ECON3102-005
Chapter 2: Measurement and National Accounts

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Measuring GDP

Gross Domestic Product (GDP) is the market value of final output produced in a country in a given time.

- In the United States, GDP is published quarterly as part of the **National Income and Product Account (NIPA)** by the U.S. Department of Commerce.
- GDP is measured in 3 possible approaches:
  - the product approach
  - the expenditure approach
  - the income approach
- We show how this is done using an example

National Income Accounting Example

- Fictional Island Economy
    - closed economy
- Agents:
    - Coconut Producer (firm), Restaurant (firm), Consumers, Government

The Coconut Producer (firm)

Table 2.1 Coconut Producer

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

- In the current year, the coconut producer produces 10 millions coconuts, worth $2 each :$20 million of total revenue.
- He pays $5 million worth of wages to his workers (themselves consumers!).
- He pays $0.5 millions as interests on a loan made to him by some consumers.
- He pays $1.5 millions in taxes to the government.

The Restaurant (firm)

Table 2.2 Restaurant

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

- Of the 10 million coconuts produced, 6 million go to the restaurant, and the remaining 4 million are bought by consumers.
- The restaurant makes $30 million in restaurant meals during the year.
- The restaurant pays its workers $4 million in wages and pays the government $3 million in taxes.

After-Tax Profits

$$\text{After-Tax Profit} = \text{Total Revenue} - \text{Total Cost} - \text{Taxes}$$

equivalently,

$$\text{After-Tax Profit} = \text{Total Revenue} - \text{Wages} - \text{Interest}$$

$$-\text{Cost of intermediate Input} - \text{Taxes}$$

After-Tax Profits

Table 2.3 After-Tax Profits

Coconut Producer	$13 million
Restaurant	$11 million

Consumers

- Consumers work for the coconut producer, the restaurant and the government, earning $14.4 million of total wages.

Table 2.5 Consumers

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

- Consumers receive $0.5 million of interest from the coconut producer.
- They pay $1 million in taxes to the government.
- They receive $24 million as after-tax profits from the coconut producer and the restaurant, in the form of dividends.

Government

Table 2.4 Government

Tax Revenue	$5.5 million
Wages	$5.5 million

- The Government uses all taxes collected to provide national defense.

The Product Approach or Value-Added Approach

- The value of all goods and services produced in an economy - the value of all intermediate goods used in production.
- We can added up the value-added by all producers in an economy.
- Value added=Value Produced-Value of intermediate goods used
- GDP=sum of values-added for all goods and services produced in the economy (both intermediate and final goods).

The Product Approach or Value-Added Approach

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

- 3 products: coconuts, restaurant food, national defense.
- Since national defense is not sold on the market, we will assume its value=its cost.

The Expenditure Approach

- GDP = **Total Spending** on all **final** goods and services production in the economy.
- Note that this approaches does NOT include intermediate goods (to avoid double-counting)!
- In the NIPA, total expenditure is calculated as:

$$\text{Total Expenditure} = C + I + G + X - M$$

- This is because C , I , G typically include some goods produced abroad. In our example, I = NX = 0.

The Expenditure Approach

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

- consumers spend $8 million on coconut (consumers buy 4 million coconuts worth $2 each) and $30 on restaurant food. So, C=$38 millions.
- The government spends $5.5 million on national defense: G=$5.5 million.

The Income Approach

- GDP=sum of incomes received by economic agents contributing to production.
- In the NIPA, income includes wages, taxes paid by businesses, proprietor's income (for self-employed), rental income, corporate profits, net interest, indirect business taxes, and depreciation (consumption of fixed capital).

The Income Approach

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

The Three Approaches

- Note that all 3 approaches give the same GDP.
- All productions are eventually sold. Hence, production=expenditure.
- What is spent on all output produced is income. Hence, income=expenditure.
- Hence, **the income-expenditure identity**:

$$\underbrace{Y}_{\text{AggregateIncome}} = \underbrace{C + I + G + NX}_{\text{AggregateExpenditure}}$$

2008 GDP in the US

Table 2.9 Gross Domestic Product for 2008

Component of GDP	$Billions	% of GDP
GDP	14,264.6	100.0
Consumption	10,057.9	70.5
Durables	1023.2	7.2
Nondurables	2965.1	20.8
Services	6069.6	42.6
Investment	1993.5	14.0
Fixed Investment	2040.5	14.3
Nonresidential	1552.8	10.9
Residential	487.7	3.4
Inventory Investment	−47.0	−0.3
Net Exports	−669.2	−4.7
Exports	1859.4	13.0
Imports	2528.6	17.7
Government Expenditures	2882.4	20.2
Federal Defense	734.9	5.2
Federal Nondefense	337.0	2.4
State and Local	1810.4	12.7

- Fixed investment is production of capital such as plant, equipment, housing (residential).
- Inventory investment consists of goods that are put into storage.
- Government expenditure in NIPA does not include transfers.

GDP versus GNP

- GNP measures the value of output produced by domestic factors, whether or not the production occurs inside U.S borders.
- For example, GNP would include income and profits from a Ford plant in Europe. GNP would not include a Toyota plant in Texas.
- Let NFP=net factor of payments from abroad to domestic residents.

$$GNP = GDP + NFP$$

GDP versus GNP

- GNP was the official measure of aggregate production before 1991, then was replaced with GDP.
- In practice, the difference between GDP and GNP is negligible in the US.
- GNP and GDP would be significantly different for countries with a large fraction of national production owned by foreign firms.

Issues with GDP as a Measure of Aggregate Output

- GDP does not include the output from the underground economy.
- Government production is difficult to measure, as the output (for example defense services) is typically not sold in the market.

Nominal and Real GDP and Price Indices

- Price Index: Weighted average of a set of observed prices that gives a measure of the price level.
- Price indices allow us to measure the inflation rate the rate of change in the price level.
- A measure of the inflation rate allows us to determine how much of an increase in GDP is nominal and how much is real.

Data for Real GDP Example

Table 2.10 Data for Real GDP Example

	Apples	Oranges
Quantity in Year 1	$Q_1^a = 50$	$Q_1^0 = 100$
Price in Year 1	$P_1^a = \$1.00$	$P_1^0 = \$0.80$
Quantity in Year 2	$Q_2^a = 80$	$Q_2^0 = 120$
Price in Year 2	$P_2^a = \$1.25$	$P_2^0 = \$1.60$

- Nominal GDP in Year 1?
- NGDP1=50*1+100*0.8=**$130**
- Nominal GDP in Year 2?
- NGDP2=80*1.25+120*1.60=**$292**
- Real GDP in Year 1 (base year 1)?
- RGDP1=**$130**
- Real GDP in Year 2 (base year 1)?
- RGDP2=80*1+120*0.80=**$176**

Growth Rates

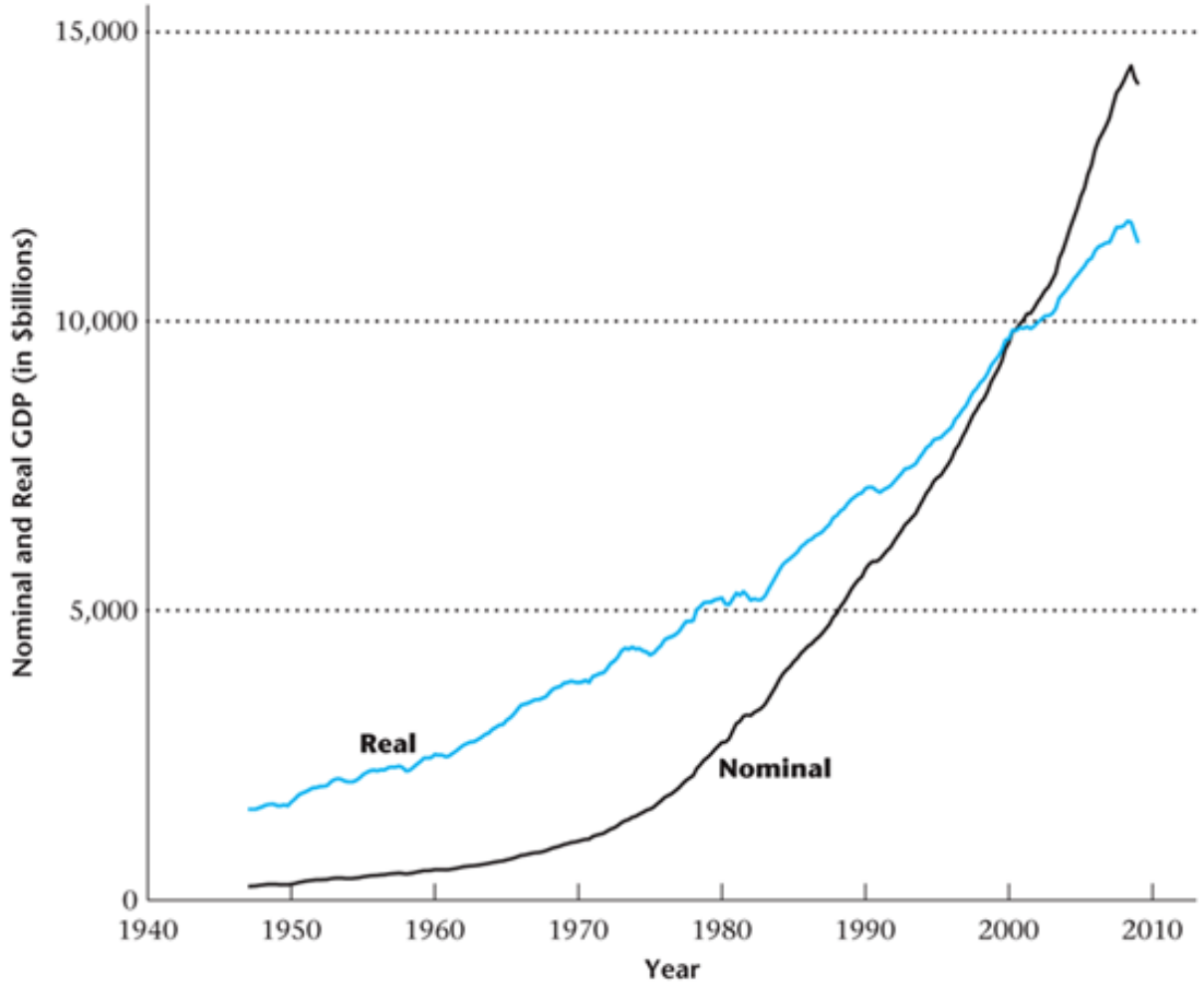
	NGDP	RGDP (base year=1)	RGDP (base year=2)
Year 1	130	130	222.5
Year 2	292	176	292

- Nominal GDP growth rate=$\left(\frac{NGDP2}{NGDP1} - 1\right) * 100\%$=125%.
- Nominal GDP grew by 125% (more than doubled).
- Using Year 1 as base year, real GDP growth rate=$\left(\frac{RGDP2}{RGDP1} - 1\right) * 100\%$=35.4%.
- Using Year 1 as base year, real GDP grew by g1=35.4.%
- Using Year 2 as base year, real GDP grew by g2=31.2.%

Chain-weighted Real GDP

- In the example, the RGDP growth rate measured using Year 1 as base year (g1) is different from that measured using Year 2 as base year (g2) because relative prices have changed!
- The relative price of apples in terms of oranges in Year $1 = \frac{1.00}{0.8} = 1.25$. That is, an apple costs 1.25 oranges.
- The relative price of apples in Year $2 = \frac{1.25}{1.6} = 0.78$.
- Note that the apples have become relatively cheaper in Year 2.
- Also, the growth in the quantity of apples is greater than the growth in the quantity of oranges.
- Thus, we observe a bigger growth rate when we use Year 1 prices.
- Chain-weighted growth rate $gc = \sqrt{g1 * g2} = 33.3\%$

Nominal GDP and Chain-weighted Real GDP in the United States



If RGDP1=100, then RGDP2=RGDP1*gc, and if GDP2 = 100, GDP1 = 100/gc.

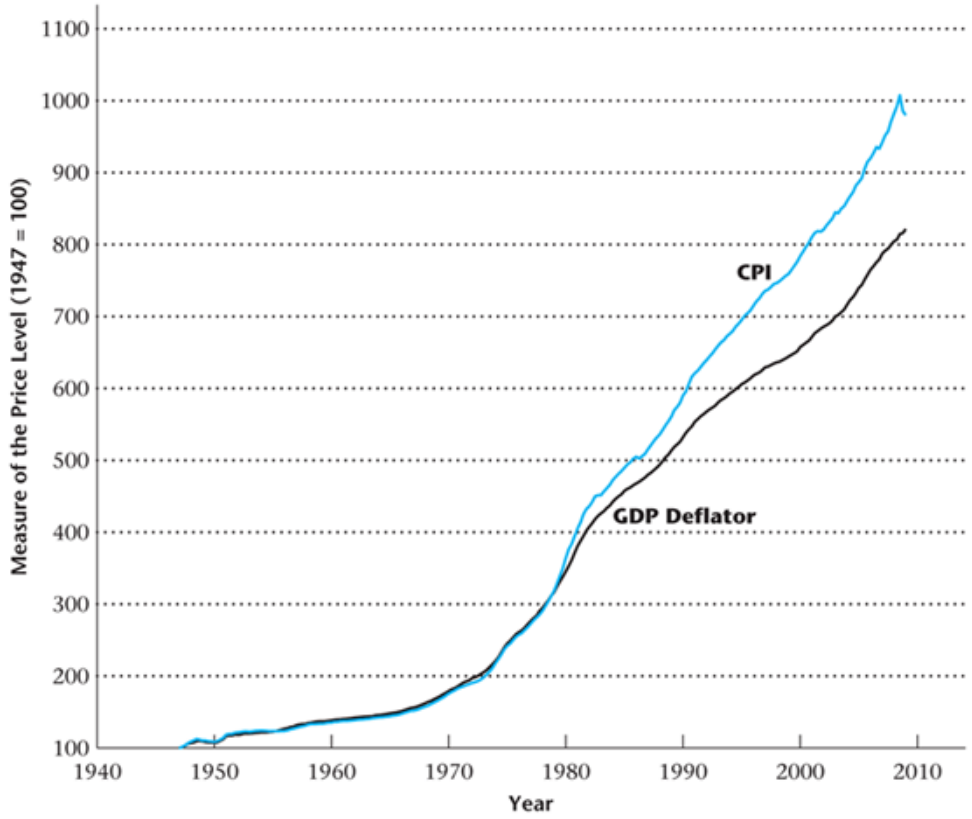
Implicit GDP Price Deflators and CPI

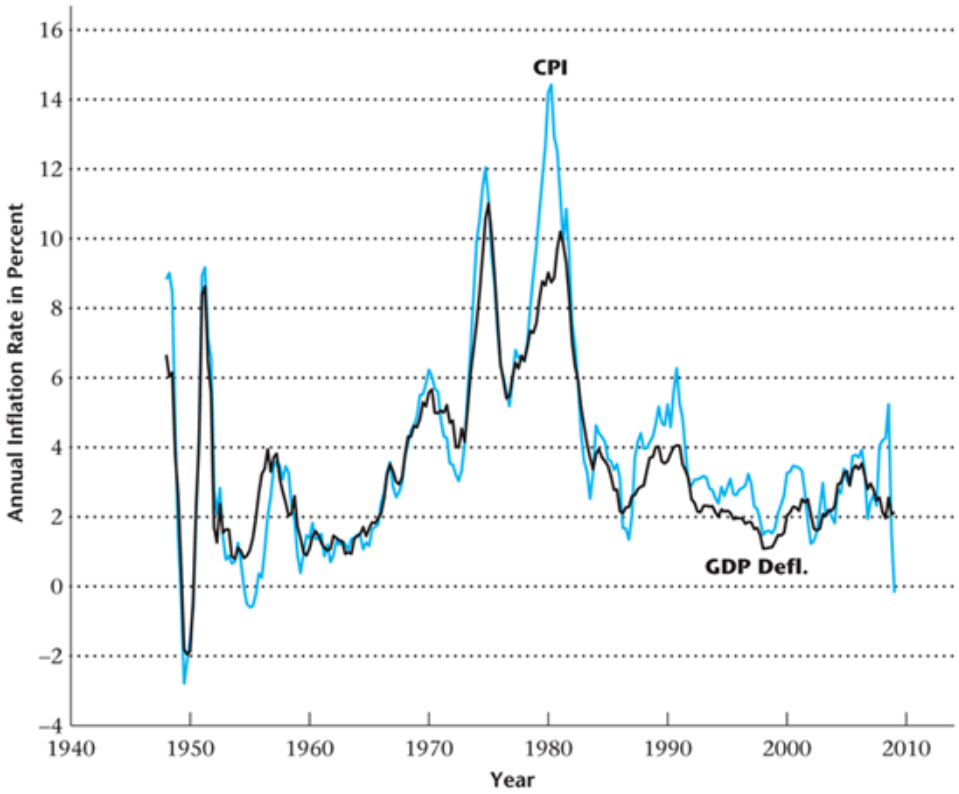
- Implicit GDP Price Deflator = Nominal GDP/Real GDP * 100
- CPI = $\frac{\text{Cost of base year quantities at current prices}}{\text{Cost of base year quantities at base year prices}}$ * 100
- The CPI is found basically with a fixed basket (fixed goods and fixed combination of quantities).

Table 2.11 Implicit GDP Price Deflators, 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

The Price Levels Measured by Implicit GDP Price Deflators and CPI, 19472009





Upward Bias of CPI

- Doesn't consider changes in consumer behavior in response to changes in relative prices:
    - When there is a relative price change consumers purchase less of goods that have become more expensive and more of those that became cheaper. Thus, if we hold the quantities constant we are putting too much weight on goods that are more expensive.
- Doesn't consider changes in quality over time: if quality increases, then price may increase.
- Doesn't consider the introduction of new goods: new PCs were introduced at a initially high price, but at a huge quality advance over calculators and type writers.