

LM 3 - Aggregate Output, Prices, and Economic Growth

KIA Fresh Graduates Program - Economics

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Learning Outcomes

The candidate should be able to:

- 1 calculate and explain gross domestic product (GDP) using expenditure and income approaches;
- 2 compare the sum-of-value-added and value-of-final-output methods of calculating GDP;
- 3 compare nominal and real GDP and calculate and interpret the GDP deflator;
- 4 compare GDP, national income, personal income, and personal disposable income;
- 5 explain the fundamental relationship among saving, investment, the fiscal balance, and the trade balance;
- 6 explain how the aggregate demand curve is generated;
- 7 explain the aggregate supply curve in the short run and long run;
- 8 explain causes of movements along and shifts in aggregate demand and supply curves;

Learning Outcomes

The candidate should be able to:

- ⑨ describe how fluctuations in aggregate demand and aggregate supply cause short-run changes in the economy and the business cycle;
- ⑩ distinguish among the following types of macroeconomic equilibria: long-run full employment, short-run recessionary gap, short-run inflationary gap, and short-run stagflation;
- ⑪ explain how a short-run macroeconomic equilibrium may occur at a level above or below full employment;
- ⑫ analyze the effect of combined changes in aggregate supply and demand on the economy;
- ⑬ describe sources, measurement, and sustainability of economic growth;
- ⑭ describe the production function approach to analyzing the sources of economic growth;
- ⑮ define and contrast input growth with growth of total factor productivity as components of economic growth

Overview

- 1 Introduction
- 2 Aggregate Output and Income
- 3 Aggregate Demand and Aggregate Supply
- 4 Economic Growth and Sustainability
- 5 Practice Questions

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Introduction to Macroeconomics

- Macroeconomics is the study of the aggregate activities of households, companies, and markets.
- Macroeconomics focuses on national aggregates, such as total investment, total consumption, employment, inflation, and the overall level of interest rates.
- Investors must be able to evaluate a country's current economic situation and to forecast its future economic environment.
- Objective is to identify asset classes and securities that will benefit from economic trends occurring within the country.

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Aggregate Output and Income

- Aggregate output, called the Gross Domestic Product (GDP), is the total market value of all final goods and services produced in an economy during a specific period.
 - ▶ Only goods that are valued in the market.
 - ▶ Final goods and services only (not intermediate).
 - ▶ Rental value for owner-occupied housing (estimated).
 - ▶ Government services (at cost)—not transfers.
- Aggregate income of an economy is the value of all the payments earned by the suppliers of factors used in production (wages, rent, interest and profits).
- Value spent on goods and services must be equal to the value of the output produced and must accrue to the factors of production
 \Rightarrow **aggregate output = aggregate expenditures = aggregate income.**

Measuring GDP

- GDP can be determined in two different ways:
 - ▶ Income approach: GDP is calculated as the total amount earned by households and companies in the economy.
 - ▶ Expenditure approach: GDP is calculated as the total amount spent on the goods and services produced within the economy during a given period.
- The two approaches yield similar results.
- Expenditures approach can be done using two distinct, but closely related, measurement methods:
 - ▶ Value of final output;
 - ▶ Sum of value added.

Measuring GDP: Example

- Suppose that a very simple economy produces only four goods and services: eye examinations, pizzas, shoes, and cheese. Assume that all the cheese in this economy is used in the production of pizzas. Use the information in the following table to calculate GDP for the year 2022.

PRODUCTION AND PRICE STATISTICS FOR 2022

(1) PRODUCT	(2) QUANTITY	(3) PRICE PER UNIT
Eye examinations	100	\$50.00
Pizzas	80	10.00
Shoes	20	100.00
Cheese	80	2.00

Measuring GDP: Example

PRODUCT	(1) QUANTITY	(2) PRICE PER UNIT	(3) VALUE
Eye examinations	100	\$50	\$5,000
Pizzas	80	10	800
Shoes	20	100	2,000

- Add the value for each of the three final goods and services to find GDP.
- $GDP = 7800\$$

Measuring GDP: Example

- The final selling price of a product must equal the sum of the values added to the product at each stage of production.

Firm	Value of Product	Value Added	Total
Cotton farmer	Value of raw cotton = \$1	Value added by cotton farmer	= \$1
Textile mill	Value of raw cotton woven into cotton fabric = \$3	Value added by textile mill = (\$3 - \$1)	= \$2
Shirt company	Value of cotton fabric made into a shirt = \$15	Value added by shirt company = (\$15 - \$3)	= \$12
L.L.Bean	Value of shirt for sale on L.L.Bean's website = \$35	Value added by L.L.Bean = (\$35 - \$15)	= \$12
-	Total value added		= \$35

Nominal vs. Real GDP

- Nominal GDP is the total value of all goods and services produced by an economy, valued at **current market prices**:

$$\text{Nominal GDP}_t = \sum_i P_{i,t} Q_{i,t}$$

- To evaluate the growth of the economic, it's useful to look at the growth of economic activity (quantities produced) keeping prices constant.
- Real GDP measures the output of the economy using prices from a base year, removing the effect of changes in prices:

$$\text{Real GDP}_t = \sum_i P_{i,B} Q_{i,t}$$

- Real economic growth is measured by the percentage change in real GDP.

Nominal vs. Real GDP: Example

Product	2012 Quantity	2012 Price	2022 Quantity	2022 Price
Eye examinations	80	\$40	100	\$50
Pizzas	90	11	80	10
Shoes	15	90	20	100

- The table shows output and prices in 2012 and 2022.
- Nominal GDP in 2012 = 5540\$.
- Nominal GDP in 2022 = 7800 \$.
- We choose 2012 as the base year.
- Real GDP in 2022 = 6680\$

GDP Deflator

- The implicit price deflator for GDP, or simply the GDP deflator, is defined as follows:

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100 = \frac{\sum_i P_{i,t} Q_{i,t}}{\sum_i P_{i,B} Q_{i,t}} \times 100$$

- GDP deflator broadly measures the aggregate changes in prices across the overall economy.
- It provides a useful measure of inflation in the economy.

GDP Deflator: Example

GDP	2017	2018
Nominal GDP	\$19,485 billion	\$20,494 billion
Real GDP	\$18,051 billion	\$18,566 billion

Formula	Applied to 2017	Applied to 2018
$\text{GDP deflator} = \left(\frac{\text{Nominal GDP}}{\text{Real GDP}} \right) \times 100$	$\left(\frac{\$19,485 \text{ billion}}{\$18,051 \text{ billion}} \right) \times 100 = 107.9$	$\left(\frac{\$20,494 \text{ billion}}{\$18,566 \text{ billion}} \right) \times 100 = 110.4$

- We can use the GDP deflator to calculate the inflation rate from 2017 to 2018.
- GDP deflator inflation rate = $\left(\frac{110.4 - 107.9}{107.9} \right) \times 100 = 2.3\%$
- Based on the GDP deflator, the price level increased by 2.3% between 2017 and 2018.

Components of GDP

- Based on the expenditure approach:

$$\begin{aligned}GDP &= C + I + G + (X - M) \\&= (C + G^C) + (I + G^I) + (X - M)\end{aligned}$$

- ▶ C = consumption spending
- ▶ I = private investment (fixed capital + change in inventories)
- ▶ G = government purchases (consumption G^C + investment G^I)
- ▶ X = exports
- ▶ M = imports

Components of GDP: Consumption

- Consumption is spending by households on goods and services, not including spending on new houses (which are counted instead in investment).
- Consumption is usually further divided into expenditure on
 - ▶ Services, such as medical care, education, and haircuts;
 - ▶ Nondurable goods, such as food and clothing;
 - ▶ Durable goods, such as automobiles and furniture.

Components of GDP: Investment

- Investment is spending by firms on new factories, office buildings, machinery, and additions to inventories, plus spending by households and firms on new houses.
- We usually measure the following categories of investment:
 - ▶ Business fixed investment, such as new factories, office buildings, machinery, and research and development;
 - ▶ Residential investment, i.e. new single-family and multi-unit houses;
 - ▶ Changes in business inventories, i.e. goods that have been produced but not yet sold.

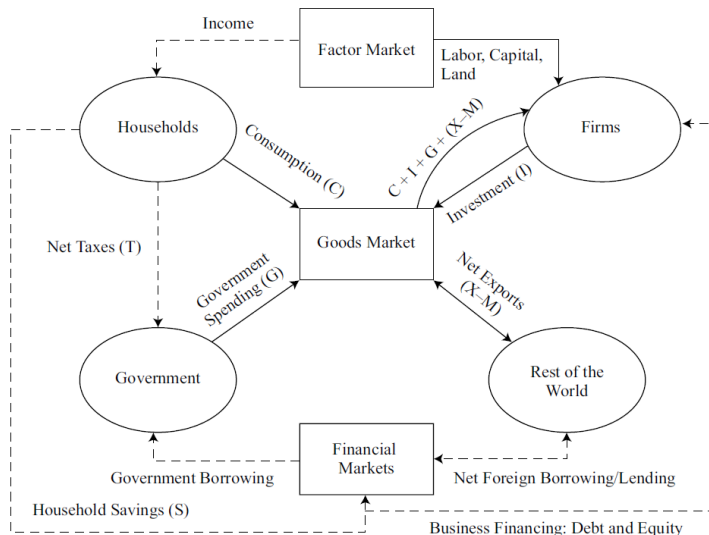
Components of GDP: Government Purchases

- Government purchases are spending by national, regional and local governments on goods and services.
- This includes both government consumption (like teachers' salaries and office supplies) and government investment (like highways and military bases).
- This does not include transfer payments, since those do not result in immediate production of new goods and services.

Components of GDP: Net Exports

- Net exports are exports minus imports.
- This difference might be positive or negative.
- Since we want to count domestic production, we add up the value of the goods and services sold to foreigners and subtract the value of the goods and services sold to residents by foreigners.
- Exports are not counted otherwise (in C , I , or G) so we need to count them somehow as production.
- Imports are counted (in C , usually) but we are trying to measure domestic production, so we don't want to count them. Subtracting them off achieves this goal.

Components of GDP



Components of GDP: Example

In each of the following cases, determine how much GDP and each of its components is affected (if at all).

- ① Adil spends \$200 on dinner at a top restaurant in Riyadh.
- ② Lolwa spends \$1800 on a new laptop to use in her business. The laptop was built in China.
- ③ Tariq spends \$1200 on a computer to use in his business. He got last year's model on sale for a great price from a local manufacturer.
- ④ A motor car manufacturer builds \$500 million worth of cars, but consumers only buy \$470 million worth of them.

Components of GDP: Example

- ① Adil spends \$200 on dinner at a top restaurant in Riyadh.
⇒ Consumption and GDP rise by \$200.
- ② Lolwa spends \$1800 on a new laptop to use in her business. The laptop was built in China.
⇒ Investment rises by \$1800, net exports fall by \$1800, GDP is unchanged.
- ③ Tariq spends \$1200 on a computer to use in his business. He got last year's model on sale for a great price from a local manufacturer.
⇒ Current GDP and investment do not change, because the computer was built last year.
- ④ A motor car manufacturer builds \$500 million worth of cars, but consumers only buy \$470 million worth of them.
⇒ Consumption rises by \$470 million, inventory investment rises by \$30 million, and GDP rises by \$500 million.

Savings, Investment, Fiscal Balance, and Trade Balance

- Based on the expenditure approach:

$$GDP = C + I + G + (X - M)$$

- Based on the income approach: $GDP = C + S + T$

- ▶ S = Private savings

- ▶ T = Net taxes

- Set the two equal: $C + S + T = C + I + G + (X - M)$

- $\Rightarrow S = I + (G - T) + (X - M)$

- Savings = Investment + Fiscal balance + Trade balance

- Rearrange to get: $(G - T) = (S - I) - (X - M)$

- These are just accounting identities!

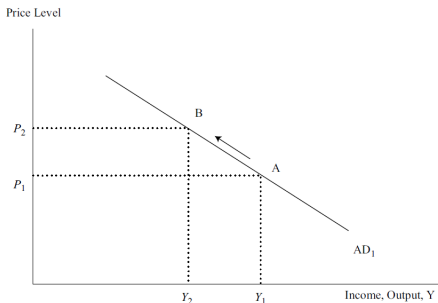
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Aggregate Demand and Aggregate Supply

- We are going to study a simple and very influential model of the macroeconomy: the AD-AS model.
- Aggregate demand (AD) represents the quantity of goods and services that households, businesses, government, and international customers want to buy at any given level of prices.
- Aggregate supply (AS) represents the quantity of goods and services that producers are willing to supply at any given level of prices.
- Shifts in AD and AS determine the short-run fluctuations in economic activity.

Aggregate Demand



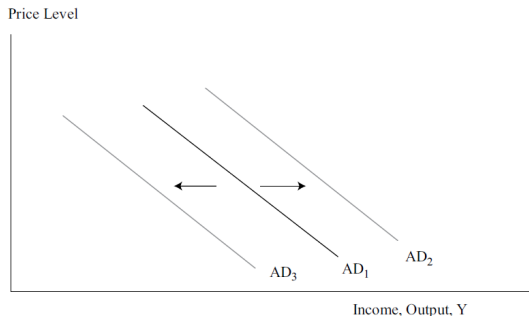
- The AD curve shows the relationship between the overall price level and real aggregate income.
- A movement along the AD curve will occur when the price level changes, and the change is not caused by a component of real GDP.
- A shift of the AD curve will occur when some component of real GDP changes.

Movements along the AD curve

The AD curve is negatively sloped due to three main effects:

- Wealth effect: lower prices increase consumers' real wealth which increases demand for goods and services.
- Interest rate effect:
 - ▶ With higher prices, consumers' demand for money increases.
 - ▶ With constant nominal money supply, interest rates must increase to restore money market equilibrium.
 - ▶ Higher interest rates, decrease consumer spending and business investment in assets.
- Real Exchange Rate Effect:
 - ▶ Increase in price level increases real price of exports in turn decreasing exports.
 - ▶ Increase in price level decreases real price of imports in turn increasing imports.
 - ▶ A fall in net exports ($X - M$) decreases aggregate demand.

Shifts in the AD curve



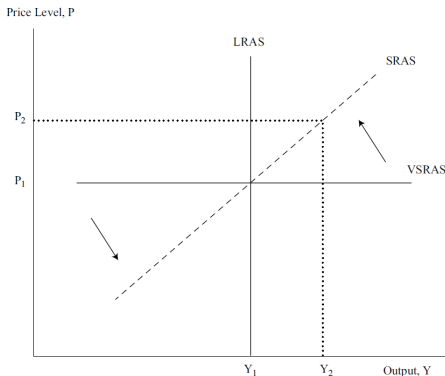
- Factors that influence the aggregate level of expenditures in the economy will cause the AD curve to shift.
- A shift to the right represents an increase in aggregate demand at any price level (e.g. AD_1 to AD_2).
- A shift to the left represents a decrease in aggregate demand at any price level (e.g. AD_1 to AD_3).

Shifts in the AD curve

Key factors that cause the AD curve to shift include:

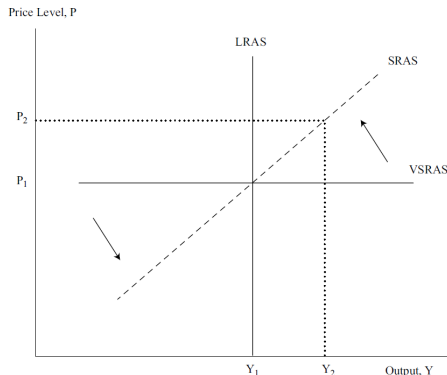
- Increases in HH's wealth increase C .
- Increases in expectations for economic growth increase C , I .
- Higher capacity utilization ($> 85\%$) increases I .
- Increases in tax rates decrease disposable income and C .
- Increases in government spending, G .
- Increases in the money supply reduce real rates and increase I , C .
- Depreciation of currency increases net exports $X - M$.
- Growth of foreign GDP relative to domestic GDP increases net exports $X - M$.

Aggregate Supply



- The aggregate supply (AS) curve represents the level of domestic output that companies will produce at each price level.
- Economists distinguish between the short-run and long-run AS curves, which differ with respect to how wages and other input prices respond to changes in final output prices.

Aggregate Supply

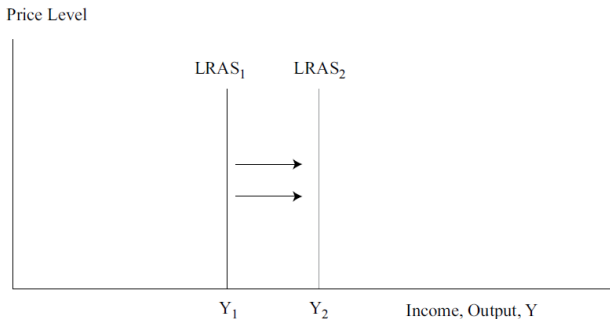


- In the very short run: AS is elastic (input prices are fixed).
- In the short run: Input prices are fixed so businesses expand real output when (output) prices increase.
- In the long run: AS is fixed at full-employment or potential real GDP.

Shifts in SR Aggregate Supply

- Factors that increase the SRAS curve:
 - ▶ Decreases in input prices;
 - ▶ Improved expectations for economic growth;
 - ▶ Decreases in business taxes;
 - ▶ Increases in business subsidies;
 - ▶ Currency appreciation that reduces the cost of imported inputs.
- In addition, factors that shift the LRAS curve will also shift the SRAS curve.

Shifts in LR Aggregate Supply



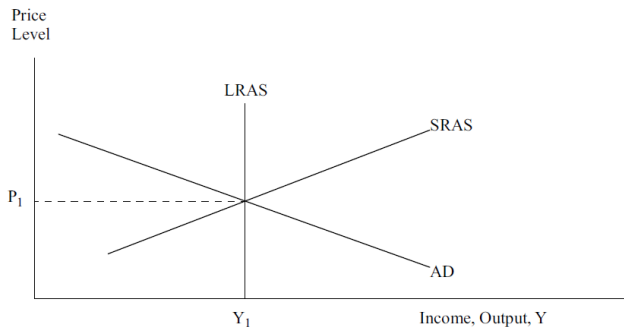
- Factors that increase the LRAS curve:

- ▶ Increase in labor supply;
- ▶ Increased availability of natural resources;
- ▶ Increased stock of physical capital;
- ▶ Increased human capital (labor quality);
- ▶ Advances in technology/labor productivity.

Equilibrium GDP and Prices

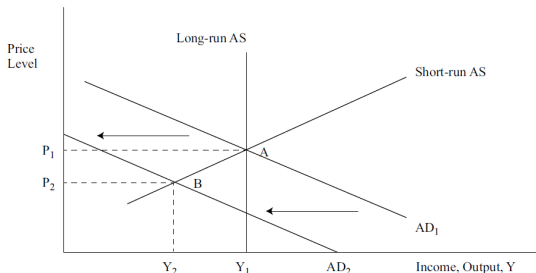
- We can combine AD and AS curves to determine the real level of GDP and the price level.
- Equilibrium occurs where the AD and AS curves intersect.
- Short-run macroeconomic equilibrium may occur at a level above or below full employment.
- We consider four possible types of macroeconomic equilibria:
 - ▶ Long-run full employment;
 - ▶ Short-run recessionary gap;
 - ▶ Short-run inflationary gap;
 - ▶ Short-run stagflation.

Long-Run Full Employment



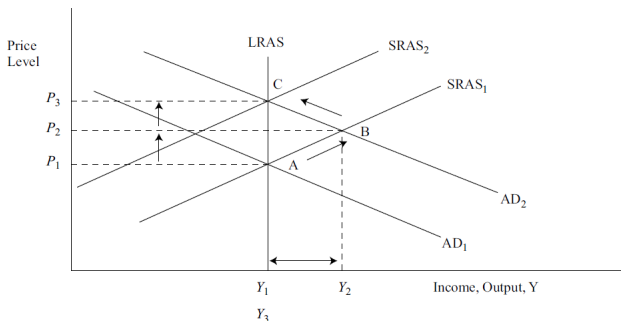
- Long-run full employment equilibrium occurs where the AD curve intersects the SRAS curve at a point on the LRAS curve.

Recessionary Gap



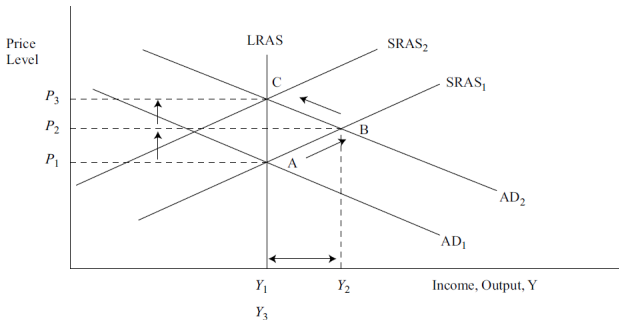
- A decline in AD results in lower GDP and lower prices.
- If the decline drives demand below potential GDP, the economy goes into a recession.
- Recessionary gap is the amount by which equilibrium output is below potential GDP.

Inflationary Gap



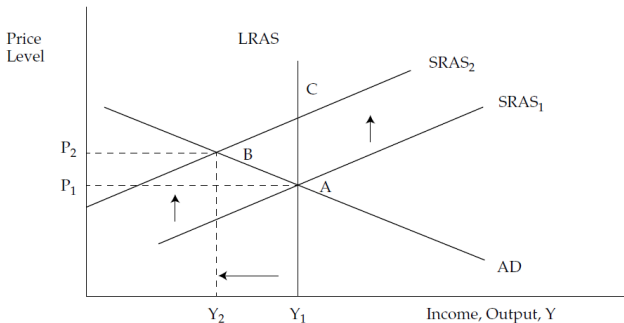
- Increases in AD lead to economic expansions as real GDP and employment increase.
- If the expansion drives the economy beyond its production capacity, inflation will occur.
- Inflationary gap is the amount by which equilibrium output exceeds potential GDP.

Inflationary Gap



- The increase in the general price level and input prices will set in motion the process of returning the economy back to potential GDP.
- Higher wages and input prices shift the $SRAS$ curve to the left (from $SRAS_1$ to $SRAS_2$), moving the economy to Point C.
- This self-correcting mechanism may work slowly.

Stagflation



- Declines in AS cause stagflation, i.e. high unemployment and increased inflation.
- This decline can be caused by an increase in input prices (e.g. oil).
- Policy problem:
 - ▶ Increasing AD to increase GDP would increase inflation.
 - ▶ Decreasing AD to reduce inflation would further reduce real GDP.

Combined Shift in AD and AD

Change in AS	Change in AD	Effect on Real GDP	Effect on Aggregate Price Level
Increase	Increase	Increase	Indeterminate
Decrease	Decrease	Decrease	Indeterminate
Increase	Decrease	Indeterminate	Decrease
Decrease	Increase	Indeterminate	Increase

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Economic Growth

- Economic growth is calculated as the annual percentage change in real GDP or the annual change in real per capita GDP.
- Growth in real GDP measures how rapidly the total economy is expanding.
- Growth in per capita GDP, defined as real GDP divided by population, measures the evolution of standard of living.
- Sustainable rate of economic growth is measured by the rate of increase in the economy's productive capacity or **potential GDP**.

Neoclassical Model of Economic Growth (Solow Model)

- Framework used to understand and analyze the underlying sources of growth for an economy.
- The model shows that potential GDP increases for two reasons:
 - ▶ Accumulation of production inputs such as capital, labor.
 - ▶ Discovery and application of new technologies that make these inputs more productive
- The cornerstone of the Solow model is the neoclassical production function.

Neoclassical Production Function

- Simplest form:

$$Y = Af(L, K)$$

- ▶ Y: level of aggregate output.
 - ▶ L: quantity of labor.
 - ▶ K: capital stock.
 - ▶ A: total factor productivity (TFP).
- TFP captures the effect of technological change and other factors on output beyond the measured contribution of the capital and labor inputs.
- TFP is not directly observed but is estimated.

Growth Accounting

- Growth accounting equation for GDP:

$$\text{Growth in potential GDP} = \text{Growth in TFP} + W_L(\text{Growth in L}) + W_K(\text{Growth in K})$$

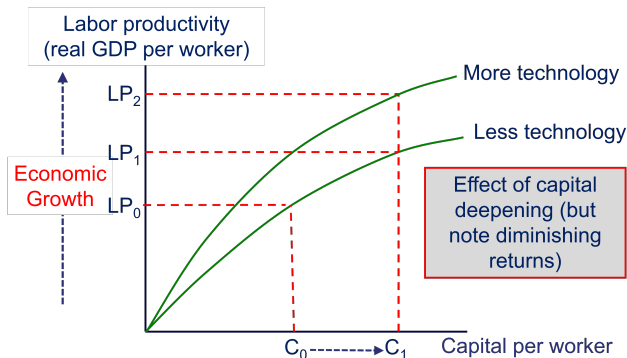
- ▶ W_L and W_K are the relative shares of capital and labor in national income.
- ▶ For many developed countries, W_L and W_K are roughly 0.7 and 0.3, respectively.

- Growth accounting equation for GDP per capita:

$$\text{Growth in per capita potential GDP} = \text{Growth in TFP} + W_K(\text{Growth in K/L})$$

- ▶ K/L : measures the amount of capital available per worker.

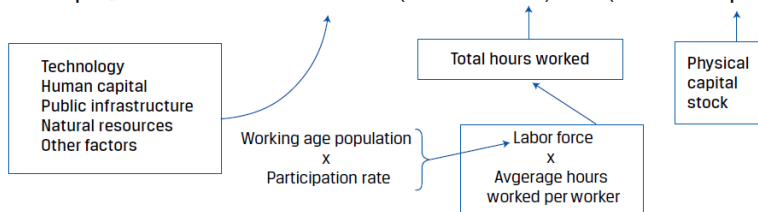
Productivity and Economic Growth



- In developed countries, K/L is already high and growth must come from TFP. In developing countries, growth comes from both.

Sources of Economic Growth

$$\text{Growth in potential GDP} = \text{Growth in TFP} + \text{WL (Growth in labor)} + \text{WC (Growth in capital)}$$



- Increase in labor supply.
- Increased availability of natural resources.
- Increased stock of physical capital.
- Increased human capital (labor quality).
- Advances in technology/labor productivity.

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Question 1

- The numerator of the GDP price deflator reflects:
 - ▶ A. the value of base year output at current prices.
 - ▶ B. the value of current year output at current prices.
 - ▶ C. the value of current year output at base year prices.

Question 2

- Consider the following data for a hypothetical country:

Account name	Amount (\$ trillions)
Consumption	15.0
Capital consumption allowance	1.5
Government spending	3.8
Gross private domestic investment	4.0
Exports	1.5
Imports	1.7

- Based only on the data given, the gross domestic product and national income are respectively closest to:
 - ▶ A. 21.1 and 20.6.
 - ▶ B. 22.6 and 21.1.
 - ▶ C. 22.8 and 20.8.

Question 3

- Equality between aggregate expenditure and aggregate output implies that the government's fiscal deficit must equal:
 - ▶ A. Private saving – Investment – Net exports.
 - ▶ B. Private saving – Investment + Net exports.
 - ▶ C. Investment – Private saving + Net exports.

Question 4

- In explaining the downward slope of the aggregate demand curve, the interest rate effect suggests that a higher price level will:
 - ▶ A. lead to lower interest rates, which will lead to higher levels of consumption and investment.
 - ▶ B. lead to higher interest rates, which will lead to lower levels of consumption and investment.
 - ▶ C. not affect interest rates and therefore will lead to a higher level of aggregate demand.

Question 5

- One of the reasons aggregate demand curve is downward sloping is because a lower price level means that the real exchange rate:
 - ▶ A. depreciates, making domestic goods cheaper in other countries and imports less competitive, resulting in a higher level of net exports.
 - ▶ B. appreciates, making domestic goods more expensive in other countries and imports more competitive, resulting in a higher level of net exports.
 - ▶ C. appreciates, making the country's exports and imports less competitive and leading to lower net exports.

Question 6

- Which of the following best describes the aggregate supply curve in the short run (e.g., 1 to 2 years)? The short run aggregate supply curve is:
 - ▶ A. flat because output is more flexible than prices in the short run.
 - ▶ B. vertical because wages and other input prices fully adjust to the price level.
 - ▶ C. upward sloping because input prices do not fully adjust to the price level in the short run.

Question 7

- Following a sharp increase in the price of energy, the overall price level is most likely to rise in the short run:
 - ▶ A. and remain elevated indefinitely unless the central bank tightens.
 - ▶ B. but be unchanged in the long run unless the money supply is increased.
 - ▶ C. and continue to rise until all prices have increased by the same proportion.

Question 8

- In the neoclassical or Solow growth model, an increase in total factor productivity reflects an increase in:
 - ▶ A. returns to scale.
 - ▶ B. output for given inputs.
 - ▶ C. the sustainable growth rate.