ECON 3020 MACROECONOMICS:

MEASUREMENT AND STRUCTURE OF THE NATIONAL ECONOMY

Karel Mertens
CORNELL UNIVERSITY
1. Introduction to Macroeconomics

- This chapter defines some of the main objects of interest to macroeconomists.
- National income, national saving, GDP and its components, the current account, inflation, interest rates, ...
Three definitions:

1. **Product approach**: Value of newly produced final goods and services within a nation during a fixed period of time

2. **Expenditure approach**: Total expenditure on domestically produced final goods and services within a nation during a fixed period of time

3. **Income approach**: Total income earned by domestically located factors of production
## GDP of Orange Town

### Orange Inc
- Wages paid: 15,000
- Taxes paid: 5,000
- Sales Revenue:
  - sold to public: 10,000
  - sold to Juice Inc: 25,000

### Juice Inc
- Wages paid: 10,000
- Taxes paid: 2,000
- Intermediate Goods (Oranges) Purchased: 25,000
- Sales Revenue (sold to public): 40,000
Gross Domestic Product (GDP)

By construction, GDP computed in all three ways should give the same number.

Why?

- The fundamental identity of national income accounting:

  \[
  \text{total production} = \text{total income} = \text{total expenditure}
  \]

- Because, in every transaction there is a seller and buyer. Buyers expenditure is the sellers income. Sellers income is the value of the (final) good sold in this transaction.
The Product Approach

- A firm's **value added** is the value of its output minus the value of the intermediate goods the firm used to produce that output.
- \( \text{GDP} = \text{value of final goods produced} = \text{sum of value added at all stages of production} \)
- The value of the final goods already includes the value of the intermediate goods, so including intermediate goods in GDP would be double-counting.
The Expenditure Approach

- Four main categories of spending: private consumption ($C$), private investment ($I$), government purchases of goods and services ($G$), and net exports ($NX$)
- The income-expenditure identity

\[ Y = C + I + G + NX \]

where $Y = GDP =$ the value of total output
\[ C + I + G + NX = \text{aggregate expenditure} \]

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

Spending by domestic households on final goods and services (including those produced abroad)

- About 2/3 (66%) of U.S. GDP
- Three subcategories:
  1. Consumer durables (examples: cars, TV sets, furniture, major appliances)
  2. Nondurable goods (examples: food, clothing, fuel)
  3. Services (examples: education, health care, financial services, transportation)
C/GDP ratio

Shaded areas indicate US recessions - 2015 research.stlouisfed.org
Investment

Spending on new capital goods and inventories.
Spending on goods bought for future use.

- About 1/6 (16%) of GDP
- Three categories:
  1. **Nonresidential fixed investment**: spending on structures, equipment and intellectual property products that firms will use to produce other goods and services
  2. **Residential fixed investment**: spending on housing units by consumers and landlords
  3. **Inventory investment**: the change in the value of all firms’ inventories
Capital vs. Investment

- Capital $K$ is a **stock** variable
- Investment $I$ is a **flow** variable
- Suppose in period $t$, $I_t = 25$ billion and the total stock of capital in period $t$ is worth $K_t = 500$ billion.
- Suppose the capital stock depreciates at a rate $\delta = 0.10$ due to wear and tear.
- Then the **capital stock** tomorrow is worth

\[
K_{t+1} = (1 - \delta)K_t + I_t = 475 \text{ billion}
\]

- Other examples of stocks vs. flows: household wealth vs. household saving; people with college degrees vs. new college graduates; government debt vs. government budget deficit
I/GDP ratio

Shaded areas indicate US recessions - 2015 research.stlouisfed.org
Government Expenditures $G$

Spending by the federal, state and local governments on final goods or services

- About 1/5 (20%) of GDP
- Some government spending is for capital goods that add to the nations capital stock, such as highways, airports, bridges, and water and sewer systems
- Transfers, including Social Security payments, welfare, and unemployment benefits, are excluded because they do not represent spending on final goods and services
G/GDP ratio: since 1947

Shaded areas indicate US recessions - 2015 research.stlouisfed.org
G/GDP ratio: since 1929

Shaded areas indicate US recessions - 2015 research.stlouisfed.org
Net Exports $NX$

Net exports: exports minus imports, the **trade balance**

- Exports: goods produced in the country that are purchased by foreigners
- Imports: goods produced abroad that are purchased by residents in the country
- Imports are subtracted from GDP, as they represent goods produced abroad, and were included in consumption, investment, and government purchases
NX/GDP ratio
The Income Approach

Adds up income generated by production (including profits and taxes paid to the government)

- compensation of employees (including benefits)
- proprietors' income (income of non-incorporated self employed)
- rental income of persons
- corporate profits
- net interest
- taxes on production and imports
- business current transfer payments
- current surplus of government enterprises

= National Income
The Income Approach

**National Income**

\[ \text{National Income} + \text{Statistical Discrepancy with production measure} = \text{Net National Product} \]

\[ \text{Net National Product} + \text{Consumption of Fixed Capital (Depreciation } \delta K_t) = \text{Gross National Product} \]

\[ \text{Gross National Product} - \text{Net Factor Payments from abroad} = \text{Gross Domestic Product} \]

- **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.
To summarize, GDP measures:

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

- Household wealth = a household’s assets minus its liabilities
- National wealth = sum of all households’, firms’, and governments’ wealth, i.e. domestic physical assets (land and capital) + net foreign assets
- Saving = current income − current spending
- Saving rate = saving/current income
- Wealth is determined by the total savings of
  1. individuals
  2. businesses
  3. government
- Wealth is a stock, savings a flow
Saving by the Private Sector

**Private sector disposable income:** the amount of income the private sector has available to spend

\[
Y + NFP + TR + INT - T = \text{Private disposable income}
\]

**Private saving** = private disposable income − consumption

\[
S^{\text{private}} = (Y + NFP - T + TR + INT) - C
\]
Saving by the Government Sector

**Net government income:** part of GDP that is not at the disposal of the private sector

\[
T \quad \text{Taxes paid by the private sector} \\
- TR \quad \text{Transfers from the government} \\
- INT \quad \text{Interest payments on government debt}
\]

\[
= \text{Net government income}
\]

**Government saving:** net government income − government purchases of goods and services

\[
S^{\text{govt}} = (T - TR - INT) - G
\]

**Government budget deficit** \(D^{\text{govt}} = -S^{\text{govt}}\)
National Saving

\[
\text{National saving} = S^{\text{private}} + S^{\text{govt}}
\]

\[
(Y + NFP - T + TR + INT) - C + (T - TR - INT) - G
\]

- private saving
- government saving

\[
= Y + NFP - C - G
\]

\[
= GNP - C - G
\]

National saving
US Saving as % of GDP
National Saving and the Current Account

Use the income-expenditure identity

\[
S^{private} + S^{govt} = Y + NFP - C - G
\]

\[
= (C + I + G + NX) + NFP - C - G
\]

\[
= I + NX + NFP
\]

\[
= I + CA
\]

**Current account balance**  CA represents the amount a country lends / borrows abroad

\[
CA = NX + NFP
\]

\[
= S^{private} + S^{govt} - I
\]

\[
= S^{private} - D^{govt} - I
\]
The US Current Account as % of GDP

Shaded areas indicate US recessions - 2015 research.stlouisfed.org
The US Current Account Deficit

\[ CA = S - I = S_{private} - D_{govt} - I \]

The US has a very large current account deficit (up to 6% of GDP)

- Decline in saving \( S \downarrow \)?
  - Decline in private saving \( S_{private} \downarrow \)?
  - Rise in government budget deficits \( D_{govt} \uparrow \)\?
    \( \rightarrow \) the **Twin Deficits**?

- Increase in investment \( I \uparrow \)?
Savings (green) and Investment (red) to GDP ratio
The Personal (not Private!) Saving Rate

Personal saving as a percentage of disposable personal income
The Government Deficit

![Graph showing the government deficit over time](image)

Legend:
- **CURRENT DEFICIT**
- **PRIMARY CURRENT DEFICIT**
- **World War II (1941–1945)**
Real vs. Nominal Variables

- **Nominal GDP** is the current market value of all final goods and services produced, i.e. in current dollars.

- **Real GDP** is the value of all final goods and services produced valued at prices of a base year, i.e. at constant dollars.

- 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.

- Real consumption, investment, government spending, etc.
<table>
<thead>
<tr>
<th>Product (quantity)</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Percent change from year 1 to year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers</td>
<td>5</td>
<td>10</td>
<td>+100%</td>
</tr>
<tr>
<td>Bicycles</td>
<td>200</td>
<td>250</td>
<td>+25%</td>
</tr>
<tr>
<td>Price</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td>$1,200/computer</td>
<td>$600/computer</td>
<td>−50%</td>
</tr>
<tr>
<td>Bicycles</td>
<td>$200/bicycle</td>
<td>$240/bicycle</td>
<td>+20%</td>
</tr>
<tr>
<td>Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td>$6,000</td>
<td>$6,000</td>
<td>0</td>
</tr>
<tr>
<td>Bicycles</td>
<td>$40,000</td>
<td>$60,000</td>
<td>+50%</td>
</tr>
<tr>
<td>Total</td>
<td>$46,000</td>
<td>$66,000</td>
<td>+43.5%</td>
</tr>
</tbody>
</table>
### Calculation of real output with base year = Year 1

<table>
<thead>
<tr>
<th></th>
<th>Current quantities</th>
<th>Base-year prices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td>5</td>
<td>×</td>
<td>$1,200</td>
</tr>
<tr>
<td>Bicycles</td>
<td>200</td>
<td>×</td>
<td>$200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$40,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$46,000</strong></td>
</tr>
</tbody>
</table>

**Percentage growth of real GDP** = \( \frac{($62,000 - $46,000)}{46,000} = 34.8\% \)

### Calculation of real output with base year = Year 2

<table>
<thead>
<tr>
<th></th>
<th>Current quantities</th>
<th>Base-year prices</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td>5</td>
<td>×</td>
<td>$600</td>
</tr>
<tr>
<td>Bicycles</td>
<td>200</td>
<td>×</td>
<td>$240</td>
</tr>
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<td>$3,000</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>$48,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$51,000</strong></td>
</tr>
</tbody>
</table>

**Percentage growth of real GDP** = \( \frac{($66,000 - $51,000)}{51,000} = 29.4\% \)
Price Indices: the GDP Deflator

Suppose there are \( N \) final goods in the economy, indexed by \( n = 1, \ldots, N \). In period \( t \), quantity \( y_t^n \) of good \( n \) is sold at price \( p_t^n \).

\[
Y_t = \sum_{n=1}^{N} p_t^n y_t^n \quad \text{Nominal GDP}
\]

\[
y_t = \sum_{n=1}^{N} p_{base}^n y_t^n \quad \text{Real GDP}
\]

\[
P_t^{def} = 100 \times \frac{Y_t}{y_t} \quad \text{GDP Deflator}
\]

Note: current methodology is based on chain-weighting
Price Indices: the Consumer Price Index

Take $\tilde{N}$ of the $N$ goods, i.e. a basket of goods

$$\sum_{n=1}^{\tilde{N}} p_t^n y_t^n$$  \hspace{1cm} \text{Current cost of the basket}

$$\sum_{n=1}^{\tilde{N}} p_{base}^n y_t^n$$  \hspace{1cm} \text{Cost of the basket in base year}

$$P_t^{CPI} = 100 \times \frac{\sum_{n=1}^{\tilde{N}} p_t^n y_t^n}{\sum_{n=1}^{\tilde{N}} p_{base}^n y_t^n}$$  \hspace{1cm} \text{Consumer Price Index}

The Bureau of Labor Statistics (BLS) surveys consumers to determine composition of the typical consumer’s “basket” of goods.
CPI vs. GDP deflator

- CPI is available at monthly frequency, GDP deflator at quarterly frequency
- 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
Inflation

Both $P_t^{\text{def}}$ and $P_t^{\text{CPI}}$ are measures of the overall price level and can be used to measure inflation.

The rate of inflation between $t$ and $t + 1$ is the percentage increase in the overall price level and equals

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$
The Boskin Commission Report

Reasons why the CPI may overstate inflation by 1% to 2%:

- **Substitution Bias**: The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.

- **Quality Adjustment Bias**: Quality improvements increase the value of the dollar, but are often not fully measured.

- **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.
Interest Rates

- Suppose you buy a certificate of deposit at a price of $100 from a bank in period $t$. In period $t+1$ the bank pays you $(1 + \ i_t)\$100$.

- Suppose you take out a $100 student loan from a bank in period $t$, and you have to repay $(1 + \ i_t)\$100$ in period $t + 1$.

- $i$ is the nominal interest rate

- The real interest rate is the difference between the nominal interest rate and the rate of inflation

  $$\text{real interest rate} = i_t - \pi_{t+1}$$

- In $t + 1$, the lender can afford $(i_t - \pi_{t+1})\%$ more goods than in $t$ as a compensation for extending the loan.
Interest Rates

- In period $t$, $\pi_{t+1}$ is unknown, and borrowing/lending decisions are based on the expected value of $\pi_{t+1}$.

- The **expected real interest rate** $r$

$$r = i_t - \pi^e_{t+1}$$

where $\pi^e_{t+1}$ is expected inflation.

- How to measure expectations?
Interest Rates

![Chart showing nominal and real interest rates from 1960 to 2010. The graph compares the nominal interest rate (in pink) and the real interest rate (in yellow). The nominal interest rate spikes in the 1980s, while the real interest rate remains relatively stable, particularly in the 1990s and 2000s.]