ECON 3123: Macroeconomic Theory I

Tutorial Note 1: Measurement of the Macroeconomy

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Output

Calculation of GDP There are 3 definitions of GDP, each corresponding to a way to calculate it.

(1) GDP is the market value of the **final** goods and services produced **in the economy** during a given period.

- Intermediate goods and services are not considered in this way of calculation.

- Foreign producers' production within the economy is counted into this economy's GDP.

(2) GDP is the sum of **value added** in the economy during a given period.

- Value added = Value of production − Value of intermediate goods used in production.

(3) GDP is the sum of **incomes** in the economy during a given period.

Exercise 1. *Carl's Computer Center sells computers to business firms. Businesses then use the computers to produce other goods and services. Over the past year, sales representatives were paid $3.5 million, $0.5 million went for rent on the building, $0.5 million went for taxes, $0.5 million was profit for Carl, and $10 million was paid for computers at the wholesale level. What was the firm's total contribution to GDP?*

Exercise 2. *Pete the Pizza Man produced $87,000 worth of pizzas in the past year. He paid $39,000 to employees, paid $11,000 for vegetables and other ingredients, and paid $5000 in taxes. He began the year with ingredient inventories valued at $1000, and ended the year with inventories valued at $2000. What was Pete's (and his employees') total contribution to GDP this year?*

Exercise 3. *In the country of Kwaki, people produce canoes, fish for salmon, and grow corn. In one year they produced 5000 canoes using labour and natural materials only, but sold only 4000, as the economy entered a recession. The cost of producing each canoe was \$1000, but the ones that sold were priced at \$1250. They fished \$30 million worth of salmon. They used \$3 million of the salmon as fertilizer for corn. They grew and ate \$55 million of corn. What was Kwaki's GDP for the year?*

Decomposition of GDP GDP is the sum of consumption, investment, government spending, net exports, and inventory investment, which we always ignored due to its relatively tiny size.

$$Y = C + I + G + NX, \quad \text{where } NX = EX - IM.$$

(1) Consumption (C) is the purchase of goods and services by consumers. It is the largest component of GDP.

(2) Investment (I) is the sum of nonresidential investment (*e.g.,* a new machine bought by firm) and residential investment (*e.g.,* purchase of a new house).

(3) Government spending (G) is the purchase of goods and services by different layers of government. Note that government transfer is not government spending.

(4) Exports (EX) are purchase of domestic goods by foreigners. Imports (IM) are purchases of foreign goods by domestic consumers, firms and government. Net exports (NX) is the difference between exports and imports. It can be negative.

(5) Inventory investment is the difference between production and sales. It can be negative.

This decomposition provides us with another approach to calculate GDP: expenditure approach, by adding all the expenditures up.

Exercise 4. *(1) Which of the following is not a category of consumption spending in the national income accounts?*

A. *Consumer durables*

B. *Nondurable goods*

C. *Services*

D. *Housing purchases*

(2) *In the expenditure approach to GDP, which of the following would be excluded from measurements of GDP?*

A. *Government payments for goods produced by foreign firms*

B. *Government payments for goods produced by firms owned by state or local governments*

C. *Government payments for welfare*

D. *All government payments are included in GDP.*

Example 1. *Suppose there are only two firms in the economy:*

- *Farm A grows strawberries. In 2016, it sold $10,000 worth of strawberries to customers, $20000 worth of strawberries to Japan, and $30,000 worth of strawberries to Cafe B. It also pays $5,000 wages to its employees and $10,000 rent to the landlord.*

- *Cafe B makes and sells strawberry cakes. In 2016, it sold $60,000 worth of strawberry cakes to customers and stored away $20,000 worth of strawberry cakes. It pays $15,000 wages to its employees, $4,000 rent for its shop and $2,000 interest payment on its loans. The stored cakes are sold in 2017.*

Profit tax is 10% and Wage tax is 10%. What is the GDP of this economy?

Nominal and Real GDP **Nominal GDP** reflects both current quantities and current prices, while **real GDP** sums up the quantities with constant prices at base year.

$$Y_{\text{Nominal, } t} = \sum_{i=1}^{N} P_{i,t} Q_{i,t}$$

$$Y_{\text{Real, } t} = \sum_{i=1}^{N} P_{i,t_0} Q_{i,t}, \text{where } t_0 \text{ is the base year.}$$

To reflect changes in relative prices over time, we use **real GDP in chained dollars**. The growth rate is

$$\bar{g}_{\text{RGDP},t} = \sqrt{\frac{\sum_{i=1}^{N} P_{i,t-1} Q_{i,t}}{\sum_{i=1}^{N} P_{i,t-1} Q_{i,t-1}} \frac{\sum_{i=1}^{N} P_{i,t} Q_{i,t}}{\sum_{i=1}^{N} P_{i,t} Q_{i,t-1}}} - 1.$$

Exercise 5. *A disadvantage of chain-weighting is that*

A. past inflation rates change whenever the base year changes.

B. past growth rates of real GDP change whenever the base year changes.

C. it causes output growth to slow.

D. the components of real GDP don't sum to real GDP.

Example 2. *Class example by spreadsheet.*

Employment

Unemployment Rate Labour force can be divided into two parts: employed people and unemployed people. Unemployed workers are people who do not have a job **but are looking for one**. Discouraged workers, i.e., those who do not want to look for a job, are not included. Mathematically, the labour force (L), employment (N) and unemployment (U) have the following relationship.

$$L = N + U,$$

The unemployment rate is

$$u = \frac{U}{L}$$

Remark. *The denominator is labour force, not total population.*

Participation Rate Labour force participation rate is defined as the ratio between total labour force and total population of working age.

$$\text{Participation rate} = \frac{\text{Labour force}}{\text{Total population of working age}}.$$

Exercise 6. *If a city has 3293 unemployed people and 69,884 employed people, then what is the city's unemployment rate?*

Price

Inflation Inflation rate reflects the change of price level during a period. Let the price level be denoted by P_t. The inflation rate during period t is

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}.$$

When $\pi_t > 0$, the economy has inflation. When $\pi_t < 0$, the economy has deflation.

Price Indices Price index can be understood as a **weighted average** of different production goods/consumption goods.

(1) GDP Deflator: The ratio between the nominal GDP and Real GDP.

$$P_t = \frac{Y_{\text{Nominal, } t}}{Y_{\text{Real, } t}} = \frac{\sum_{i=1}^{N} P_{i,t} Q_{i,t}}{\sum_{i=1}^{N} P_{i,t_0} Q_{i,t}} = \sum_{i=1}^{N} \left[P_{i,t} \underbrace{\frac{Q_{i,t}}{\sum_{i=1}^{N} P_{i,t_0} Q_{i,t}}}_{\text{weight of good } i} \right].$$

(2) Consumer Price Index (CPI): The ratio between the cost of market basket in current year and the base year.

$$P_t = \frac{\text{Price of basket in year } t}{\text{Price of basket in the base year}} = \frac{\sum_{i=1}^{N} P_{i,t} C_{i,t_0}}{\sum_{i=1}^{N} P_{i,t_0} C_{i,t_0}} = \sum_{i=1}^{N} \left[P_{i,t} \underbrace{\frac{C_{i,t_0}}{\sum_{i=1}^{N} P_{i,t_0} C_{i,t_0}}}_{\text{weight of good } i} \right],$$

where C represents consumption.

Exercise 7. *Chapter 2, Question 7 in Blanchard, Olivier (2021), Macroeconomics, 8th ed., Pearson.*

Exercise 8. *The CPI may overstate inflation for all the following reasons except*

A. problems measuring changes in the quality of goods.

B. substitution by consumers towards cheaper goods.

C. problems measuring the quality of services.

D. changes in Social Security benefits.

Exercise 9. *Nominal GDP in a country was \$8759.9 billion in 2024 and \$9254.6 billion in 2025. The GDP deflator was 1.0286 for 2024 and 1.0437 for 2025.*

(i) What is the growth rate of nominal GDP between 2024 and 2025?

(ii) What is the inflation rate from 2024 to 2025?

(iii) What is the growth rate of real GDP from 2024 to 2025?

Example 3. *The consumer price index (CPI) was 180 for 2009 when using 1995 as the base year (1995 = 100). Now suppose we switch and use 2009 as the base year (2009 = 100). What is the CPI for 1995 with the new base year?*

Example 4. *Two years ago, the GDP deflator for Old York was 300, and today it is 330.75. Based on this information, what is the annual average inflation rate for the two years?*