

# Lecture 2 Measurement I

## Economic Aggregates

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### 3 Approach to Measure GDP

Source: National Income and Product Accounts (NIPA)

- ① **Product (value-added) approach:** sum of **value added** to all goods and services across all productive units in the economy
- ② **Expenditure approach:** sum of **spending** on all final goods and services produced in the economy
- ③ **Income approach:** sum of all **income received** by economic agents contributing to production

If no measurement error, all should give the same answer!

# 3 Approach to Measure GDP: Example

Variable	Quantity (\$M)		
	Coconut Producer	Restaurant	Government
Revenue*	20	30	5.5
sales for consumption	8	30	-
sales as intermediate	12	0	-
Costs	7	19	5.5
wages	5	4	5.5
interest on loan	0.5	-	-
cost of intermediates	-	12	-
taxes*	1.5	3	-
After-Tax Profits**	13	11	-

\* government gets revenue from taxes on producers and consumers, spends wages to provide defense services  
 \*\* profits are revenues minus costs

Question: how to calculate GDP?

# The Product Approach

**Question:** What is the value added by each agent?

- **Coconut Producer:** Final good  $\$20M$ , no intermediate input
- **Restaurant:** Final goods  $\$30M$ , with intermediate input  $\$12M$  from Coconut Producer
  - value added:  $30 - 12 = 18M$
- **Government:** Defence services, valued at cost  $\$5.5M$
- **GDP:**  $20 + 18 + 5.5 = 43.5M$

# The Expenditure Approach

**Question:** What is the total spending?

- **Formula:**  $Y = C + I + G + NX$
- **Consumption ( $C$ ):** “sale for consumption” row
  - To Coconut Producer:  $8M$
  - To Restaurant:  $30M$
- No investment ( $I$ ) and net export ( $NX$ ).
- **Government ( $G$ ):** defense service  $5.5M$
- **GDP ( $Y$ ):**  $38 + 5.5 = 43.5M$

# Income Approach

**Question:** how much does agent earn?

- **Workers:** wages  $5M$  from Coconut Producer,  $4M$  from Restaurant and  $5.5M$  from Government
- **Firms:**
  - After-tax Profits:  $13M$  to Coconut Producer and  $11M$  to Restaurant
  - Interest on loan:  $0.5M$  for Coconut Producer
- **Government:** Taxes  $1.5M$  from Coconut Producer and  $3M$  from Restaurant
  - Expenditure is  $5.5M \Rightarrow$  budget deficit
- **GDP:**  $5 + 4 + 5.5 + 13 + 11 + 0.5 + 1.5 + 3 = 43.5M$

**Income-Expenditure Identity:** Income earned goes to expenditure

# Prices in GDP measurement

The **revenue** row is calculated by  $10M$  coconuts  $\times$  \$2 each

- What if coconut price increases to \$3 next year?

**Solution:** common **price index** across different time

Two ways to build common price index:

- ① GDP deflator: common **GDP** standard
- ② Consumer Price Index (CPI): common **consumption basket** ( $Q$ )

# Prices in GDP measurement (Cont.)

## ■ GDP deflator: ratio between nominal and real GDP

### ① Calculate real GDP relative to base year by base year **price level**

- E.g.  $RealGDP_{2020} = \text{Cost of } Q_{2020} \text{ at } P_{2000}$ , use 2000 as base year
- While  $NominalGDP_{2020} = \text{Cost of } Q_{2020} \text{ at } P_{2020}$
- **Problem:** choose which year?  $\Rightarrow$  “**chain-weighting**” (rolling base)

### ② Calculate ratio: $\frac{NominalGDP_{2020}}{RealGDP_{2020}} \times 100$

## ■ CPI: normalize **consumption basket** of **base year** as 100, relative to **other year**

- E.g.  $CPI_{2020} = \frac{\text{Cost of } Q_{2000} \text{ at } P_{2020}}{\text{Cost of } Q_{2000} \text{ at } P_{2000}} \times 100$ , use 2000 as base year
- **Problem:**
  - ①  $\Delta P$  outside of consumption basket & not accounted
  - ② new goods & services introduced, old goods & services obsolete



# Example: Nominal v.s. Real GDP

- **Nominal GDP**: value of goods & services at current price
- **Real GDP**: value of goods & services at base year price

	Apples		Oranges		GDP Measure		
Year	Quantity	Price	Quantity	Price	Nominal	Real (base year = 1)	Real (base year = 2)
1	50	\$1.00	100	\$0.80	\$130	\$130	\$222.5
2	80	\$1.25	120	\$1.60	\$292	\$176	\$292

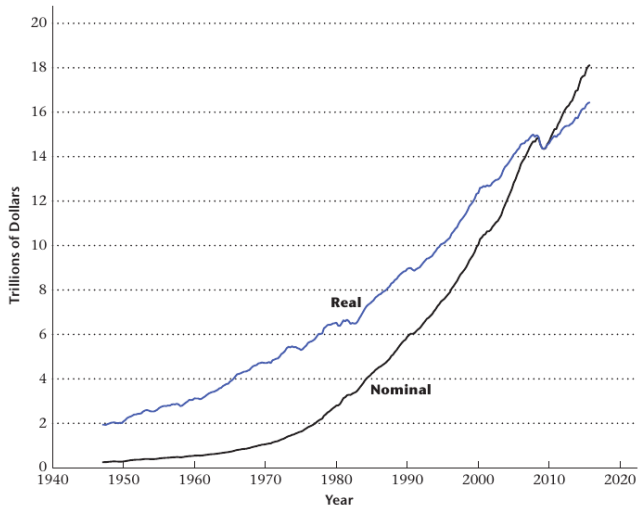
Choice of base year affects the GDP measure!

alternative: chain-weighting

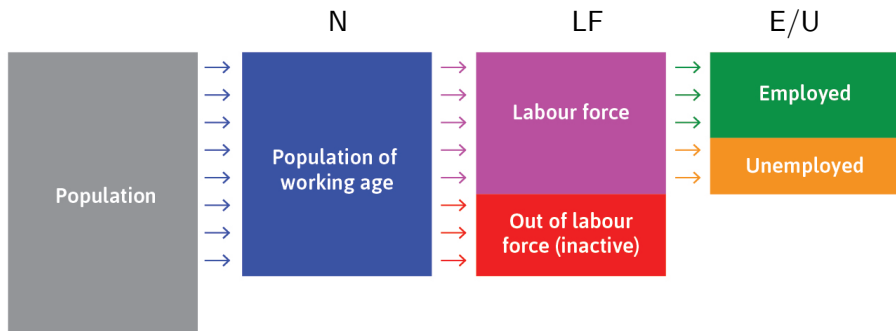
# Data: Nominal v.s. Real GDP

- inflation growth  
+ economics  
growth =  
nominal grows  
faster than real
- **Question:** What  
year is the base  
year on this  
graph?
- Ans: 2009, when  
Nominal = Real

Figure 2.1 Nominal GDP and Chain-Weighted Real GDP



# Population Composition



■ participation rate =  $\frac{LF}{N}$

■ unemployment rate =  $\frac{U}{LF}$

■ employment rate =  $\frac{E}{N}$