

## HOW ARE KEY MACROECONOMIC VARIABLES MEASURED?

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### A. Measuring GDP: The National Income Accounts(NIPA)

- Goal: Obtain a measure of the total quantity of goods and services produced in a country over a period of time
- Gross Domestic Production(GDP)-the dollar value of final output produced with in the US borders.

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### Approaches to measuring GDP

- 1) Product (Value Added) Approach- Add the value of all goods and services produces less intermediated goods used in production

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2) Expenditure Approach-Calculate GDP as total spending on all final goods and services produced in the economy.

$$GDP = C + I + G + NX$$

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3) Income Approach – GDP is calculated by adding up all incomes received by economic agents who contribute to production.

$$GDP = \text{Compensation of employees} + \text{proprietors income} + \text{profits} + \text{rental income} + \text{net interest} + \text{indirect taxes} + \text{depreciation}$$

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### Example to Illustrate Approaches

- Firm that harvests coconut and sell to a restaurant firm and consumer at \$2.00 per coconut. This firm must hire labor, borrow funds from consumers and pay taxes. Profits are distributed to owners.
- Restaurant firm sells meals to consumers and has labor, coconut costs, wage costs, and pays taxes.

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- Consumers earn wage income, interest income and profits from producers. With this income they buy coconuts, buy dinners at the restaurant, and pay taxes.
- A Government collects taxes and hires labor to provide protection.

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**Table 2.1** Coconut Producer

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

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**Table 2.2** Restaurant

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

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**Table 2.3** After-Tax Profits

Coconut Producer	\$13 million
Restaurant	\$11 million

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**Table 2.5** Consumers (Buys \$8 million worth of coconuts and spends \$30 million at restaurant)

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

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**Table 2.4** Government

Tax Revenue	\$5.5 million
Wages	\$5.5 million

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**Table 2.6** GDP Using the Product Approach  
(Value of Goods Produced Less Intermediate Inputs)

Value added—coconuts	\$20 million
Value added—restaurant food	\$18 million
Value added—government	\$5.5 million
GDP	\$43.5 million

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**Table 2.7** GDP Using the Expenditure Approach  
( $GDP = C + I + G + NX$ )

Consumption	\$38 million
Investment	0
Government Expenditures	\$5.5 million
Net Exports	0
GDP	\$43.5 million

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**Table 2.8** GDP Using the Income Approach  
( $GDP = \text{Factor Payments} + \text{Indirect Business Taxes} + \text{Depreciation Costs}$ )

Wage income	\$14.5 million
After-tax profits	\$24 million
Interest income	\$0.5 million
Taxes	\$4.5 million
GDP	\$43.5 million

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## Gross Domestic Product(GDP) vs. Gross National Product(GNP)

- GDP-value of output produced within a countries border
- GNP-value of output produced by domestic factors of production anywhere.
- $GNP = GDP + \text{Net Factor Payments}$

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- Nike owns a plant in China and managed by US employees. Does this income enter GDP or GNP?
- Honda has a plant in Dayton. Do the Japanese profits enter US GDP or GNP?

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## The Components of Aggregate Expenditure

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**(2) Calculate Nominal GDP**  
 $GDP(t) = P^c(t) \cdot Q^c(t) + P^h(t) \cdot Q^h(t)$

Year	GDP	Value
2001	$1.00 \cdot 100.0 + 1.00 \cdot 106.0 =$	206.00
2002	$0.80 \cdot 104.8 + 1.05 \cdot 97.75 =$	202.45

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**(3) Calculate Real GDP using 2001 prices**

$$RGDP(t) = P^c(01) \cdot Q^c(t) + P^h(01) \cdot Q^h(t)$$

Year	GDP	Value
2001	$1.00 \cdot 100.0 + 1.00 \cdot 106.0 =$	206.00
2002	$1.00 \cdot 131.0 + 1.00 \cdot 93.0 =$	224.00

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**(4) What was the growth rate of real GDP between 2001 and 2002 when year 2001 prices are used?**

$$\begin{aligned}
 g(01) &= \frac{RGDP(2002) - RGDP(2001)}{RGDP(2001)} \\
 &= [RGDP(2002)/RGDP(2001)] - 1 \\
 &= (224/206) - 1 \\
 &= .0873 \text{ (8.73\%)}
 \end{aligned}$$

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**(5) Calculate Real GDP using 2002 prices**

$$\text{RGDP}(t) = P^c(02) * Q^c(t) + P^h(02) * Q^h(t)$$

Year	GDP	Value
2001	$0.80 * 100.0 + 1.05 * 106.0 =$	191.30
2002	$0.80 * 131.0 + 1.05 * 93.0 =$	202.45

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**(6) What was the growth rate of real GDP between 2001 and 2002 when ?**

$$\begin{aligned} g(02) &= \frac{(\text{RGDP}(2002) - \text{RGDP}(2001))}{\text{RGDP}(2001)} \\ &= [\text{RGDP}(2002) / \text{RGDP}(2001)] - 1 \\ &= (202.45 / 191.30) - 1 \\ &= .0582 \text{ (5.82\%)} \end{aligned}$$

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**(8) The base year matters because relative prices change. To minimize this problem, NIPA adopted a chain-weighted approach in 1996**

$$\begin{aligned} g(\text{chain}) &= \sqrt{(1 + g(01)) * (1 + g(02))} \\ &= \sqrt{(1.0873) * (1.0582)} \\ &= 1.0726 \end{aligned}$$

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### How do you use this information to calculate RGDP if 2001 is base?

- Suppose  $RGDP(2001)=206$
- $RGDP(2002)$  using 2001 price as base  
 $RGDP(2002)=RGDP(2001)*(1+g(2001))$   
 $= 206*(1+.0873)=223.98$

$$RGDP(chain)=RGDP(2002)*(1+g(chain))$$
$$=206*(1.0726)=220.95$$

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### How do you use this information to calculate RGDP if 2002 is base?

- Suppose  $RGDP(2002)=202.45$
- $RGDP(2001)$  using 2002 price as base  
 $RGDP(2002)=RGDP(2001)/(1+g(2001))$   
 $= 202.45/(1+.0582)=191.32$
- $RGDP(chain)=RGDP(2002)/(1+g(chain))$   
 $=202.45/(1.0726)=188.75$

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### C. Measures of the Price Level

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## 1. Consumer Price Index

- Step 1-Find nominal expenditures for 2001

$$\begin{aligned} \text{EXP}(01) &= P^c(01) * Q^c(01) + P^h(01) * Q^h(01) \\ &= 1.00 * 100.0 + 1.00 * 106.0 \\ &= 206 \end{aligned}$$

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- Step 2 –Find expenditures for 2002 if quantities stay the same as 2001

$$\begin{aligned} \text{EXP}(02) &= P^c(02) * Q^c(01) + P^h(02) * Q^h(01) \\ &= 0.80 * 100.0 + 1.05 * 106.0 \\ &= 191.3 \end{aligned}$$

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- Step 3 – Construct the price index

$$\begin{aligned} \text{CPI}(02) &= \frac{\text{expenditures in 2002}}{\text{expenditures in base year}} \\ &= (191.3 / 206.0) * 100 \\ &= 92.86 \end{aligned}$$

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## 2. GDP Deflator

- Formula:  $PGDP = \frac{GDP}{RGDP} * 100$

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### Example: Calculate Implicit Deflator if quantity base 2001

- $PGDP(2001) = (206.00/206.00) * 100 = 100$
- $PGDP(2002) = (202.45/224.00) * 100 = 90.4$

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### Example: Calculate Implicit Deflator if quantity base 2002

- $PGDP(2001) = (206.00/191.30) * 100 = 107.68$
- $PGDP(2002) = (202.45/202.45) * 100 = 100.0$

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### Example: Calculate Implicit Deflator if chain weighted

- $PGDP(2001) = (206.00/206.0) * 100 = 100.00$
- $PGDP(2002) = (202.45/220.95) * 100 = 91.62$

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### Example: Implicit Deflators

	Year 1	Year 2	%Increase
Year 2001=base	100.00	90.4	-9.60
Year 2002=base	107.68	100.00	-7.13
Chain-weighted	100.00	91.62	-8.38

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### Problems with Measuring Real GDP and the Price Level

- Relative prices change over time which change buying patterns
- Quality changes introduces biases
- How do you account for new goods?

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## D. Savings, Wealth and Capital

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## Stocks and Flows

- A flow is a rate per unit of time.(eg., GDP, investment)
- A stock is the quantity in existence of some object at a point in time.(eg., housing, wealth)

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## Private Disposable Income- $Y^d$

(1)  $Y^d = Y + NFP + TR + INT - T$

Private Saving - $S^p$

(2)  $S^p = Y^d - C$

Government Saving- $S^g$

(3)  $S^g = T - INT - TR - G$

National Savings

(4)  $S = S^p + S^g = Y + NFP - C - G$

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$$\begin{aligned}
 (5) \quad S &= Y + NFP - C - G \\
 &= C + I + G + NX - C - G \\
 &= I + NX + NFP \\
 &= I + CA
 \end{aligned}$$

Let  $K$  be the capital stock or the Nation's wealth

$$(6) \quad K_{t+1} = (1-d)K_t + I_t = (1-d)K_t + S_t + CA_t$$

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## E. Labor Market Measures

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- Total Working Age Population = employed + unemployed + not in labor force
- Unemployment Rate = number unemployed / labor force
- Participation Rate = Labor Force / Total Working Age Population

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