

The Measurement and Structure of the National Economy

ECON202 Macroeconomics – UG-I, 2025: Semester III

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Sections Covered

§	Topic
2-1	National Income Accounting
2-2	Gross Domestic Product
2-3	Saving and Wealth
2-4	Real GDP, Price Indexes, and Inflation
2-5	Interest Rates

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Learning Objectives

1. Differentiate among the **three approaches** to national income accounting
2. Explain how GDP is measured
3. Discuss the measurement of aggregate saving and its relation to wealth
4. Explain the calculations of real GDP, price indexes, and inflation
5. Define real and nominal interest rates

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- 2-1 · National Income Accounting
- 2-2 · Gross Domestic Product
- 2-3 · Saving and Wealth
- 2-4 · Real GDP, Price Indexes, and Inflation
- 2-5 · Interest Rates

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National Income Accounting (1 of 3)

- **National income accounts:** an accounting framework used in measuring current economic activity
- **Three alternative approaches give the same measurements**
 - **Product approach:** the amount of output produced
 - **Income approach:** the incomes generated by production
 - **Expenditure approach:** the amount of spending by purchasers

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National Income Accounting (2 of 3)

- **Juice business example** shows that all three approaches are equal
- **Important concept in product approach: Value added** = value of output minus value of inputs purchased from other producers

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National Income Accounting (3 of 3)

Why are the three approaches equivalent?

- They must be, by definition
- Any output produced (product approach) is purchased by someone (expenditure approach) and results in income to someone (income approach)
- **The fundamental identity of national income accounting:**

$$\text{total production} = \text{total income} = \text{total expenditure} \quad (2.1)$$

This **identity** holds at all times; the key **macro equations** we will derive hold only under specific conditions.

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- 2-1 · National Income Accounting
- 2-2 · Gross Domestic Product
- 2-3 · Saving and Wealth
- 2-4 · Real GDP, Price Indexes, and Inflation
- 2-5 · Interest Rates

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A Brief History of GDP

- **1934** – Simon Kuznets develops national income accounting for the US Congress to measure the economy during the Depression
- **1944** – Bretton Woods conference adopts GDP as the standard for comparing national economies internationally
- **1953** – UN publishes the first System of National Accounts (SNA), standardising GDP methodology globally
- **1991** – US shifts from GNP to GDP as its primary headline measure (most other countries had already done so)
- **Since then** – Periodic SNA revisions (1968, 1993, 2008) refine treatment of R&D, intangibles, and financial services

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Why GDP Persists Despite Its Critics

- **One number** – easy to compare across countries and time; no rival has matched that simplicity
- **Infrastructure lock-in** – decades of national accounts; IMF, World Bank, and UN systems all built around it
- **Reasonable proxy** – correlates with jobs, tax revenue, and poverty reduction, even if imperfectly
- **Institutions are wired to it** – IMF conditions, credit ratings, election narratives, central bank mandates all reference GDP growth
- **No consensus alternative** – every replacement involves contested value judgements; GDP is comparatively “neutral” (just market transactions)

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Major Alternatives to GDP

- **HDI** (UNDP, 1990) – income + health + education
- **GPI** (Genuine Progress Indicator) – adjusts for inequality, pollution, unpaid work
- **GNH** (Bhutan, 1972) – survey-based wellbeing index
- **OECD Better Life Index** (2011) – multi-dimensional, no single aggregate
- **Inclusive Wealth Index** (UN) – produced, human, and natural capital stocks
- **Stiglitz-Sen-Fitoussi Commission** (2009)  Dashboard approaches
- **Pattern:** “GDP-and” rather than “GDP-instead-of”

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The Product Approach

- **GDP (gross domestic product)** is the market value of final goods and services newly produced within a nation during a fixed period of time

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The Product Approach

- **Market value:** allows adding together unlike items by valuing them at their market prices
 - **Problem:** misses nonmarket items such as homemaking, the value of environmental quality, and natural resource depletion
 - There is some adjustment to reflect the underground economy
 - Govt. services (not sold in markets) are valued at their cost of production
- **Newly produced:** counts only things produced in the given period; excludes things produced earlier

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The Product Approach

- **Final goods and services**
 - Don't count intermediate goods and services (those used up in the production of other goods and services in the same period that they themselves were produced)
 - Final goods & services are those that are not intermediate
 - Capital goods (goods used to produce other goods) are final goods since they aren't used up in the same period that they are produced

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The Product Approach

- **Final goods and services**
 - **Inventory investment** (the amount that inventories of unsold finished goods, goods in process, and raw materials have changed during the period) is also treated as a final good
 - Adding up value added works well, since it automatically excludes intermediate goods

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GNP vs GDP

- **GNP (gross national product)** = output produced by domestically owned factors of production
- **GDP** = output produced within a nation
- $GDP = GNP - NFP$ (2.2)
- **NFP** = net factor payments from abroad = payments to domestically owned factors located abroad minus payments to foreign factors located domestically

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GNP vs GDP

- **Example:** Engineering revenues for a road built by a U.S. company in Saudi Arabia is part of U.S. GNP (built by a U.S. factor of production), not U.S. GDP, and is part of Saudi GDP (built in Saudi Arabia), not Saudi GNP
- Difference between GNP and GDP is small for the United States, about 0.2%, but higher for countries that have many citizens working abroad

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The Expenditure Approach

- Measures total spending on final goods and services produced within a nation during a specified period of time
- Four main categories of spending: consumption (C), investment (I), Govt. purchases of goods and services (G), and net exports (NX)

$$Y = C + I + G + NX \quad (2.3)$$

the income-expenditure identity

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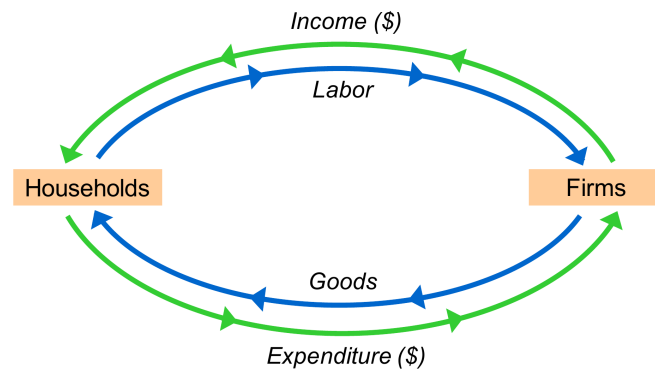
The Expenditure Approach

- **Consumption:** spending by domestic households on final goods and services (including those produced abroad)
- About $\frac{2}{3}$ of U.S. GDP
- **Three categories**
 - Consumer durables (examples: cars, TV sets, furniture, major appliances)
 - Nondurable goods (examples: food, clothing, fuel)
 - Services (examples: education, health care, financial services, transportation)

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Income = Expenditure

$$\text{INCOME} = \text{EXPENDITURE}$$



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The Expenditure Approach

- **Investment:** spending on new capital goods (fixed) plus inventory investment
- Volatile: fixed investment $\approx$ 13%–20% of U.S. GDP
- **Nonresidential fixed investment:** structures, equipment, intellectual property (software, R&D, artistic originals)
- **Residential fixed investment:** construction of houses and apartment buildings
- **Inventory investment:** changes in firms' unsold goods holdings

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The Expenditure Approach

- **Govt. purchases (G):** spending on currently produced goods and services
- **Not all Govt. outlays count as G**
 - Transfers (Social Security, welfare, unemployment) – no current production exchanged
 - Interest payments on Govt. debt
- Some G is for capital goods (highways, airports, bridges)

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The Expenditure Approach

- **Net exports:** exports minus imports
- **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 Govt. purchases

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T2.1: Expenditure Approach to Measuring GDP

	Billions of dollars	Percent of GDP
Personal consumption expenditures (C)	15,750	68.5
Consumer durables	2025	8.8
Nondurable goods	3457	15.0
Services	10,269	44.7
Gross private domestic investment (I)	4108	17.9
Business fixed investment	3051	13.3
Nonresidential structures	579	2.5
Equipment	1273	5.5
Intellectual property products	1200	5.2
Residential investment	1083	4.7
Inventory investment	-26	-0.1
Government purchases of goods and services (G)	4052	17.6
Federal	1565	6.8
National defense	905	3.9
Nondefense	660	2.9
State and local	2487	10.8
Net exports (NX)	-916	-4.0
Exports	2480	10.8
Imports	3396	14.8
Total (equals GDP) (Y)	22,994	100.0

Note: Numbers may not add to totals shown owing to rounding.

Source: Bureau of Economic Analysis website, www.bea.gov, NIPA Table 1.1.5, January 27, 2022.

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The Income Approach

- Adds up income generated by production (including profits and taxes paid to the Govt.)
- **National income** = employee compensation + proprietors' income + rental income + corporate profits + net interest + production taxes + business transfers + govt. enterprise surplus
- National income + statistical discrepancy = net national product (NNP)
- NNP + depreciation = GNP
- $GNP - NFP = GDP$

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The Income Approach (Private and Govt.)

- **Private disposable income:** income from home (Y) and abroad (NFP), plus govt. transfers (TR) and interest (INT), minus taxes (T)

$$= Y + NFP + TR + INT - T \quad (2.4)$$

- Govt.'s net income = $T - TR - INT$ (2.5)
- Private + Govt. net income = $GDP + NFP = GNP$

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Table 2.2: Income Approach to Measuring GDP

	Billions of dollars	Percent of GDP
Compensation of employees	12,581	54.7
Proprietor's income	1822	7.9
Rental income of persons	726	3.2
Corporate profits	2806	12.2
Net interest	686	3.0
Taxes on production and imports	1148	5.0
Business current transfer payments	164	0.7
Current surplus of government enterprises	-13	-0.1
Total (equals National Income)	19,920	86.6
Plus Statistical discrepancy	-520	-2.3
Equals Net National Product	19,401	84.4
Plus Consumption of fixed capital	3848	16.7
Equals Gross National Product (GNP)	23,249	101.1
Less Factor income received from rest of world	1145	5.0
Plus Payments of factor income to rest of world	893	3.9
Equals Gross Domestic Product (GDP)	22,996	100.0

Note: Numbers may not add to totals shown owing to rounding.

Source: Bureau of Economic Analysis website, www.bea.gov, NIPA Tables 1.7.5 and 1.12, March 30, 2022.

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Juice Business Example: Setup

Orangelnc Transactions

Wages paid to Orangelnc employees	\$15,000
Taxes paid to government	5,000
Revenue received from sale of oranges	35,000
Oranges sold to public	10,000
Oranges sold to Juicelnc	25,000

Juicelnc Transactions

Wages paid to Juicelnc employees	\$10,000
Taxes paid to government	2,000
Oranges purchased from Orangelnc	25,000
Revenue received from sale of orange juice	40,000

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Approach 1: Product (Value-Added) Approach

Concept: Sum the value added at each stage of production

Company	Total Output	Purchased Inputs	Value Added
Orangelnc	\$35,000	\$0	\$35,000
Juicelnc	\$40,000	\$25,000	\$15,000
Total GDP			\$50,000

Key Point: We subtract intermediate goods (\$25,000 oranges) to prevent double counting!

Wrong approach: \$35,000 + \$40,000 = \$75,000 (counts oranges twice)

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Approach 2: Income Approach

Method A – Before-tax incomes: Sum all income earned by factors of production (wages + profits)

Income Source	Orangelnc	Juicelnc	Total
Profits	\$20,000	\$5,000	\$25,000
Wages	\$15,000	\$10,000	\$25,000
Total GDP			\$50,000

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Approach 2B: Income Approach (Alternative)

After-tax incomes + Govt. revenue:

Income Source	Amount
Orangelnc after-tax profits	\$15,000
Juicelnc after-tax profits	\$3,000
Total wages (no worker taxes)	\$25,000
Govt. tax revenue	\$7,000
Total GDP	\$50,000

Both methods give the same result: \$50,000

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Approach 3: Expenditure Approach

Concept: Sum spending by ultimate users of final goods and services

Final Good	Purchased By	Amount
Fresh oranges	Households	\$10,000
Orange juice	Households	\$40,000
Total GDP		\$50,000

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GDP Identity: All Methods Give the Same Result!

Approach	Result
Product Approach (Value Added)	\$50,000
Income Approach A (Before-tax)	\$50,000
Income Approach B (After-tax + taxes)	\$50,000
Expenditure Approach	\$50,000

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Key Concepts Review

Double Counting Problem:

- Wrong: $\$35,000 + \$40,000 = \$75,000$
- Right: Use value-added approach = \$50,000

Final vs. Intermediate Goods:

- Final: Oranges and juice bought by households
- Intermediate: Oranges bought by JuiceInc for processing
- Only final goods count in the expenditure approach

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Wealth

- **Household wealth** = a household's assets minus its liabilities
- **National wealth** = sum of all households', firms', and Govt.s' wealth within the nation
- Savings by individuals, businesses, and Govt. determine wealth

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Measures of Aggregate Saving-1

- **Saving** = current income — current spending
- **Saving rate** = saving / current income
- **Private saving** = private disposable income — consumption

$$S_{pvt} = (Y + NFP + TR + INT - T) - C \quad (2.6)$$

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Measures of Aggregate Saving-2

- **Govt. saving** = net Govt. income — Govt. purchases of goods and services

$$S_{govt} = (T - TR - INT) - G \quad (2.7)$$

- **Govt. saving** = Govt. budget surplus = Govt. receipts — Govt. outlays
 - Govt. receipts = tax revenue (T)
 - Govt. outlays = Govt. purchases (G) + transfers (TR) + interest on Govt. debt (INT)
- **Govt. budget deficit** = $-S_{govt}$

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Measures of Aggregate Saving-3

- **National saving** = private saving + Govt. saving

$$S = S_{pvt} + S_{govt} \quad (2.8) \quad (1)$$

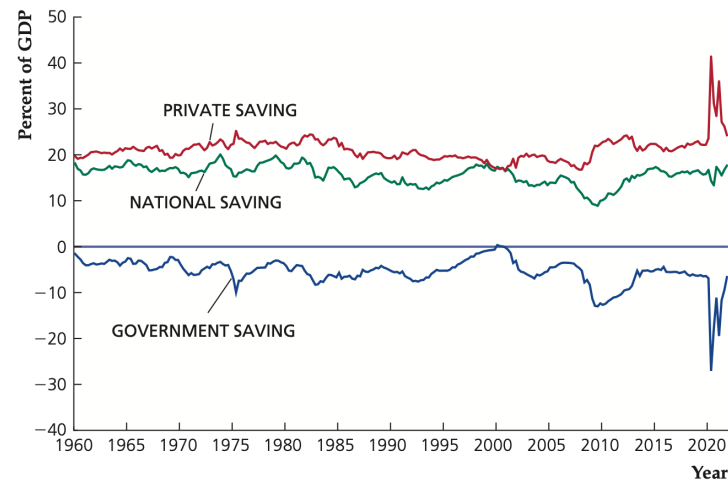
$$= [Y + NFP + TR + INT - C - T] + [T - TR - INT - G] \quad (2)$$

$$= Y + NFP - C - G \quad (3)$$

$$= GNP - C - G \quad (4)$$

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Figure 2.1: U.S. Saving Measures



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The Uses of Private Saving

$$S = I + (NX + NFP) \quad (2.9) \quad (5)$$

$$S = I + CA \quad (2.10) \quad (6)$$

$$S_{pvt} = I + (-S_{govt}) + CA \quad (2.11) \quad (7)$$

Saving is used in three ways:

- investment (I)
- Govt. budget deficit ($-S_{govt}$)
- current account balance (CA)

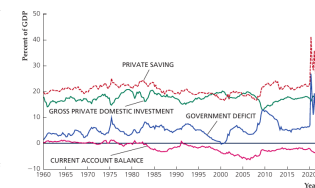
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Figure 2.2: Components of the U.S. Uses-of-Saving Identity

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FIGURE 2.2
Components of the U.S. uses-of-saving identity, 1960Q1–2021Q4

Private saving equals the sum of gross private domestic investment, the government budget deficit, and the current account balance. The current account balance has been negative since the early 1990s, which means that foreigners have been providing funds for U.S. investment and the government budget deficit.



annual GDP figures measure the economy's production per year. Variables that are measured per unit of time are called **flow variables**. In contrast, some economic variables, called **stock variables**, are defined at a point in time. Examples of stock variables include the amount of money in your bank account on September 15 of this year and the total value of all houses in the United States on January 1, 2023.

In many applications, a flow variable is the rate of change in a stock variable. A classic example is a bathtub with water flowing in from a faucet. The amount of water in the tub at any moment is a stock variable. The units of a stock variable (gallons, in this case) don't have a time dimension. The rate at which water enters the tub is a flow variable; its units (gallons per minute) have a time dimension. In this case the flow equals the rate of change of the stock.

Wealth and Saving as Stock and Flow. Saving and wealth are related to each other in much the same way that the flow and stock of water in a bathtub are related. The wealth of any economic unit (a household, firm, or government), also called *net worth*, is its assets (the things that it owns, including IOUs from other economic units) minus its liabilities (what it owes to other units). Wealth is measured in dollars at a point in time and is a stock variable. Saving is measured in dollars per unit time and is a flow variable. Because saving takes the form of an accumulation of assets or a reduction in liabilities (for example, if saving is used to pay off debts), it adds to wealth just as water flowing into a bathtub adds to the stock of water.

National Wealth. National wealth is the total wealth of the residents of a country. National wealth consists of two parts: (1) the country's domestic physical assets,

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Relating Saving and Wealth

• Stocks and flows

- **Flow variables:** measured per unit of time (GDP, income, saving, investment)
- **Stock variables:** measured at a point in time (quantity of money, value of houses, capital stock)
- Flow variables often equal rates of change of stock variables

• Wealth and saving as stock and flow

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Relating Saving and Wealth

- **National wealth:** domestic physical assets + net foreign assets
- Country's domestic physical assets (capital goods and land)
- Country's net foreign assets = foreign assets (foreign stocks, bonds, and capital goods owned by domestic residents) minus foreign liabilities (domestic stocks, bonds, and capital goods owned by foreigners)
- Wealth matters because the economic well-being of a country depends on it

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Relating Saving and Wealth

National wealth: domestic physical assets + net foreign assets

- **Changes in national wealth**
 - Change in value of existing assets and liabilities (change in price of financial assets, or depreciation of capital goods)
 - National saving ($S = I + CA$) raises wealth

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Real GDP, Price Indexes, and Inflation

- **Nominal variables** are those in dollar terms
- **Problem:** Do changes in nominal values reflect changes in prices or quantities?
- **Real variables:** adjust for price changes; reflect only quantity changes

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Nominal vs Real GDP

- Example of computers and bicycles
- **Nominal GDP** is the dollar value of an economy's final output measured at current market prices
- **Real GDP** is an estimate of the value of an economy's final output, adjusting for changes in the overall price level

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Real GDP Growth Rate

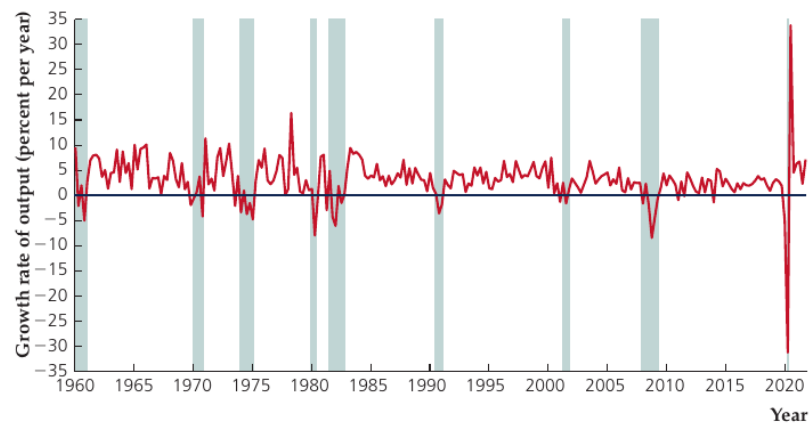
- Quarterly annualized growth rates of GDP are calculated using the formula

$$\frac{\Delta Y}{Y} = \left(\frac{Y(t)}{Y(t-1)} \right)^4 - 1 \quad (2.12)$$

- U.S. data are also generally seasonally adjusted
- Figure 2.3 shows quarterly annualized U.S. GDP growth rates

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The Annualised Quarterly Growth Rate



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Table 2.3: Production and Price Data

	Year 1	Year 2	Percent change from year 1 to year 2
Product (quantity)			
Computers	5	10	+100%
Bicycles	200	250	+25%
Price			
Computers	\$1200/computer	\$600/computer	-50%
Bicycles	\$200/bicycle	\$240/bicycle	+20%
Value			
Computers	\$6000	\$6000	0
Bicycles	\$40,000	\$60,000	+50%
Total	\$46,000	\$66,000	+43.5%

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Calculation of Real Output with Alternative Base Years

Calculation of real output with base year = Year 1					
	Current quantities		Base-year prices		
Year 1					
Computers	5	×	\$1200	=	\$6000
Bicycles	200	×	\$200	=	\$40,000
			Total	=	\$46,000
Year 2					
Computers	10	×	\$1200	=	\$12,000
Bicycles	250	×	\$200	=	\$50,000
			Total	=	\$62,000
Percentage growth of real GDP = $(\$62,000 - \$46,000)/\$46,000 = 34.8\%$					
Calculation of real output with base year = Year 2					
	Current quantities		Base-year prices		
Year 1					
Computers	5	×	\$600	=	\$3000
Bicycles	200	×	\$240	=	\$48,000
			Total	=	\$51,000
Year 2					
Computers	10	×	\$600	=	\$6000
Bicycles	250	×	\$240	=	\$60,000
			Total	=	\$66,000
Percentage growth of real GDP = $(\$66,000 - \$51,000)/\$51,000 = 29.4\%$					

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Price Indexes

A price index measures the average level of prices for some specified set of goods and services, relative to the prices in a specified base year

- Calculate inflation rate:

$$\pi_{t+1} = (P_{t+1} - P_t)/P_t = \Delta P_{t+1}/P_t$$

- Two measures of π_{t+1} : GDP deflator and CPI.

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GDP Deflator

- **GDP deflator** = $100 \times \text{nominal GDP} / \text{real GDP}$
- Note that base year $P = 100$
- Inflation = growth rate of GDP deflator

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Consumer Price Index

Consumer Price Index (CPI)

- Monthly consumer price index; base = 100 (reference period: 1982-84)
- Fixed basket of goods from the expenditure base period (updated periodically)

The CPI Basket (for 2012 Base Year): Expenditure Shares

<https://public.flourish.studio/visualisation/13807161/>

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Chain-Weighted GDP

The computer revolution and chain-weighted GDP

- Choice of expenditure base period matters for GDP when prices and quantities of a good, such as computers, are changing rapidly
- BEA compromised by developing chain-weighted GDP
- Now, however, components of real GDP don't add up to real GDP, but discrepancy is usually small

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Quantity Index Formulas-1

Laspeyres Quantity Index (Base Year Prices)

Uses **base year prices** as weights:

$$\text{Laspeyres Quantity Index} = \frac{P_0 \cdot Q_1}{P_0 \cdot Q_0}$$

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Quantity Index Formulas-2

Paasche Quantity Index (Current Year Prices)

Uses **current year prices** as weights:

$$\text{Paasche Quantity Index} = \frac{P_1 \cdot Q_1}{P_1 \cdot Q_0}$$

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Chain-Weighted Index Formula

The Problem

- Laspeyres index may **overstate** growth (uses old, high prices)
- Paasche index may **understate** growth (uses new, low prices)
- Problem is severe when prices change rapidly (like computers in 1990s)

Chain-Weighted Solution (geometric mean of both indexes:)

$$C_t = \sqrt{L_t \times P_t} = (L_t \times P_t)^{1/2}$$

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Example: Computer-Bicycle Economy

Given Data from Table 2.4

- $L_1 = \$46,000$ (Year 1 output at Year 1 prices)
- $L_2 = \$62,000$ (Year 2 output at Year 1 prices)
- $P_1 = \$51,000$ (Year 1 output at Year 2 prices)
- $P_2 = \$66,000$ (Year 2 output at Year 2 prices)

Chain-Weighted Calculations

$$C_1 = \sqrt{L_1 \times P_1} = \sqrt{46,000 \times 51,000} = \$48,400 \quad (8)$$

$$C_2 = \sqrt{L_2 \times P_2} = \sqrt{62,000 \times 66,000} = \$63,970 \quad (9)$$

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Growth Rate Comparison

Chain-Weighted Growth Rate

$$\text{Growth Rate} = \frac{C_2 - C_1}{C_1} = \frac{63,970 - 48,400}{48,400} = \frac{15,570}{48,400} = 32.06\%$$

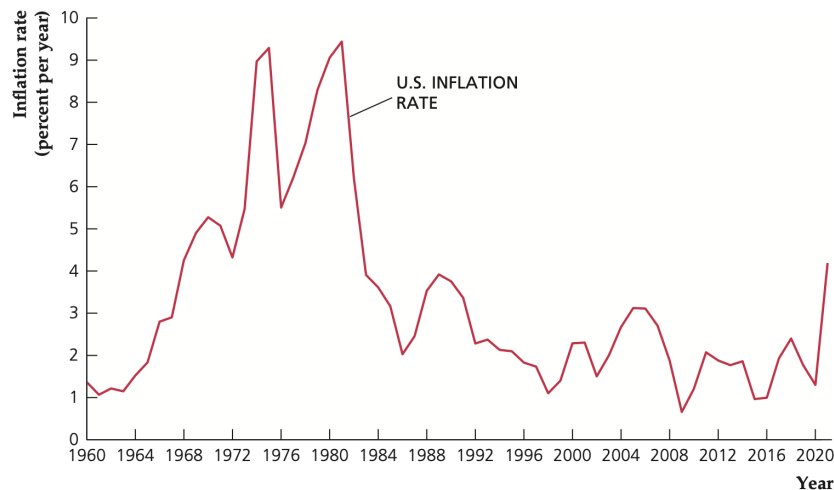
Comparison with Traditional Methods

Method	Growth Rate
Laspeyres	$\frac{62,000 - 46,000}{46,000} = 34.8\%$
Paasche	$\frac{66,000 - 51,000}{51,000} = 29.4\%$
Simple Average	$\frac{34.8\% + 29.4\%}{2} = 32.1\%$
Chain-Weighted	32.06%

Key Insight: Chain-weighting gives result very close to simple average!

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The Inflation Rate in the United States, 1960-2021



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Does CPI Inflation Overstate the Rise in the Cost of Living?

- Boskin Commission: CPI biased upward by 1-2 percentage points per year
- Quality adjustment is very difficult to measure accurately
- Fixed baskets miss consumer substitution when relative prices change – **substitution bias**
- If CPI overstates inflation: real incomes are understated; Social Security is over-indexed

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CPI versus GDP Deflator

- Discrepancy 1: goods produced in the economy (GDP) are different from goods purchased by consumers (CPI)
 - Some goods in GDP are sold to firms (I), the Govt. (G), or foreigners (NX), not to consumers
 - Some goods in CPI are imported from abroad, not produced domestically
- Discrepancy 2: the basket of goods is fixed in CPI but variable in GDP deflator
 - Because the composition of GDP varies over time
- **YET, CPI AND GDP DEFLATOR MOVE TOGETHER!!**

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The Fed's Preferred Inflation Measures

- The Fed's preferred measure: **personal consumption expenditures (PCE) price index**
- Forecasts both overall PCE and core PCE (excludes food and energy)
- PCE is superior to CPI: avoids substitution bias; revised as better data arrive
- PCE vs. CPI differ in formula, item coverage, and weights

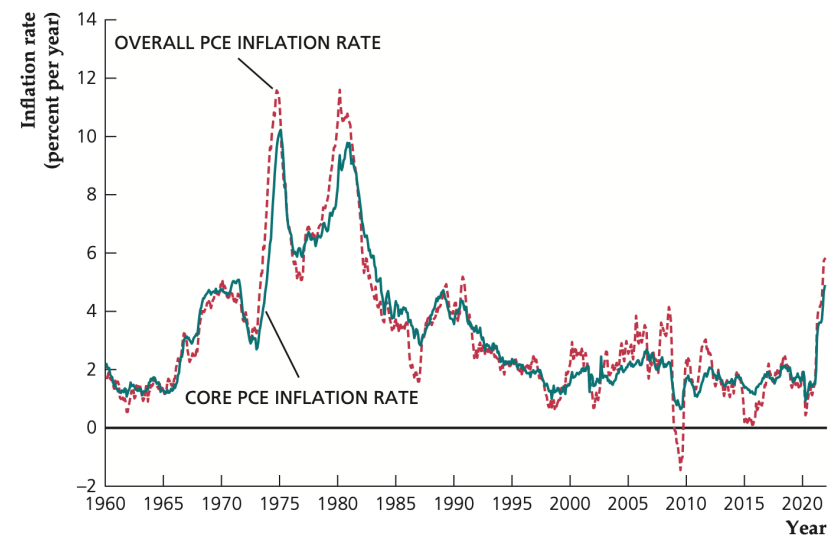
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The Fed's Preferred Inflation Measures

- Core PCE measures the underlying inflation trend (strips out volatile food and energy)
- Fed tracks both core and overall PCE – underlying trend AND actual household costs matter
- Overall PCE tends to revert to core after deviations (Figure 2.5)

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Figure 2.5: Overall PCE Inflation Rate and Core PCE



January 1960 to December 2021

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Why Do We Care About Inflation: Classical Reasons

- **Purchasing power:** Not all prices/wages rise proportionally – redistributes real income
- **Fixed prices by law:** Minimum wage and legally fixed prices lose real value
- **Long-term contracts:** Fixed nominal payments (loans, pensions) lose real value
- **Tax distortion:** Fixed income brackets push taxpayers into higher brackets
- **Uncertainty:** Unpredictable inflation complicates economic planning

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Why Do We Care About Inflation: Psychological Reasons

- **Strong public dislike:** People seem to strongly dislike inflation
- **Shiller Survey (1996):** Robert Shiller conducted a survey of 600 households in Brazil, Germany, and the US
- **Anger response:** 85% of respondents say that “when they go to the store and see that prices are higher, they sometimes feel a little angry at someone”
- **Blame attribution:** They are usually angry at “manufacturers”, “store owners” and “businesses”, accused of “greed”
- **Real-world example:** <https://www.nytimes.com/2014/03/14/world/americas/rocketing-prices-confound-an-argentina-racked-by-inflation.html>

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- 2-1 · National Income Accounting
- 2-2 · Gross Domestic Product
- 2-3 · Saving and Wealth
- 2-4 · Real GDP, Price Indexes, and Inflation
- 2-5 · Interest Rates

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Interest Rates

- **Real vs nominal interest rates**
 - **Interest rate:** return promised by a borrower to a lender
 - **Real interest rate:** rate at which an asset's real value grows
 - **Nominal interest rate:** rate at which an asset's nominal value grows

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Interest Rates

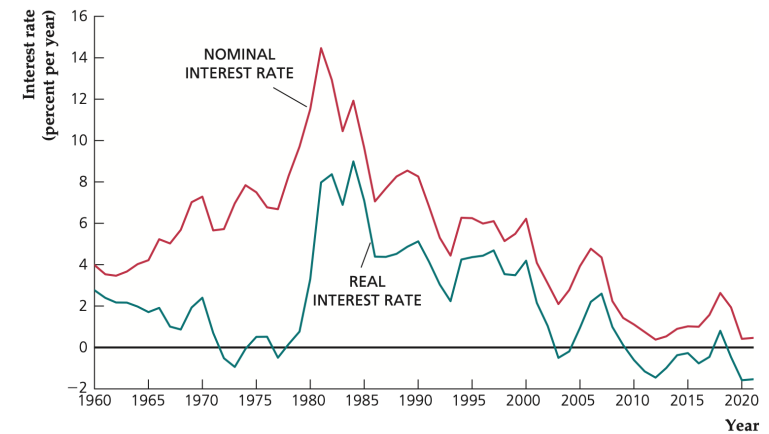
- Real vs nominal interest rates

$$\text{Real interest rate} = i - \pi \quad (2.13)$$

- Figure 2.6 plots nominal and real interest rates for the United States since 1960

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Nominal and Real Interest Rates in the US: 1960-2021



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The Expected Real Interest Rate

- The expected real interest rate

$$r = i - \pi^e \quad (2.14)$$

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Summary

- Key concepts learned:
 - Three approaches to national income accounting (all equivalent)
 - GDP measurement: $Y = C + I + G + NX$
 - Saving-investment identity: $S = I + CA$
 - Real vs nominal variables and price measurement
 - Real vs nominal interest rates: $r = i - \pi$
- These accounting identities form the foundation for macroeconomic analysis
- They must hold by definition, providing a solid base for economic modeling

§ Practice Problems

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Problem 1

Kwaki produces canoes, salmon, and corn in one year:

- Made 5000 canoes (\$1000 each to produce); sold only 4000, at \$1250 each.
- Fished \$30m of salmon; \$3m of it used as fertilizer for the corn.
- Grew and consumed \$55m of corn.

What was Kwaki's GDP?

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Problem 3

ABC builds \$140m of components (labor \$70m, interest \$7m, taxes \$14m) and sells all of it to XYZ. XYZ turns them into 4 supercomputers (\$56m cost each: \$35m components, \$14m labor, \$7m taxes), sells 3 at \$70m each, and holds the 4th as \$56m inventory.

1. Show that all three approaches give the same GDP.
2. Redo if ABC also paid \$35m for **imported** chips.

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Problem 5

- $I = 40, G = 30, \text{GNP} = 200, \text{CA} = -20$
- $T = 60, \text{TR} = 25, \text{INT} = 15$ (all INT $\Rightarrow$ domestic Hhs)
- Factor income from RoW = 7; factor payments to RoW = 9

Find (assuming Govt. investment = 0):

- | | |
|--------------------|-------------------|
| 1. C | 5. S_{pvt} |
| 2. NX | 6. S_{Govt} |
| 3. GDP | 7. $S_{National}$ |
| 4. NFP from abroad | |

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Problem 6

An economy produces only apples, bananas, and oranges:

Fruit	Base qty	Base price	Curr. qty	Curr. price
Apples	3,000	\$2	4,000	\$3
Bananas	6,000	\$3	14,000	\$2
Oranges	8,000	\$4	32,000	\$5

Base vs. current year, find: (a) nominal GDP & % rise; (b) real GDP & % rise; (c) GDP deflator & % price change; (d) is the nominal rise mainly prices or quantities?

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Problem 8

Loretta lends Ted \$500,000 at a nominal rate of 8%. Both expect 2% inflation.

1. Find the expected real interest rate.
2. If inflation turns out to be 3%, what is the real rate? Who gains?
3. If inflation turns out to be 1%, what is the real rate? Who gains?

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"I know you think you understand what you thought I said, but I'm not sure you realize that what you heard is not what I meant."

– Alan Greenspan