

Product Approach: add the value of all goods and services produced in the economy and subtract the value of intermediate goods.

Expenditure Approach: Total expenditure = $C + I + G + NX$

Income Approach: add up all income received by economic agents contributing to production, including the profits made by firms

Income-expenditure identity: Y denote total GDP,

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

Gross Nation Product (GNP): measures the value of output produced by domestic factors of production. $GNP = GDP + NFP$, NFP : net factor payments from abroad to domestic residents.

Implicit GDP price deflator and CPI: Implicit GDP price deflator: $\text{Nominal GDP} / \text{Real GDP}$; current year CPI = $(\text{cost of base year quantities at current prices}) / (\text{cost of base year quantities at base year prices})$

Savings:

$$\begin{aligned} Y^d &= Y + NFP + TR + INT - T \\ S^p &= Y^d - C = Y + NFP + TR + INT - T - C, S^g = T - TR - INT - G, D = -S^g \\ S &= S^p + S^g = Y + NX + NFP = I + CA, CA = NX + NFP \end{aligned}$$

Y^d : private disposable income, S^p : private sector saving, TR : government transfer, INT : interest on government debt, S^g : government saving or government surplus, CA : current account surplus, D : government deficit

Labor market measurement: **Unemployment rate** = unemployed / Labor force; **participation rate** = labor force / total working age population, **employment ratio** = total employment / total working age population.

Marginal rate of substitution of leisure for consumption is the rate at which the consumer is just willing to substitute leisure for consumption goods.

The labor supply curve tells us how much labor the representative consumer wishes to supply given any real wage.

Exogenous variables: G, z, K ; **Endogenous variables:** C, N^s, N^d, T, Y

Competitive Equilibrium: 1. competitive refers to the fact that all consumers and firms are price-takers. 2. the economy is in the equilibrium when demand equals supply in all markets, i.e. **all markets clear**.

Production possibilities frontier (PPF): the technological possibilities for the economy as a whole, in terms of the production of consumption goods and leisure.

MRT: the rate at which one good can be converted technologically into another.

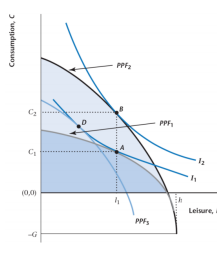
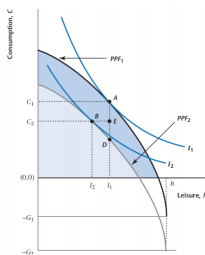
Pareto optimality: if there is no way to rearrange production or to reallocate goods so that someone is made better off without making someone else worse off.

C.E: 1. **first fundamental...: under certain conditions**, a C.E is Pareto optimal; 2. **second fundamental...: a Pareto optimum is a C.E.** **

$$\begin{aligned} Y &= C + G, T = G, N^d = N^s = N, \pi = Y - wN^d, Y = zF(K, N) = zF(K, h - l) \\ MPT_{l,c} &= MP_N = MRT_{l,c} \end{aligned}$$

Effects of increase in $G, z(TFP)$ and Business cycle: employment, consumption, real wage are procyclical

- $\Delta C < 0$, $\Delta l < 0$, $\Delta Y > 0$, $\Delta w < 0$



Malthusian Model and its steady state: Total land L is fixed

$$\text{equilibrium : } C = Y = zF(L, N), \frac{N'}{N} = g\left(\frac{C}{N}\right) = g\left(\frac{zF(L, N)}{N}\right) = g\left(zF\left(\frac{L}{N}, 1\right)\right)$$

$$\text{steady state : } N' = N = N^*, y = \frac{Y}{N} = c = \frac{C}{N}, l = \frac{L}{N}, f(l) = F(l, 1) \Rightarrow \frac{N'}{N} = g(c) = 1$$

Solow Model: Exogenous Growth

$$\text{Basic assumption : } N' = (1 + n)N, C = (1 - s)Y, S = sY, y = zf(k), K' = (1 - d)K + I$$

$$\text{Competitive Equilibrium : } S = I, Y = C + I = C + S, K' = sY + (1 - d)K = szF(K, N) + (1 - d)K$$

$$\text{In the Long Run : } K = K^* N, Y = y^* N, \dots, \text{grow rate} = n$$

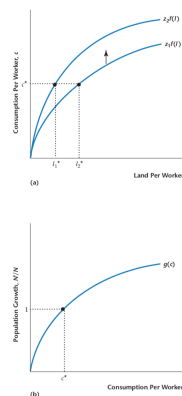
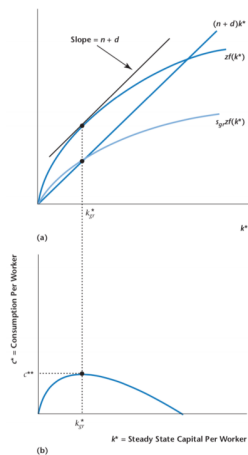
$$\Rightarrow \frac{K'N'}{N'N} = sz \frac{F(K, N)}{N} + (1 - d) \frac{K}{N} \Rightarrow k' = \frac{szf(k) + (1 - d)k}{1 + n}$$

$$\text{Steady State : } k' = k = k^* \Rightarrow szf(k^*) = (n + d)k^*, c^* = (1 - s)zf(k^*) = zf(k^*) - (n + d)k^*$$

$$\text{Solow Residual : } \hat{z} = \frac{\hat{Y}}{\hat{K}^\alpha \hat{N}^{1-\alpha}}, \alpha = 0.3$$

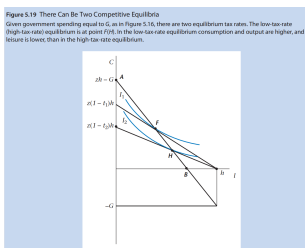
The Golden Rule Quantity of Capital per Worker

The Effects of an Increase in z on the Steady State



Distorting Tax on Wage Income:

$$C = w(1 - t)(h - l) + \pi, Y = zN^d, \pi = Y - zN^d, \text{in equilibrium : } w = z, \pi = 0, C = (1 - t)z(h - l)$$



In Laffer curve, there are two equilibrium tax rate t_1, t_2 . And that real wage,

consumption and income are procyclical.