Gross Domestic Product (GDP)

ECON 101 Introductory Economics

Columbia College

Macroeconomics v.s. Microeconomics

Topic	Microeconomics	Macroeconomics
Income	income of a person or revenue of a firm	income of an entire country or a national economy
Output	production of a single worker, firm, or industry	production of an entire economy
Employment	job status and decisions of an individual or firm	job status of a country's population, especially the number of people who are jobless
Prices	price of a single good	the combined prices of all goods in an economy

Major Topics in Macroeconomics

- Economic growth: how to achieve (and maintain) steady and sustainable economic expansion
  - Economic stability: policy responses to "shocks" to the economy (natural disasters, technological breakthrough, changes in the world economic environment, etc.)

- (Un)employment: how to avoid having too many people unemployed

- Money and banking: regulating the financial system
  - Inflation: keeping things affordable

Learning Objectives of This Lecture

1. Define GDP and explain why the value of production, income and expenditure are the same for an economy

2. Describe how economic statisticians measure GDP and distinguish between nominal and real GDP

3. Describe the uses of real GDP and explain its limitations as a measure of the standard of living

GDP Defined

- GDP is short for **Gross Domestic Product**

- It's the market value of all the final goods and services produced within a country in a given time period
    - **market value**: use market prices to value production
    - **final goods/services**: produced for its final user, and not as a component of another good or service
    - **within a country**: reason why it's called gross *domestic* product
    - **in a given time period**: typical units are year, quarter, month

Types of Goods/Services

- Final good/service is a good or service that is produced for its final user and not as a component of another good or service

- Intermediate good/service is a good or service that is produced by one firm, purchased by another firm as input of production of some final good/service
  - Ford buys steel or tires (intermediate goods) as input for its cars (final good)
  - McDonald's buys beef (intermediate good) as input for its burgers (final good)

- GDP includes only final goods and services

Value-Added

Value-added is the increase in the market value at each stage of production
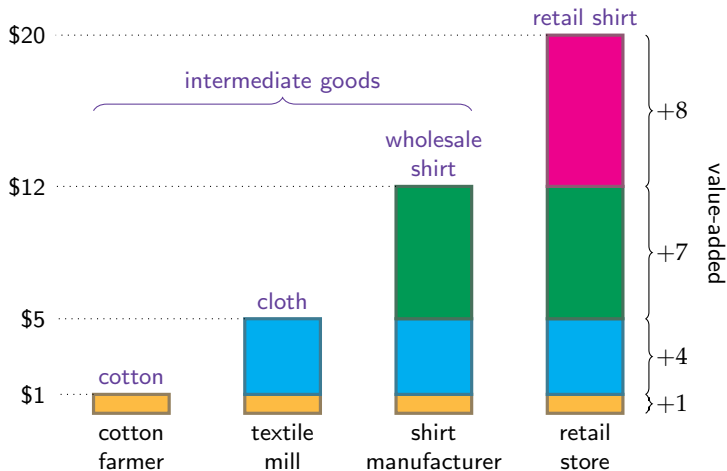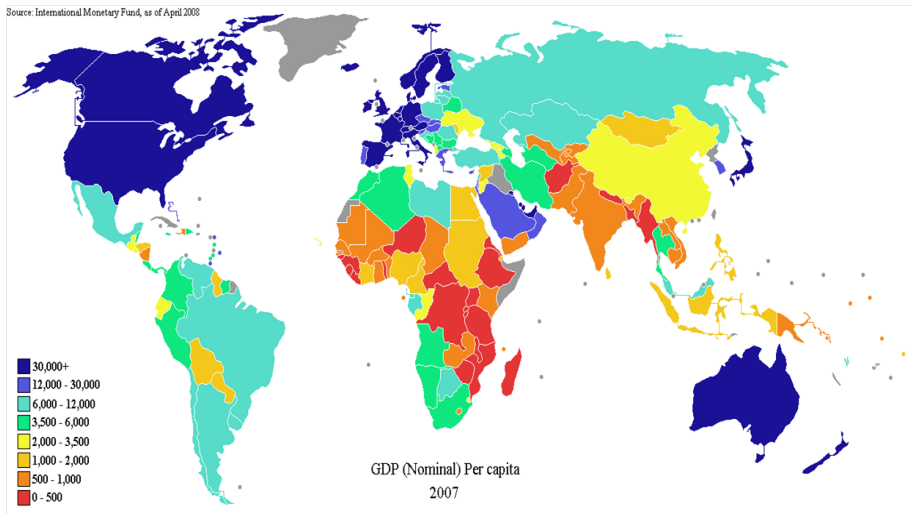
Value-Added

- Measuring value-added in each stage of production avoids "double-counting" the values of the intermediate goods

- In previous example, if we add up all the market values of each good produced, we would get $1 + 5 + 12 + 20 = \$38$

- However, if we only count the value-added in each stage, we would get $1 + 4 + 7 + 8 = \$20$, which is equal to the market value of the final good

GDP of the World

Source: International Monetary Fund, as of April 2008

GDP (Nominal) Per capita
2007

- 30,000+
- 12,000 - 30,000
- 6,000 - 12,000
- 3,500 - 6,000
- 2,000 - 3,500
- 1,000 - 2,000
- 500 - 1,000
- 0 - 500

Measuring GPD

There are three generally accepted ways to calculate GDP:

- Product approach: adding up the market values of all final goods/services

- Expenditure approach: adding up the total expenditure of different sectors of the economy

- Income approach: adding up the income generated by the production of final goods/services

Product Approach

- Sum of market value of all final goods/services

- Suppose there are N goods, with quantities $Q_1, Q_2, \ldots, Q_N$ and unit prices $P_1, P_2, \ldots, P_N$, respectively. Then GDP is calculated as

$$\text{GDP} = P_1 Q_1 + P_2 Q_2 + \cdots + P_N Q_N$$

- E.g. a tropical island economy produces three goods: coconut, banana, and orange, with the following quantities and prices

Product	Quantity	Price
Coconut	40	$3
Banana	38	$9
Orange	29	$7

Then the GDP of this economy would be

$$\$3 \times 40 + \$9 \times 38 + \$7 \times 29 = \$665$$

Expenditure Approach

- **Consumption expenditure** is the expenditure by households on consuming goods/services

- **Investment** is the purchase of new capital goods (tools, instruments, machines, buildings, and other constructions) and additions to inventories

- **Government purchases** is the expenditure by all levels of government on goods/services

- **Net exports** is the value of exports of goods/services *minus* the value of imports of goods/services
    - **Exports** are goods produced *within* Canada and sold to the rest of the world
    - **Imports** are goods produced *outside* Canada and purchased by Canadian households, firms, and governments

Expenditure Approach

- Total expenditure is the total amount received by producers of final goods/services

- Thus, according to this approach,

$$\text{GDP} = C + I + G + NX$$

  - C: consumption
  - I: investment
  - G: government purchases
  - NX: net export

Income Approach

- Sum of income generated by the production of final goods/services

$$
\begin{aligned}
\text{GDP} = \quad & \text{wage} && \text{(income for labor)} \\
& + \text{rent} && \text{(income for land)} \\
& + \text{interest} && \text{(income for capital)} \\
& + \text{profit} && \text{(income for firms)}
\end{aligned}
$$

Equivalence of the Three Approaches

- Households (consumers) supply the factors of production; moreover, they own the firms (in the form of stocks)

- Firms pay out everything (including profits) they receive as incomes to the factors of production

- Therefore,

    total value of production $=$ total expenditure $=$ total income

Circular Flow Diagram
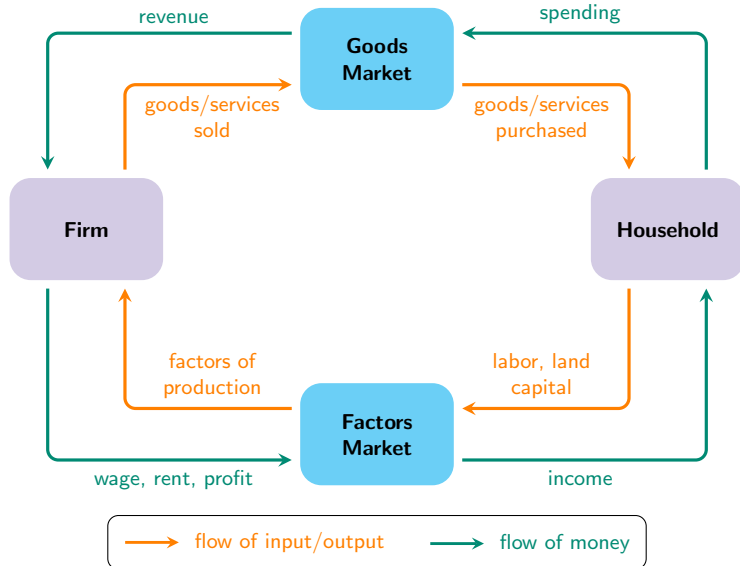
Measuring GDP — Example

TABLE 20.1

GDP: The Expenditure Approach

Item	Symbol	Amount in 2009 (second quarter) (billions of dollars)	Percentage of GDP
Consumption expenditure	C	9,996	70.7
Investment	I	1,559	11.0
Government expenditure	G	2,927	20.7
Net exports	NX	−339	−2.4
GDP	Y	14,133	100.0

SOURCE OF DATA: U.S. Department of Commerce, Bureau of Economic Analysis.

Not Included in GDP

- Used goods, or second hand sales
  - These goods were part of GDP in the period when they were produced and during which time they were new goods
  - No current production; they were counted the first time sold
  - E.g. a 2003 Toyota bought in 2016, or the sales of a used textbook
  - However, the salesperson's commission would count, because his service is new

- Financial assets
  - When households buy financial assets such as bonds and stocks, they are making loans, not buying goods/services

- Public transfer payments (e.g. welfare, unemployment benefit, social security)
  - These do not contribute to final production

GNP — Gross National Product

- **Gross National Product (GNP)** is the market value of all goods/services produced in a given time period by the citizens of a country

- Whereas GDP is defined based on *where* the production takes place, GNP is based on *who* produces the goods/services
    - E.g. profits generated by General Electric in China is not included in U.S. GDP but is in U.S. GNP

  GNP = GDP

        + income earned by citizens from investing overseas

        − income earned by foreign nationals in domestic economy

Real v.s. Nominal GDP

- **Real GDP** is the value of the final goods/services produced in a given year, expressed in the prices of some "base year"

- **Nominal GDP** is the value of the final goods/services produced in a given year, expressed in the prices of that same year

- The goal of calculating real GDP is to measure the extent to which total production has increased
  - Recall that GDP $= P_1 Q_1 + P_2 Q_2 + \cdots + P_N Q_N$
  - Differences in (nominal) GDP in different years may be due to changes in either prices or quantities
  - Real GDP removes the influence of price changes, so that we can focus on comparing the changes in output alone
  - Changes in price level are the subject of another macroeconomic inquiry: inflation

Calculating Real and Nominal GDP

- Suppose the base year is 2014. Then the real and nominal GDPs in 2016 are given by

$$\text{Real GDP}^{2016} = P_1^{2014}Q_1^{2016} + P_2^{2014}Q_2^{2016} + \cdots + P_N^{2014}Q_N^{2016}$$

$$\text{Nominal GDP}^{2016} = P_1^{2016}Q_1^{2016} + P_2^{2016}Q_2^{2016} + \cdots + P_N^{2016}Q_N^{2016}$$

- More generally, economists usually use the number "0" to denote the base year, and thus for any year t, we have:

General Formula for Real and Nominal GDP

$$\text{Real GDP}^t = P_1^0Q_1^t + P_2^0Q_2^t + \cdots + P_N^0Q_N^t$$

$$\text{Nominal GDP}^t = P_1^tQ_1^t + P_2^tQ_2^t + \cdots + P_N^tQ_N^t$$

Real and Nominal GDP — Example

Item	Q^{2010}	P^{2010}	Q^{2015}	P^{2015}
T-shirts	10	5	4	5
Computer chips	3	10	2	20
Security services	1	20	6	40

- Let 2010 be the base year.

$$\text{Nominal GDP}^{2010} = \underline{\quad 10 \times 5 + 3 \times 10 + 1 \times 20 = 100 \quad}$$
$$\text{Real GDP}^{2010} = \underline{\quad 10 \times 5 + 3 \times 10 + 1 \times 20 = 100 \quad}$$
$$\text{Nominal GDP}^{2015} = \underline{\quad 4 \times 5 + 2 \times 20 + 6 \times 40 = 300 \quad}$$
$$\text{Real GDP}^{2015} = \underline{\quad 4 \times 5 + 2 \times 10 + 6 \times 20 = 160 \quad}$$

Economic Growth

- The **GDP growth rate**, r, between year 0 and year 1 is calculated by

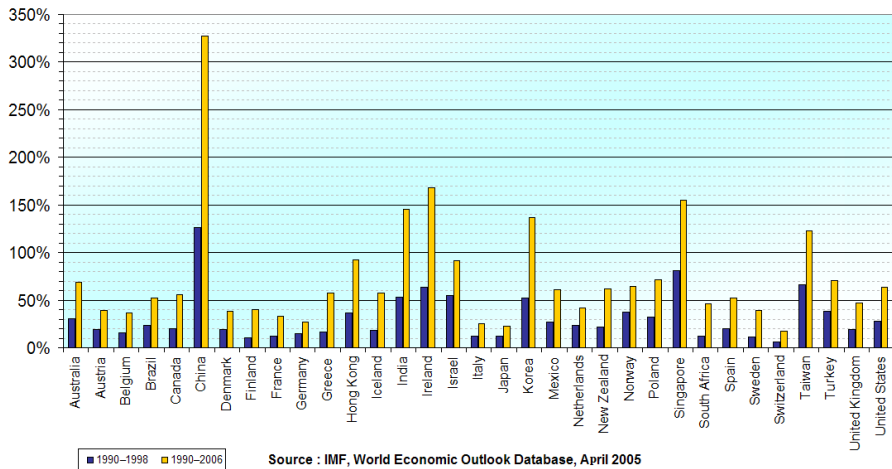$$r = \frac{\text{Real GDP}^1 - \text{Real GDP}^0}{\text{Real GDP}^0}$$

- In the previous example, where Real $\text{GDP}^{2010} = 100$ and Real $\text{GDP}^{2015} = 160$, the (5-year) GDP growth rate is

$$r = \frac{160 - 100}{100} = 0.6 = 60\%$$

and the average annual growth rate is $0.6/5 = 0.12 = 12\%$.

GDP Growth in the World

GDP accumulated growth, in percent, constant prices

Source : IMF, World Economic Outlook Database, April 2005

Legend: ■ 1990–1998 ☐ 1990–2006

The Uses of GDP

- Gauge the performance of an economy, both over time and across different countries

- Compare the living standards, both over time and across different countries
  - Usually calculate real GDP per person, i.e. real GDP divided by the population size

GDP Per Capita in the World

	102211
	85237.33
	68263.67
	51290
	34316.33
	17342.67
	369
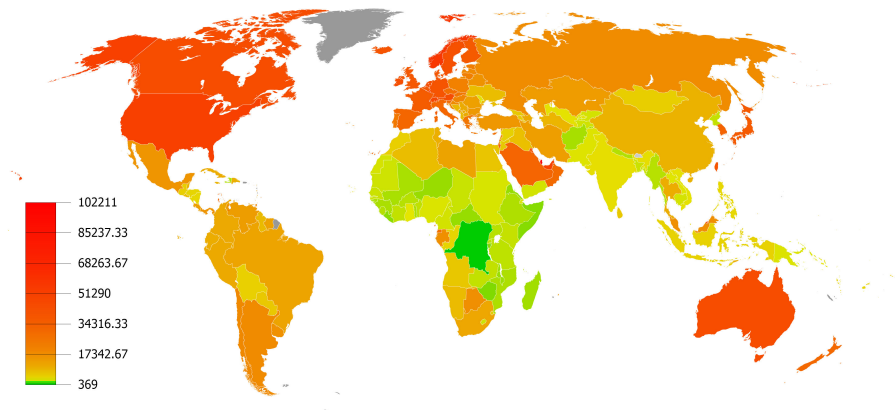
The Limitations of GDP

- Household production
  - Housework (cleaning, cooking) and volunteer work are not part of GDP, because these don't generate payment

- Underground production
  - Payments that typically get under-reported or even unreported
  - A cash-only restaurant under-reports its revenues on tax forms
  - Illegal business activities: selling drugs, gun-for-hire

- Leisure time
  - Only values generated by working are included in GDP
  - But leisure has value too — some people actually pay not to go to work

The Limitations of GDP

- Environmental quality
  - Pollution is not subtracted from GDP
  - Deteriorating atmosphere is not counted against GDP

- Improved product quality
  - (Real) GDP mainly measures quantity, but doesn't take into account the value of improvements in product quality

- Health and life expectancy

- Political freedom and social justice