

National Income: Where It Comes From and Where It Goes

1. What determines the total production of goods and services?
2. How is national income distributed to the factors of production?
3. What determines the demand for goods and services?
4. What brings the supply and demand for goods and services into equilibrium?

1 A Closed Economy

- Three groups of decision makers:
 - Households: buy goods, supply labor and rent capital to the firms, buy financial assets, pay taxes to the government
 - Firms: sell goods and services, hire labor and buy capital goods, sell securities (bonds and stocks)
 - Government: buys goods and services, collects taxes, sells bonds
- Three markets: goods and services, factors of production, and financial assets
- Equilibrium: Supply equals demand in the above three markets.

2 Production of Goods and Services

Suppose that capital and labor are supplied inelastically in the long run,

$$L = \bar{L}, K = \bar{K}$$

Prices are flexible in the long run, so labor and capital are fully employed.

Suppose the technology for combining labor and capital is

$$Y = F(K, L).$$

Since capital and labor are in fixed supply and are fully employed, output is

$$Y = F(\bar{K}, \bar{L}).$$

In the long run, output depends on the supply of labor and capital and on technology.

2.1 Restrictions on the Production Function

1. More Input, More Output

Definition 2.1 Marginal Product of Capital (labor) is the extra amount of output the firm gets from one extra unit of capital (labor), holding the amount of labor (capital) fixed.

The marginal product can be represented mathematically as the partial derivatives of the production function. So the first assumption means

$$MPK = \frac{\partial F(K, L)}{\partial K} > 0$$

$$MPL = \frac{\partial F(K, L)}{\partial L} > 0$$

2. Diminishing Marginal Product

This can be represented as the second-order partial derivatives.

$$\frac{\partial MPK}{\partial K} = \frac{\partial^2 F(K, L)}{\partial K^2} < 0$$

$$\frac{\partial MPL}{\partial L} = \frac{\partial^2 F(K, L)}{\partial L^2} < 0$$

3. Constant Return to Scale (CRTS)

To represent it mathematically: for any positive number λ

$$F(\lambda K, \lambda L) = \lambda Y$$

3 How is income divided among labor and capital?

3.1 Decision Facing the Competitive Firm

Taking the prices of its output, P , and its inputs, W and R as given, a competitive firm

$$\begin{aligned} & \max_{K,L} \pi (K, L | P, W, R) \\ &= \max_{K,L} (PY - WL - RK) \\ &= \max_{K,L} [PF(K, L) - WL - RK] \end{aligned}$$

Differentiate with respect to K and L , we get

$$\begin{aligned} P \frac{\partial F(K, L)}{\partial L} - W &= 0 \\ P \frac{\partial F(K, L)}{\partial K} - R &= 0 \end{aligned}$$

3.2 Factor Prices in Equilibrium

$$\frac{W}{P} = \frac{\partial F(K, L)}{\partial L}$$
$$\frac{R}{P} = \frac{\partial F(K, L)}{\partial K}$$

Definition 3.1 *Real Wage* $\left(\frac{W}{P}\right)$ is the payment to labor measured in units of output rather than in dollars.

Definition 3.2 *Real Rental Price of Capital* $\left(\frac{R}{P}\right)$ is the rental price measured in units of goods rather than in dollars.

3.3 The Division of National Income

Total output is divided among workers and owners of capital according to their marginal productivities:

$$\begin{aligned}\text{Total Labor Income} &= (W/P) \times L = MPL \times L \\ \text{Total Capital Income} &= (R/P) \times K = MPK \times K\end{aligned}$$

If the production function has constant returns to scale, then

$$Y = (W/P) \times L + (R/P) \times K$$

Euler's Theorem

Economic Profit versus Accounting Profit

Example: black death and factor prices

4 The Demand for Goods and Services

4.1 Aggregate Demand

$$Y = C + I + G + NX$$

Assume a closed economy where $NX = 0$, then

$$Y = C + I + G$$

4.2 Consumption

Definition 4.1 *Disposable Income is the income after the payment of all taxes. It is represented as $Y - T$.*

Consumers allocate the disposable income between consumption and saving:

$$Y - T = C + S$$

Assume that consumption is an increasing functions of disposable income.

$$C = C_0 + c \times (Y - T),$$

Definition 4.2 *Marginal Propensity to Consume (MPC) is the amount by which consumption changes in response to a marginal increase in income.*

Empirically, c is around 0.9

Question: Is saving an increasing function of disposable income?

4.3 Investment

The quantity of investment depends on the real interest rate,

$$I = I(r)$$

Why?

For an investment project to be profitable, the expected return must exceed the cost.

The real interest rate measures the opportunity cost of the funds needed to finance an investment project.

External financing

Internal financing

The higher is r , the fewer the number of projects that satisfy this break even criterion.

Real versus Nominal Interest Rates

The nominal interest rate, i , is the one quoted every day in the WSJ and other financial sources.

The real interest rate, r , is the nominal rate i , adjusted for inflation π ,

$$1 + r = (1 + i)/(1 + \pi)$$

If i and π are small, the real interest rate can be approximated by $r = i - \pi$.

The real interest rate is a better measure of the cost of borrowing in an inflationary economy.

4.4 Government Purchases

For now, assume that spending and taxes are exogenous,

$$G = \bar{G}, T = \bar{T}$$

Here T equal taxes minus transfer payments.

Budget Deficit if $G - T > 0$

When the government runs a deficit, it must borrow from the public or from abroad.

It does so by selling Treasury bonds.

5 What Brings Supply and Demand into Equilibrium?

5.1 Market for Goods and Services

$$C = C_0 + c(Y^S - T)$$

$$I = I(r)$$

$$G = \bar{G}$$

$$T = \bar{T}$$

$$Y^D = C_0 + c(Y^S - T) + I(r) + G$$

$$Y^S = F(\bar{K}, \bar{L})$$

At the equilibrium interest rate,

$$Y^D = Y^S$$

5.2 Supply and Demand for Loanable Funds

Loanable funds are supplied by savers.

Total saving is the sum of private and public saving,

$$S = (Y - T - C) + (T - G).$$

(The government usually runs a deficit and subtracts from national saving.)

According to our assumptions, S depends only on income and not on real interest rates.

The demand for loanable funds comes from investment, and varies inversely with r .

The real interest rate adjusts to achieve balance between the supply and demand for loanable funds.

i.e., it adjusts so that

$$I = S$$

6 Summary of Closed Economy Model

1. Output is determined by factor supplies and technology in the long run.
2. Income shares are determined by marginal productivity.
3. Real interest rates adjust to equate AD with AS , or S with I .

7 Examples

- An increase in government purchases
Wars and Interest Rates in the United Kingdom
- A decrease in taxes
Reagan's tax cut

	$r(\%)$	$I/Y(\%)$
1970s	0.4	16.7
1980s	5.8	14.1

- Changes in investment demand.