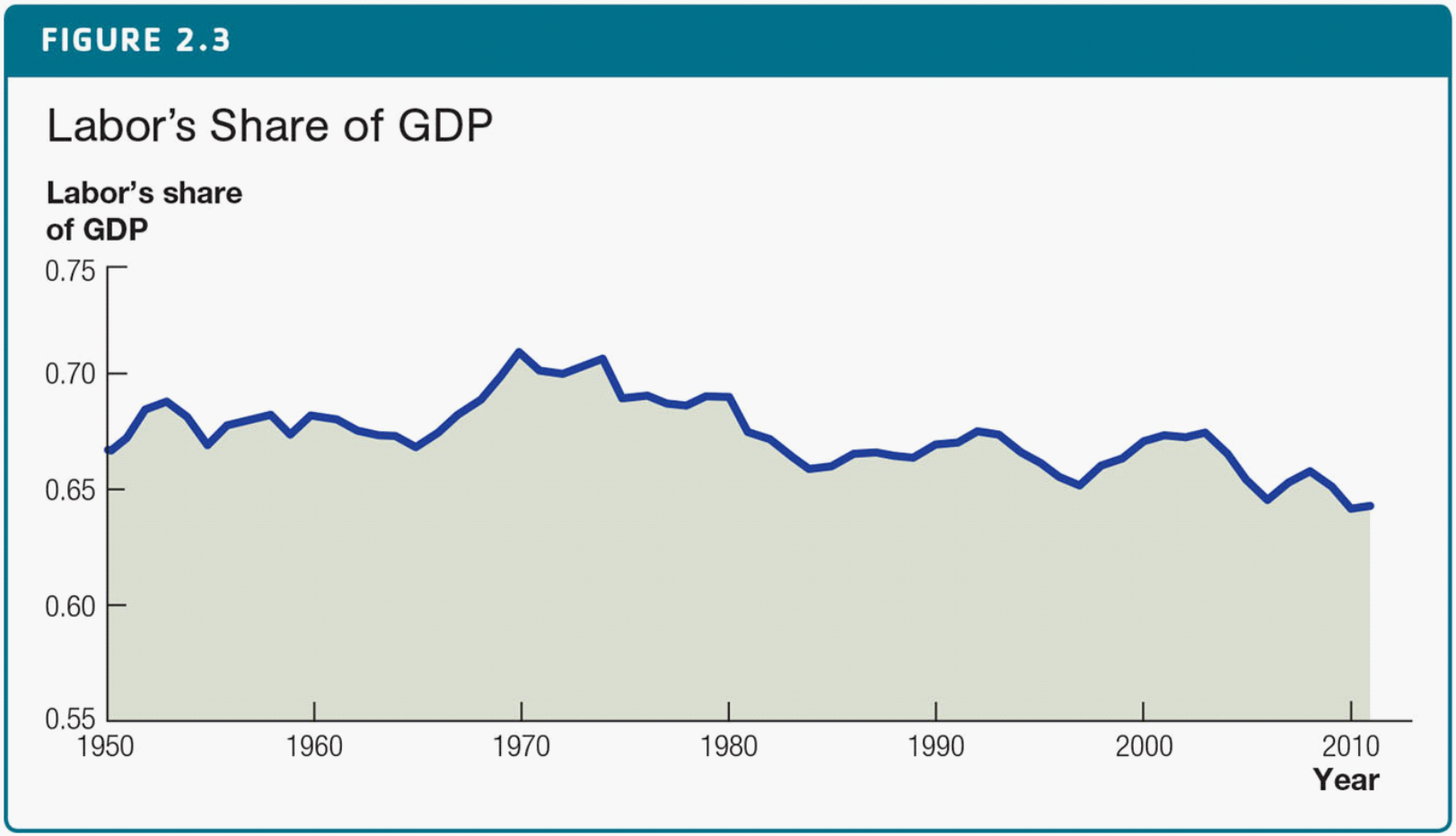
The income approach

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

The value added approach

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

The labor share of income has been declining since the early 1970's



III – Measuring Changes over Time

Price Indices

- Price indices: what are they for?
- They are used to obtain macroeconomic aggregates measured in **real values**.
- What are real values?
- Values measured in terms of monetary units but removing the effects of inflation: **monetary values at constant prices**.
- Real values as opposed to what?
- In opposition to **nominal values**
- An aggregate measured in nominal values is expressed in **monetary values at current prices**.
- Simply put

$$\text{Real } GDP = \frac{\text{Nominal } GDP}{\text{Implicit } GDP \text{ price index}}$$

- For macroeconomics only real aggregates are relevant

What kind of price indices are there?

- There are two major types of price indices
  - Built upon a fixed base year
  - Built upon a chain-weighting process
- Fixed base year indices
  - Paashe index
  - Laspeyres index
  - Fisher index

Fixed year base indices

- Assume the following symbology:
  - Q for quantities
  - P for prices
  - $i = 1, ..., j$ as the ith product; while t stands for time period
- The Paashe Index $P_t^{\mathcal{P}}$ is given by

$$P_t^{\mathcal{P}} = \frac{\sum_{i=1}^{j} Q_{i(t)} \times P_{i(t)}}{\sum_{i=1}^{j} Q_{i(t)} \times P_{i(\mathbf{0})}} \tag{1}$$

- The Laspeyres index is given

$$P_t^{\mathcal{L}} = \frac{\sum_{i=1}^{j} Q_{i(0)} \times P_{i(t)}}{\sum_{i=1}^{j} Q_{i(0)} \times P_{i(0)}} \tag{2}$$

- The Fisher index

$$P_t^{\mathcal{F}} = \sqrt{P_t^{\mathcal{P}} \cdot P_t^{\mathcal{L}}} \tag{3}$$

Fixed year base indices: problems

- While we can not go into great detail here, both the $P_t^{\mathcal{P}}$ and the $P_t^{\mathcal{L}}$ have serious problems
- Laspeyres price index: tends to overstate inflation by assuming that households buy the same basket of goods in period t as in period 0: **it overstates inflation**
- In contrary: the Paashe index tends to **understate inflation**
- So, construct a geometric average of the two and the problem is reduced: that's the Fisher index

Fixed year base indices: a terrible problem

- However we still have another problem: the fixed base year logic leads to an aberration:
  - whenever the base year is changed, we have to rewrite the history of the economy!
- We will demonstrate this below
- This problem can be minimized by adopting a **rolling over year base**: chain-weighted index

Fixed year base indices: an example

- Suppose an economy produces apples & oranges: periods 1,2

	Apples	Oranges
Quantity in Year 1	$Q_1^a = 50$	$Q_1^o = 100$
Price in Year 1	$P_1^a = \$1.00$	$P_1^o = \$0.80$
Quantity in Year 2	$Q_2^a = 80$	$Q_2^o = 120$
Price in Year 2	$P_2^a = \$1.25$	$P_2^o = \$1.60$

- Nominal GDP is

$$GDP_1 = 50 \times 1 + 100 \times 0.8 = 130 \text{ dollars}$$

$$GDP_2 = 80 \times 1.25 + 120 \times 1.6 = 292 \text{ dollars}$$

- Nominal GDP grows between periods 1 and 2 at a rate

$$\left(\frac{GDP_2}{GDP_1} - 1 \right) = 25\%$$

- However, what happens to the real value of GDP? How much does it grow over that period?

Fixed year base indices: an example (cont.)

	Apples	Oranges
Quantity in Year 1	$Q_1^a = 50$	$Q_1^o = 100$
Price in Year 1	$P_1^a = \$1.00$	$P_1^o = \$0.80$
Quantity in Year 2	$Q_2^a = 80$	$Q_2^o = 120$
Price in Year 2	$P_2^a = \$1.25$	$P_2^o = \$1.60$

- If **period 1 is the base year**, real GDP_1 has to be equal to nominal GDP_1

$$realGDP_1 = GDP_1 = 130$$

- Calculate $realGDP_2$ as if prices remain constant (equal to period 1)

$$realGDP_2 = 80 \times 1 + 120 \times 0.8 = 176 \text{ dollars}$$

- Then, real GDP grows between periods 1 and 2 at a rate

$$g_{b1}\left(\frac{\text{real}\, GDP_2}{\text{real}\, GDP_1} - 1\right) = 35.4\%$$

Fixed year base indices: an example (cont.)

- Now let's play a trick: **take period 2 as the base year**
- We know that real GDP_2 has to be equal to nominal GDP_2

$$\text{real}\, GDP_2 = GDP_2 = 80 \times 1.25 + 120 \times 1.6 = 292 \text{ dollars}$$

- What's the real value of GDP_1? Quantities at 1, times the prices at 2

$$realGDP_1 = 50 \times 1.25 + 100 \times 1.6 = 222.5 \text{ dollars}$$

- Then, real GDP grows between periods 1 and 2 at a rate

$$g_{b2} = \left(\frac{\text{real}\, GDP_2}{\text{real}\, GDP_1} - 1 \right) = 31.2\%$$

Fixed year base indices: an example (cont.)

- **Funny**: real GDP grew at different rates depending on the base year considered
  - If we take period 1 as the base year: 35.4%
  - If we take period 2 as the base year: 31.2%
- The chain-weighted index tries to minimize the problem of considering different base fixed base year
- Uses the Fisher price index on a rolling over base year
- Let's call the chain weighted index as g_c

$$g_c = \sqrt{g_{b1} \times g_{b2}} = \sqrt{1.354 \times 1.312} = 1.333$$

The chain-weighted index: how to use it

- Once we know the value of g_c between two periods we can calculate the value of real GDP in chained dollars for a particular year

$$\text{real}\, GDP_2(chain) = realGDP_1 \times g_c = 130 \times 1.333 = 173.29\ dollars$$

- Or, taking period two as the base year, real GDP for period 1 is

$$\text{real}\, GDP_1(chain) = realGDP_2 / g_c = 292/1.333 = 219.05\ dollars$$

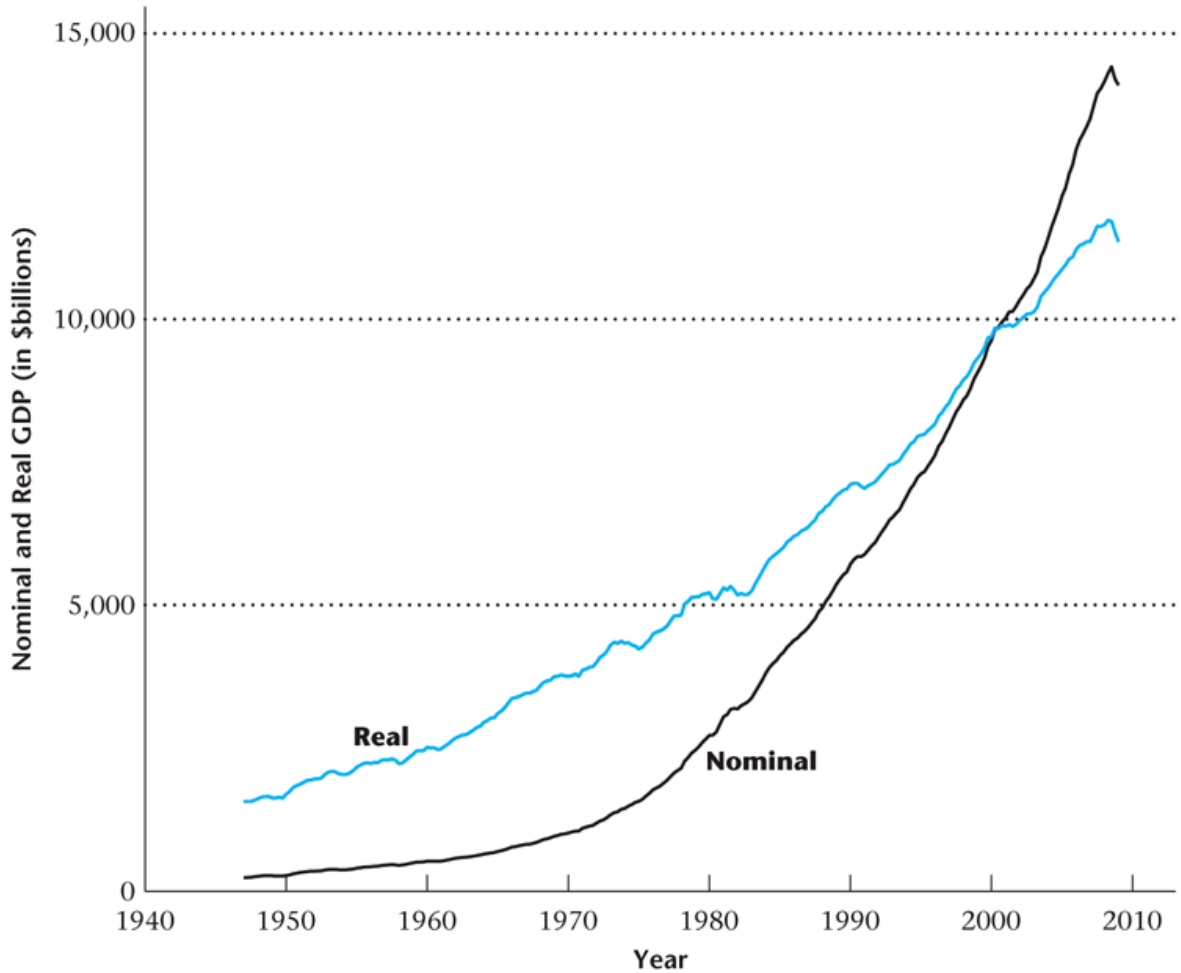
- So, when we say that "GDP is expressed in chained 2005 Euros", even though the index does not have a fixed base year ... we mean that the rolling over process started in 2005

The chain-weighted index: summary

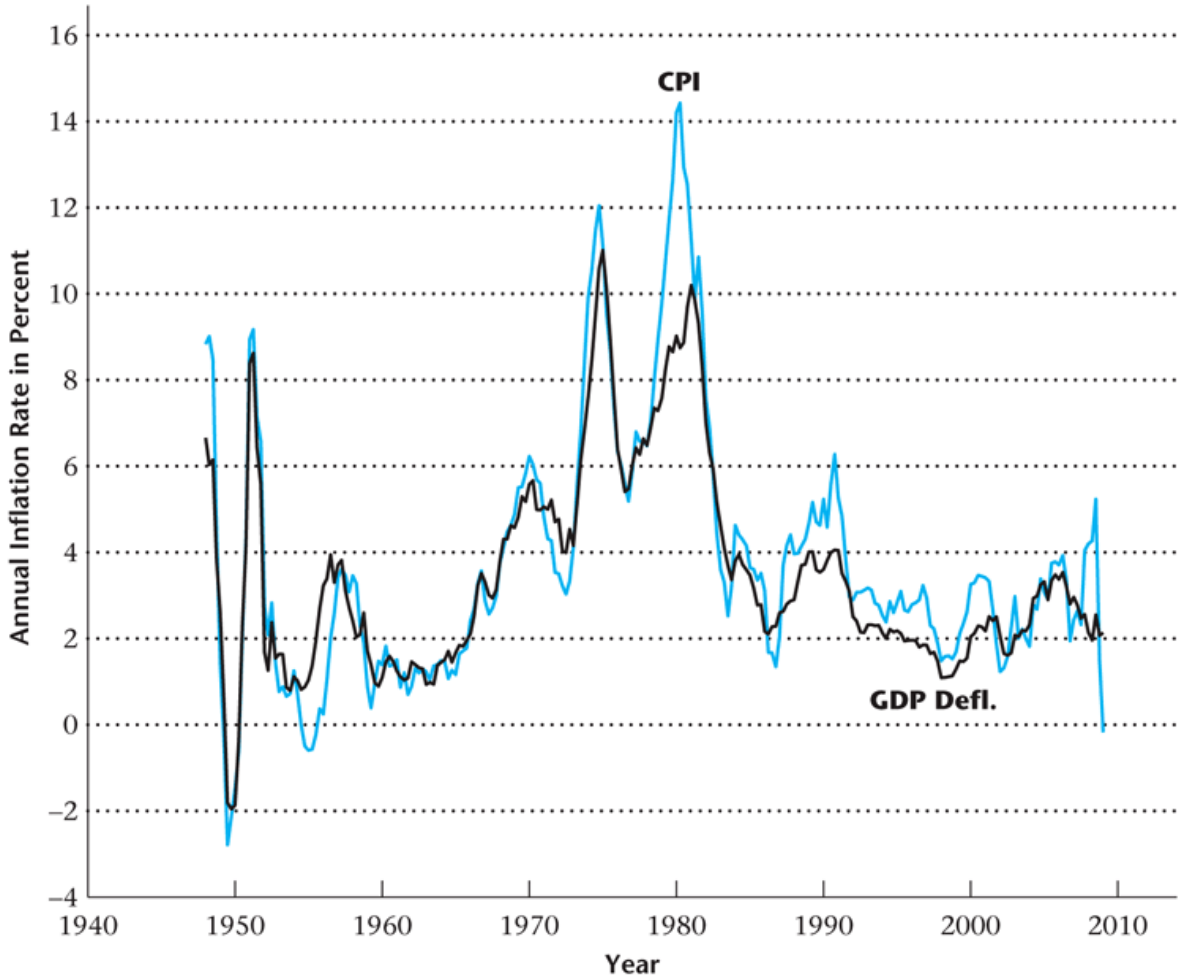
- Let's summarize our exercise. Real GDP in period 2 is equal to:
  - $realGDP_2 = 176$ dollars — period 1 as base year
  - $realGDP_2 = 292$ dollars — period 2 as base year
  - $realGDP_2 = 173.29$ dollars — chained period 1 dollars
- Example

	Year 1	Year 2	% Increase
Year 1 = base year	100	165.9	65.9
Year 2 = base year	58.4	100	71.2
Chain-weighting	100	168.5	68.5

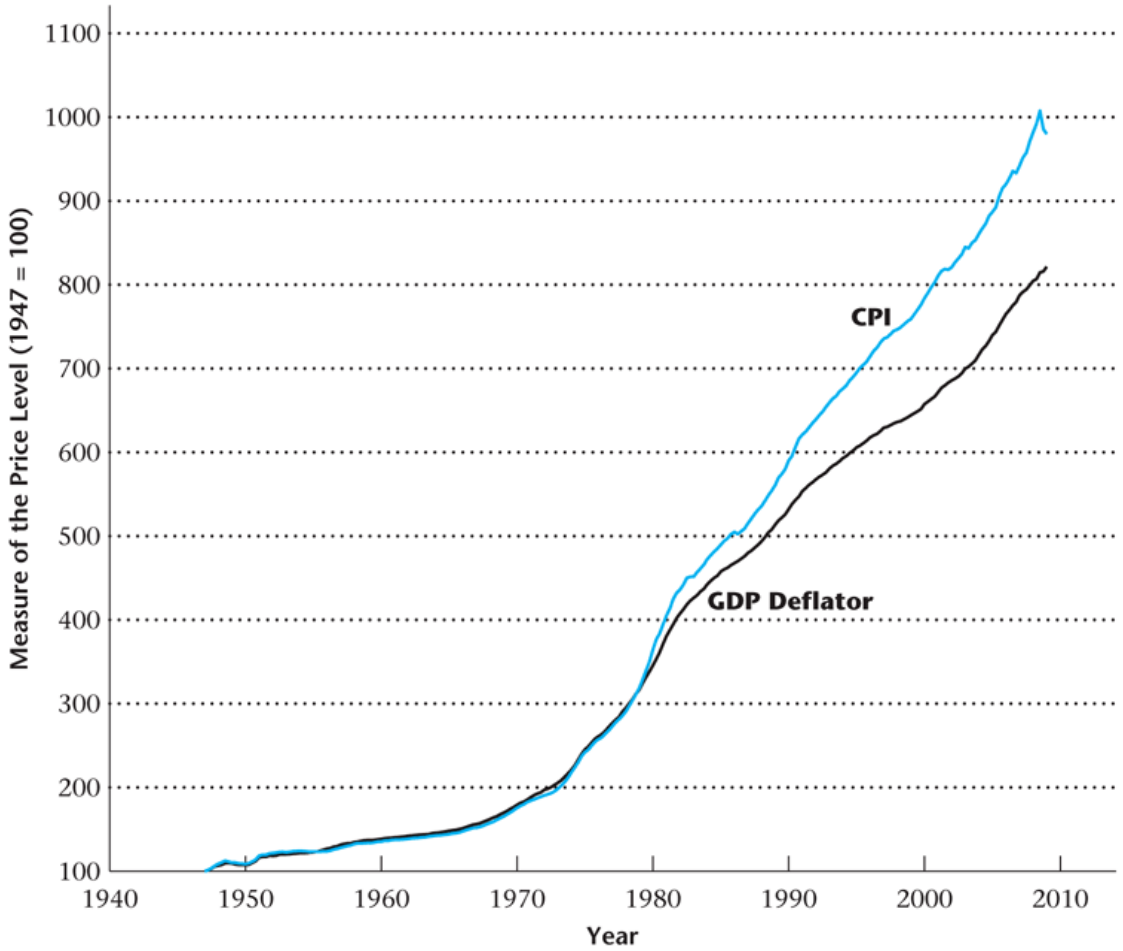
Real vs nominal variables



CPI vs GDP deflator



CPI vs GDP deflator



IV – Comparing Economic Performance across Countries

We will not cover this section. It is about real and nominal exchange rates and we will discuss this topic later on in this course.

V – Required readings

Required reading

For this week you are required to read **Read Chapter 2** of our adopted textbook. Remember, that we did not cover section 2.4 in classes (so do not read it).

Charles I. Jones (2014). Macroeconomics, Third Edition, W. W. Norton & Company.

For the issue of **Price Indices**, it is better if you read the section *"Nominal and Real GDP and Price Levels"* in **Chapter 2** of the following textbook:

Stephen Williamson (2013). Macroeconomics, Fifth Edition, Pearson Editors.