CHAPTER 7 - GDP AND THE CPI: TRACKING THE MACROECONOMY

CHAPTER 7 LECTURE - GDP AND THE CPI: TRACKING THE MACROECONOMY

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WHAT YOU WILL LEARN IN THIS CHAPTER

- How do economists use aggregate measures to track the performance of the economy?
- What is gross domestic product (GDP) and how is it calculated?
- What is the difference between real GDP and nominal GDP and why is real GDP the appropriate measure of real economic activity?
- What is a price index and how is it used to calculate the inflation rate?

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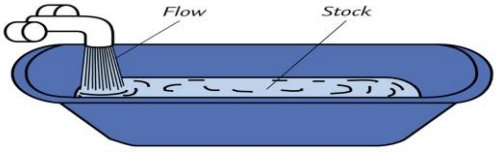
STOCKS AND FLOWS

- The distinction between a stock and a flow is very important.
- A stock is a position at a moment of time, for example, the stock of inventories in the economy at year end 2005. (Balance sheets report stocks.)
- A flow is the rate of change in a stock, for example, the change in the stock of inventories in the economy in 2005. (Profit and loss statements report flows.)
- If the bath tub is filling up, the stock is rising.



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GROSS DOMESTIC PRODUCT

- GDP Defined
  - GDP or gross domestic product is the market value of all final goods and services produced in a country in a given time period.
  - This definition has four parts:
- Market value
- Final goods and services
- Produced within a country
- In a given time period

- Excludes financial transactions and income transfers since these do not reflect production.
- Net additions to inventory are current period output so are also included.

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GROSS DOMESTIC PRODUCT

- Market Value
  - GDP is a market value—goods and services are valued at their market prices.
  - To add apples and oranges, computers and popcorn, we add the market values so we have a total value of output in dollars.
- Final Goods and Services
- GDP is the value of the final goods and services produced.
- A final good (or service) is an item bought by its final user during a specified time period.
- A final good contrasts with an intermediate good, which is an item that is produced by one firm, bought by another firm, and used as a component of a final good or service.
- Excluding the value of intermediate goods and services avoids counting the same value more than once.

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GROSS DOMESTIC PRODUCT

- Produced Within a Country
  - GDP measures production within a country—domestic production.
- In a Given Time Period
  - GDP measures production during a specific time period, normally a year or a quarter of a year.

Gross National Product (GNP) is the total market value of final goods and services produced during a given period by the citizens of a country no matter where they live. The goods and services are produced by the "nationals" of the country.

GDP is the preferred measure these days. Why?

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GROSS DOMESTIC PRODUCT

- GDP and the Circular Flow of Expenditure and Income
  - GDP measures the value of production, which also equals total expenditure on final goods and total income.
  - The equality of income and value of production shows the link between productivity and living standards.
  - The circular flow diagram on the next slide illustrates the equality of income and expenditure.

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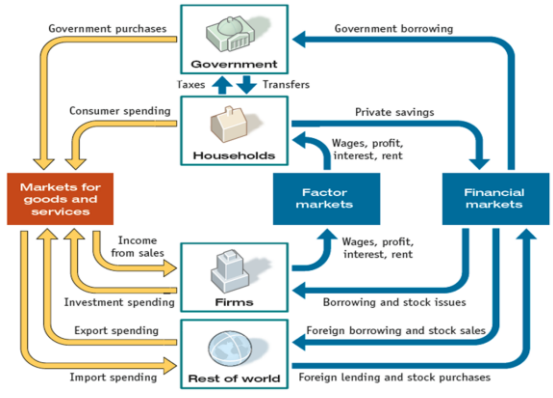
AN EXPANDED CIRCULAR FLOW DIAGRAM



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GROSS DOMESTIC PRODUCT

- The circular flow shows two ways of measuring GDP.
- **GDP Equals Expenditure Equals Income**
- Total expenditure on final goods and services equals GDP.
  - GDP = $C + I + G + X - IM$.
- Aggregate income equals the total amount paid for the use of factors of production: wages, interest, rent, and profit.
- Firms pay out all their receipts from the sale of final goods, so income equals expenditure,
  - $Y = C + I + G + (X - IM)$.

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MEASURING NATIONAL INCOME

- 3 ways of measuring national income :

- *GDP by value added*
- *GDP on the expenditure side*
- *GDP on the income side*

- All methods should result give similar answers when adjusted for market prices versus factor costs.

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VALUE ADDED IN A FIVE-STAGE PRODUCTION PROCESS

(1) Stage of Production	(2) Sales Value of Materials or Product	(3) Value Added
	$ 0	$120 (= $120 − $ 0)
Firm A, sheep ranch	120	60 (= 180 − 120)
Firm B, wool processor	180	40 (= 220 − 180)
Firm C, coat manufacturer	220	50 (= 270 − 220)
Firm D, clothing wholesaler	270	80 (= 350 − 270)
Firm E, retail clothier	350	
Total sales values	$1140	
Value added (total income)		$350

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VALUE ADDED ONCE MORE

2. Aggregate spending on domestically produced final goods and services = $21,500

	National Ore, Inc.	National Steel, Inc.	National Motors, Inc.	Total factor income
Value of sales	$4,200 (iron ore)	$9,000 (steel)	$21,500 (car)	
Intermediate goods	0	4,200 (iron ore)	9,000 (steel)	
Wages	2,000	3,700	10,000	$15,700
Interest payments	1,000	600	1,000	2,600
Rent	200	300	500	1,000
Profit	1,000	200	1,000	2,200
Total expenditure by firm	4,200	9,000	21,500	
Value added per firm = Value of sales − Cost of intermediate goods	4,200	4,800	12,500	

3. Total payments to factors = $21,500

1. Value of production of final goods and services, sum of value added = $21,500

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GDP AS EXPENDITURES

- GDP is the sum of the amount each sector (households, investors, governments, and foreigners) spends on final user goods and services.
- There are four components of GDP:
  - personal consumption expenditures (C),
  - gross private domestic investment (I),
  - government purchases (G) of goods and services, and,
  - net exports (NX) = *(exports - imports)*
- GDP = C + I + G + NX

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PERSONAL CONSUMPTION

- Consumer Durables
  - Durable has a life of over 3 years: cars, furniture, etc
- Consumer Non-Durables
  - Goods with a life of less than three years: food, utilities, clothing
- Services
  - Housing, healthcare, recreation, education

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INVESTMENT: ADDING TO THE CAPITAL STOCK

- Flows and Stocks
  - A stock is a quantity: capital, inventories and wealth are stock variables
  - A flow is an addition to or a subtraction from a stock: Investment and income are flow variables
- Investment in National Stocks
  - Residential Investment (homes)
  - Non-residential Investment (business investments in structures and equipment)
  - Changes in Inventories (changes get registered)

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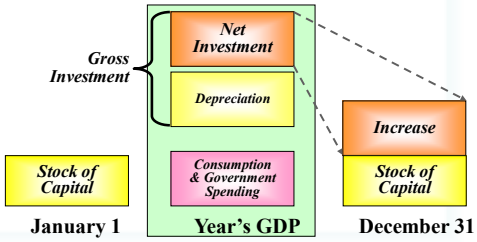
NET INVESTMENT

Gross Investment
– Depreciation or Capital Consumption Allowance
= Net Investment



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GOVERNMENT

- Government Expenditures reflect direct consumption, *not transfers*
- Defense, Government investments in roads and other infrastructure, government services such as Department of Motor Vehicles. Police and Congress are all expenditures.
- Transfer payments represent money redistributed from one group of citizens (taxpayers) to another (poor, unemployed, elderly).
  - While transfers are included in government budgets as outlays they are not purchases of currently produced goods and services.
    - Does not result in production of new goods and services
    - Does not included in government purchases or in GDP
  - Examples: Social Security, Medicare and Medicaid and Interest payments on national debt

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EXTERNAL ACCOUNTS

Imports (M): Product Accounts: Goods and Services
Exports (X): Product Accounts: Goods and Services

Net Exports = NX = X – IM

If NX = X – IM > 0 Trade Surplus

If NX = X – IM < 0 Trade Deficit

- Here are some examples of exports of services
  - Spending of foreign tourists in USA or Qatar
  - transportation services
  - insurance / banking services
  - medical services
  - retail services (souvenirs)
  - hotel accommodation services

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VALUE ADDED VS SPENDING METHOD

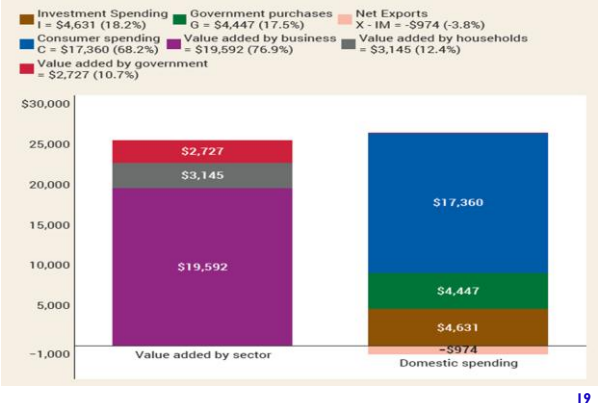

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TABLE 4.1 GDP: The Expenditure Approach

Item	Symbol	Amount in 2014 (billions of dollars)	Percentage of GDP
Personal consumption expenditures	*C*	11,729	68.8
Gross private domestic investment	*I*	2,714	15.9
Government expenditure on goods and services	*G*	3,139	18.4
Net exports of goods and services	*X*–*M*	–538	–3.2
Gross domestic product	***Y***	**17,044**	**100.0**

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis. The data are for the first quarter of 2014 at an annual rate.

https://www.bea.gov/data/gdp

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MEASURING GDP

- The Income Approach
  - The *income approach* measures GDP by summing the incomes that firms pay households for the factors of production they hire.
  - The *National Income and Expenditure Accounts* divide incomes into two broad categories:
    - 1. Compensation of employees
    - 2. Net operating surplus
  - *Compensation of employees* is the payments for labor services. The sum of net wages plus taxes withheld plus social security and pension fund contributions.
  - *Net operating surplus* is the sum of other factor incomes. It includes net interest, rental income, corporate profits, and proprietor's income.

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MEASURING GDP

- The sum of all factor incomes is *net domestic income at factor cost*.
  - Two adjustments must be made to get GDP:
- 1. Indirect taxes less subsidies are added to get from *factor cost* to *market prices*.
- 2. Depreciation is added to get from *net* domestic income to *gross* domestic income.

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TABLE 4.2 GDP: The Income Approach

Item	Amount in 2014 (billions of dollars)	Percentage of GDP
Compensation of employees	9,109	53.4
Net interest	685	4.0
Rental income	623	3.7
Corporate profits	1,514	8.9
Proprietors' income	1,351	7.9
Net domestic income at factor cost	13,282	77.9
Indirect taxes *less* subsidies	1,244	7.3
Net domestic income at market prices	14,526	85.2
Depreciation	2,699	15.8
GDP (income approach)	**17,225**	**101.1**
Statistical discrepancy	−181	−1.1
GDP (expenditure approach)	**17,044**	**100.0**

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis. The data are for the first quarter of 2014 at annual rate.

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Expenditure vs. Income Approach

Consumption by Households + Investment by Businesses + Government Purchases + Expenditures By Foreigners = GDP = Wages + Rents + Interest + Profits + Statistical Adjustments

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LEARN BY DOING: PRACTICE QUESTION 1

- Are the following included in U.S. GDP?

(1) The price paid by a German tourist when staying at a New York hotel.

(2) The price paid by an American tourist when staying at a Berlin hotel.

a) Both are included in U.S. GDP.
b) Neither are included in U.S. GDP.
c) Only the price paid by a German tourist when staying at a New York hotel is included in U.S. GDP.
d) Only the price paid by an American tourist when staying at a Berlin hotel is included U.S. GDP.

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LEARN BY DOING: PRACTICE QUESTION 1 (ANSWER)

- Are the following included in U.S. GDP?

(1) The price paid by a German tourist when staying at a New York hotel.

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a) Both are included in U.S. GDP.
b) Neither is included in U.S. GDP.
c) Only the price paid by a German tourist when staying at a New York hotel is included in U.S. GDP. (correct answer)
d) Only the price paid by an American tourist when staying at a Berlin hotel is included U.S. GDP.

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LEARN BY DOING: PRACTICE QUESTION 2

- Suppose country A sells $100 million worth of goods and services to country B. Country B sells $50 million worth of goods and services to country A. These are the only two countries in Macroworld. Net exports in country:

a) B equal −$50 million.
b) A equal $150 million.
c) A equal −$150 million.
d) B equal $50 million.

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LEARN BY DOING: PRACTICE QUESTION 2 (ANSWER)

- Suppose country A sells $100 million worth of goods and services to country B. Country B sells $50 million worth of goods and services to country A. These are the only two countries in Macroworld. Net exports in country:

a) B equal −$50 million. (correct answer)
b) A equal $150 million.
c) A equal −$150 million.
d) B equal $50 million.

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LEARN BY DOING: PRACTICE QUESTION 3

- Income spent on imported goods:
  a) represents income that has leaked across national borders.
  b) must be subtracted from spending data to calculate an accurate value for domestic production.
  c) is income that is not spent on domestically produced goods and services.
  d) Answers (a), (b), and (c) are all correct.

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LEARN BY DOING: PRACTICE QUESTION 3 (ANSWER)

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  c) is income that is not spent on domestically produced goods and services.
  d) **Answers (a), (b), and (c) are all correct. (correct answer)**

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MEASURING GDP

- Nominal GDP and Real GDP
  - Real GDP is the value of final goods and services produced in a given year when valued at *valued at the prices of a reference base year*.
  - The current base year is 2012. Real GDP shows what GDP would have been in each year if it were priced in 2012 dollars. That's how it removes the effect of inflation.
  - Nominal GDP is the value of goods and services produced during a given year valued at the prices that prevailed in that same year.
  - Nominal GDP is just a more precise name for GDP.

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MEASURING GDP

- Calculating Real GDP
  - Table 4.3 (a) shows the quantities produced and the prices in 2009 (the base year).
  - Nominal GDP in 2009 is $100 million.
  - Because 2009 is the base year, real GDP equals nominal GDP and is $100 million.
- Table 4.3(b) shows the quantities produced and the prices in 2014.
- Nominal GDP in 2014 is $300 million.
- Nominal GDP in 2014 is three times its value in 2009.

TABLE 4.3 Calculating Nominal GDP and Real GDP

	Item	Quantity (millions)	Price (dollars)	Expenditure (millions of dollars)
(a) In 2009				
C	T-shirts	10	5	50
I	Computer chips	3	10	30
G	Security services	1	20	20
Y	Real GDP in 2009			100
(b) In 2014				
C	T-shirts	4	5	20
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	Nominal GDP in 2014			300

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MEASURING GDP

- In Table 4.3(c), we calculate real GDP in 2014.
- The quantities are those of 2014, as in part (b).
- The prices are those in the base year (2009) as in part (a).
- The sum of these expenditures is real GDP in 2014, which is $160 million.

TABLE 4.3 Calculating Nominal GDP and Real GDP

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(a) In 2009				
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G	Security services	1	20	20
Y	Real GDP in 2009			100
(b) In 2014				
C	T-shirts	4	5	20
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	Nominal GDP in 2014			300
(c) Quantities of 2014 valued at prices of 2009				
C	T-shirts	4	5	20
I	Computer chips	2	10	20
G	Security services	6	20	120
Y	Real GDP in 2014			160

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GDP DEFLATOR FORMULA CALCULATOR
(BASE YEAR = 2016)

Prices and Quantities

Year	Price of Hamburgers	Quantity of Hamburgers	Price of Ice-creams	Quantity of Ice-creams
2016	$1	100	$2	50
2017	$2	150	$3	100
2018	$3	200	$4	150

Calculating Nominal GDP

2016	($1 per hamburger * 100 hamburger) + ($2 per ice-cream * 50 ice-cream) = $200
2017	($2 per hamburger * 150 hamburger) + ($3 per ice-cream * 100 ice-cream) = $600
2018	($3 per hamburger * 200 hamburger) + ($4 per ice-cream * 150 ice-cream) = $1200

Calculating Real GDP

2016	($1 per hamburger * 100 hamburger) + ($2 per ice-cream * 50 ice-cream) = $200
2017	($1 per hamburger * 150 hamburger) + ($2 per ice-cream * 100 ice-cream) = $350
2018	($1 per hamburger * 200 hamburger) + ($2 per ice-cream * 150 ice-cream) = $500

Calculating the GDP Deflator

2016	($200 / $200) * 100 = 100
2017	($600 / $350) * 100 = 171
2018	($1,200 / $500) * 100 = 240

https://www.omnicalculator.com/finance/gdp-deflator

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REAL-LIFE GDP

Table 2 Nominal versus Real GDP in 2002, 2012, and 2022

	Nominal GDP (billions of current dollars)	Real GDP (billions of 2012 dollars)
2002	$10,929	$13,488
2012	16,254	16,254
2022	25,464	20,015

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REAL VS NOMINAL GDP

- Except in the base year, real GDP is not the same as **nominal GDP:** output valued at current prices.
- **Chained dollars:** the method of calculating changes in real GDP using the average between the growth rate calculated on an early base year and the growth rate calculated on a late base year
- **GDP per capita:** average GDP per person; not by itself an appropriate policy goal

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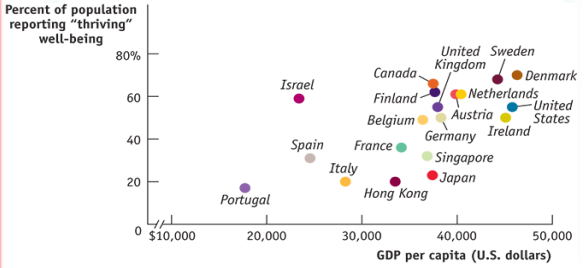
GDP AND THE MEANING OF LIFE

- Rich is better.
- Money matters less as you grow richer.
- Money isn't everything.



Data from: Gallup; World Bank.

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PRICE INDEXES AND THE AGGREGATE PRICE LEVEL

- **Aggregate price level:** a measure of the overall level of prices in the economy
- To measure the aggregate price level, economists calculate the cost of purchasing a **market basket.**
- **Market basket:** a hypothetical set of consumer purchases of goods and services

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PRICE INDEXES

- **Price index:** the cost of purchasing a given market basket in a given year, where that cost is normalized so that it is equal to 100 in the selected base year
- **Price index in a given year:**

$$\frac{\text{Cost of market basket in a given year}}{\text{Cost of market basket in base year}} \times 100$$

WPI vs CPI

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MARKET BASKETS AND PRICE INDEXES

Calculating the cost of a market basket

	Pre-frost	Post-frost
Price of orange	$0.20	$0.40
Price of grapefruit	0.60	1.00
Price of lemon	0.25	0.45
Cost of market basket (200 oranges, 50 grapefruit, 100 lemons)	(200 × $0.20) + (50 × $0.60) + (100 × $0.25) = $95.00	(200 × $0.40) + (50 × $1.00) + (100 × $0.45) = $175.00

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PRICE INDEXES

- **Price index**: the cost of purchasing a given market basket in a given year, where that cost is normalized so that it is equal to 100 in the selected base year.
- Price index in a given year:

$$\frac{\textit{Cost of market basket in a given year}}{\textit{Cost of market basket in base year}} \times 100$$

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INFLATION RATE, CPI, AND OTHER INDEXES

- The **inflation rate:** the yearly percentage change in a price index, typically based on consumer price index (CPI), the most common measure of the aggregate price level.
- The CPI measures the cost of the market basket of a typical urban American family
- **Inflation rate:**

$$\frac{\text{Price index in year 2} - \text{Price index in year 1}}{\text{Price index in year 1}} \times 100$$

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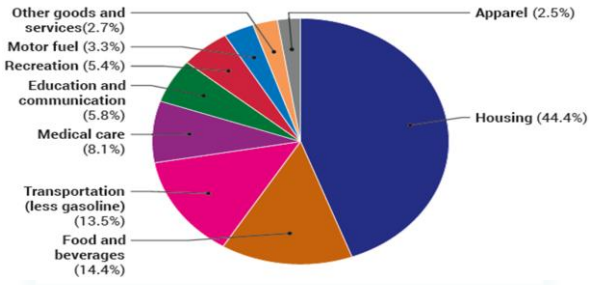
THE CONSUMER PRICE INDEX

The makeup of the consumer price index in 2023



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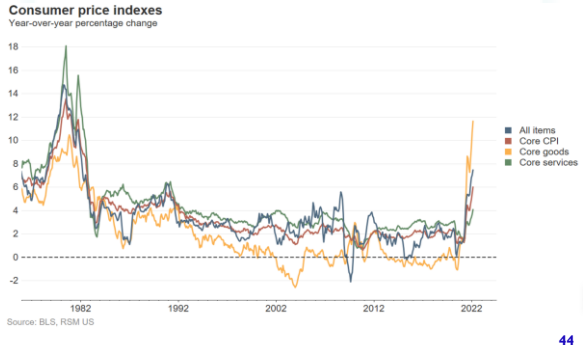
CONSUMER PRICE INDEX OVER TIME

The annual percentage increases in recent years have been much smaller than those of the 1970s and early 1980s, but have picked up after COVID.



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OTHER PRICE MEASURES

- **Producer price index (PPI)**: similar to the CPI but measures changes in the prices of goods purchased by producers
- Economists also use the **GDP deflator,** which measures the price level by calculating the ratio of nominal to real GDP.
- **The GDP deflator** for a given year is 100 times the ratio of nominal GDP to real GDP in that year.

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

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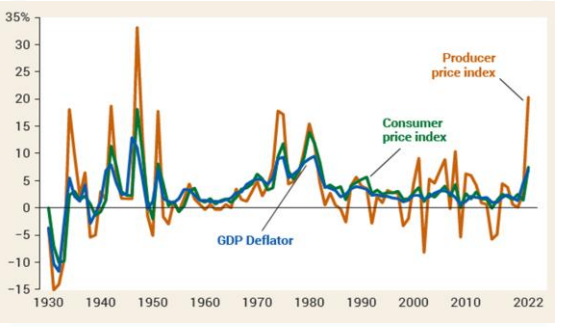
THE CPI, THE PPI, AND THE GDP DEFLATOR

The three measures usually move closely together.



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THE USES AND LIMITATIONS OF REAL GDP

- The Standard of Living Over Time
  - **Real GDP per person** is real GDP divided by the population.
  - Real GDP per person tells us the value of goods and services that the average person can enjoy.
  - By using *real* GDP, we remove any influence that rising prices and a rising cost of living might have had on our comparison.

Long-Term Trend

  - A handy way of comparing real GDP per person over time is to express it as a ratio of some reference year.
  - For example, in 1960, real GDP per person was $15,850 and in 2012, it was $42,800.
  - So real GDP per person in 2012 was 2.7 times its 1960 level—that is, $42,800 ÷ $15,850 = 2.7.

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GDP AS A MEASURE OF WELFARE

Shortcomings of GDP as a Measure of Welfare

- Nonmarket activities
  - HOUSEWORK AND CHILDCARE
- Leisure
- Improved product quality
- The underground economy
- GDP and the environment
- Composition and distribution of the output
- Noneconomic sources of well-being

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WHAT GDP DOES AND DOES NOT CAPTURE

- Can you think of other activities not captured by GDP that ought to be included?
- Genuine Progress Indicator (GPI)*
  - Adjust GDP for welfare-reducing activities such as resource depletion; environmental damage; crime; and quality of life. https://dnr.maryland.gov/mdgpi/Pages/what-is-the-GPI.aspx
- GDP can also be a poor measure of the living standards in various nations.
- To get around the problem, economists use *purchasing power parity (PPP)*, which adjusts for different relative prices among nations before making comparisons.

http://www.indexmundi.com/g/r.aspx?c=mr&v=67

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GDP Counts	GDP *Doesn't* Count
• Air pollution	• The health of our children
• Cigarette advertising	• Quality of their education
• Ambulances to clear highways of carnage	• Joy of their play
• Locks for our doors	• Beauty of our poetry
• Jails for the people who break them	• Strength of our marriages
• Destruction of the redwoods	• Intelligence of our public debate
• Loss of natural wonder in chaotic sprawl	• Integrity of our public officials
• Napalm	• Our wit
• Nuclear warheads	• Our courage
• Armored police cars to fight riots	• Our wisdom
• Guns and knives	• Our learning
• TV programs which glorify violence	• Our compassion
	• Our devotion to our country

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PRACTICE PROBLEM 1

	2022		2023		2024	
	P	Q	P	Q	P	Q
good A	$30	900	$31	1,000	$36	1,050
good B	$100	192	$102	200	$100	205

- **Compute nominal GDP in each year.**
- **Compute real GDP in each year using 2022 as the base year.**

Answers to Practice Problem, part 1

nominal GDP *multiply Ps & Qs from same year*

2022: $46,200 = $30 × 900 + $100 × 192

2023: $51,400

2024: $58,300

real GDP *multiply each year's Qs by 2012 Ps*

2022: $46,200

2023: $50,000

2024: $52,000 = $30 × 1050 + $100 × 205

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PRACTICE PROBLEM 2

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2022	$46,200	$46,200	100.0	*n.a.*
2023	51,400	50,000	102.8	2.8%
2024	58,300	52,000	112.1	9.1%

- **Use your previous answers to compute the GDP deflator in each year.**
- **Use GDP deflator to compute the inflation rate from 2022 to 2023, and from 2023 to 2024.**

$$\text{GDP deflator}(2023) = 100 \times \frac{51{,}400}{50000} = 102.8$$

$$\text{GDP deflator}(2024) = 100 \times \frac{58{,}300}{52{,}000} = 112.1$$

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AN EXAMPLE

We can show the calculation of Real GDP for 2024 using 2012 as the base year.

Example: Given the following figures for 2012 and 2024.

	Nominal GDP	GDP Deflator	Real GDP
2012	100,000,000	100	100,000,000
2024	120,000,000	110	109,090,909

Real GDP in 2024 = Nominal GDP in 2040 X 100.
(Base year = 2012) GDP deflator (2024)

= 120,000,000 X 100 = 109,090,909
110

Real GDP in 2024 = 109,090,909. The statistics indicate that in nominal terms, GDP rose by 20% over the period 2012 to 2024. However, during the same period prices rose by ten percent. Thus, real GDP rose by just over nine percent.

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GDP PER CAPITA

- GDP Per Capita is GDP divided by the size of the population: it is equal to the average GDP per person.
- Not an end in itself as it does not address how a country uses that output to affect living standards.

$$\text{Per capita GDP} = \frac{\text{GDP}}{\text{Population}}$$

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https://ourworldindata.org/grapher/gdp-per-capita-worldbank

https://www.worldometers.info/gdp/gdp-by-country/

http://statisticstimes.com/economy/projected-world-gdp-ranking.php

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