EE312 Macroeconomic Theory

Chapter 4

A Closed-Economy One-Period Macroeconomic Model

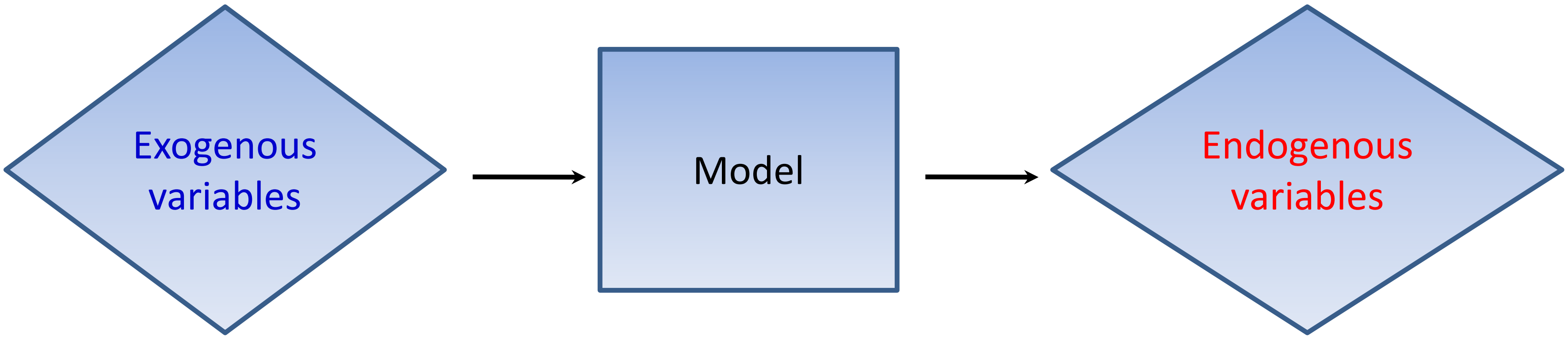
Closed-economy one-period model

- Representative consumer.
- Representative firm.
- Government.
- Competitive equilibrium.
- Economic efficiency and Pareto optimality.
- The effect of an increase in government spending and total factor productivity.

Government sector

- Government (G) spends on consumption goods.
- Spending is financed totally by taxes (T).
- The government's budget constraint: G = T
  - G is exogenous.
- **Exogenous variables**: values are determined outside the model.
- **Endogenous variables**: values are determined inside the model.

One-Period macroeconomic model



- **Exogenous variables**: z, G and K.
- **Endogenous variables**: C, Y, N^d, N^s, w, T.

Competitive equilibrium

- The values of endogenous variables (C, Y, N^d, N^s, w, T) at which, given z, K and G:
  - **The representative consumer** chooses C and N^s so that utility is maximized, given w, T and π.
  - **The representative firm** chooses Y and N^d so that profit is maximized, given w, z and K.
  - **The labor market** clears: $N^d = N^s$.
  - **The government budget constraint**: G = T.

Income-expenditure identity

$$Y = C + G$$

- In a competitive equilibrium, the goods market clears:
  - Y = total output or income.
  - C = consumption expenditure.
  - G = government expenditure.

The consumer's budget constraint

$$C = wN^s + \pi - T$$

$$as\ \pi = Y - wN^d and\ G = T$$

$$C = wN^s + Y - wN^d - G$$

$$C = Y - G$$

$$Y = C + G$$

- In equilibrium, $N^s = N^d$ and the equation is reduced to Y = C + G.

The production function

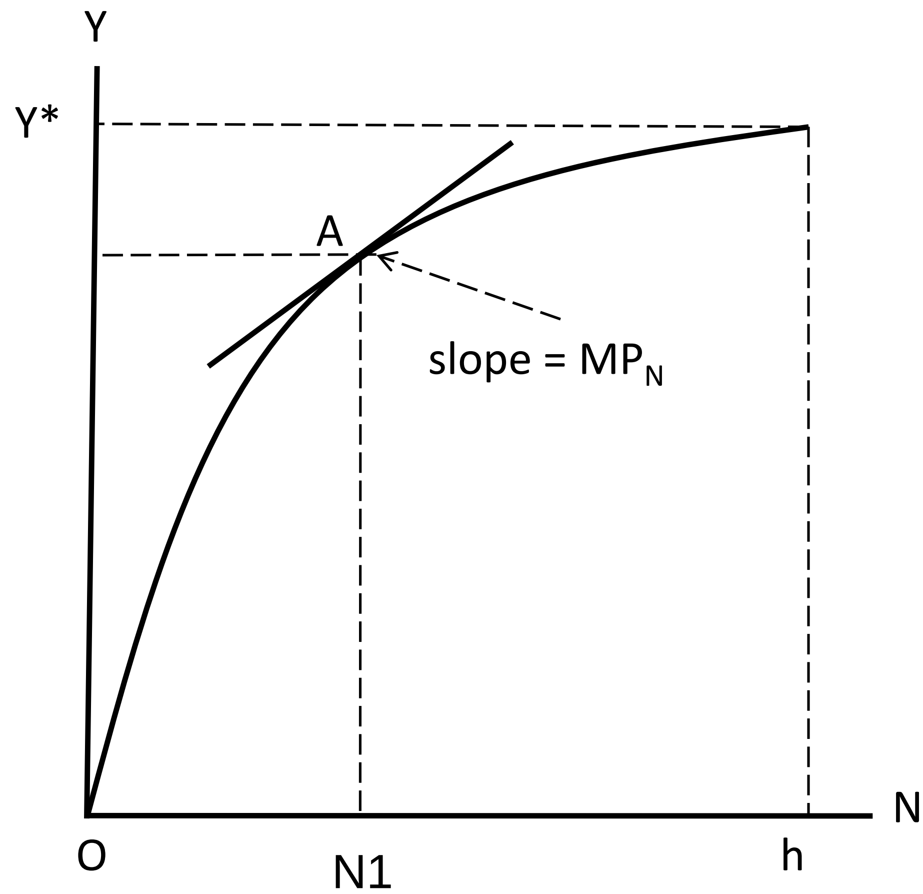
- In equilibrium, $N^d = N^s = N$; and $N = h - L$, therefore:

$$Y = zF(K, N)$$

$$Y = zF(K, h - l)$$

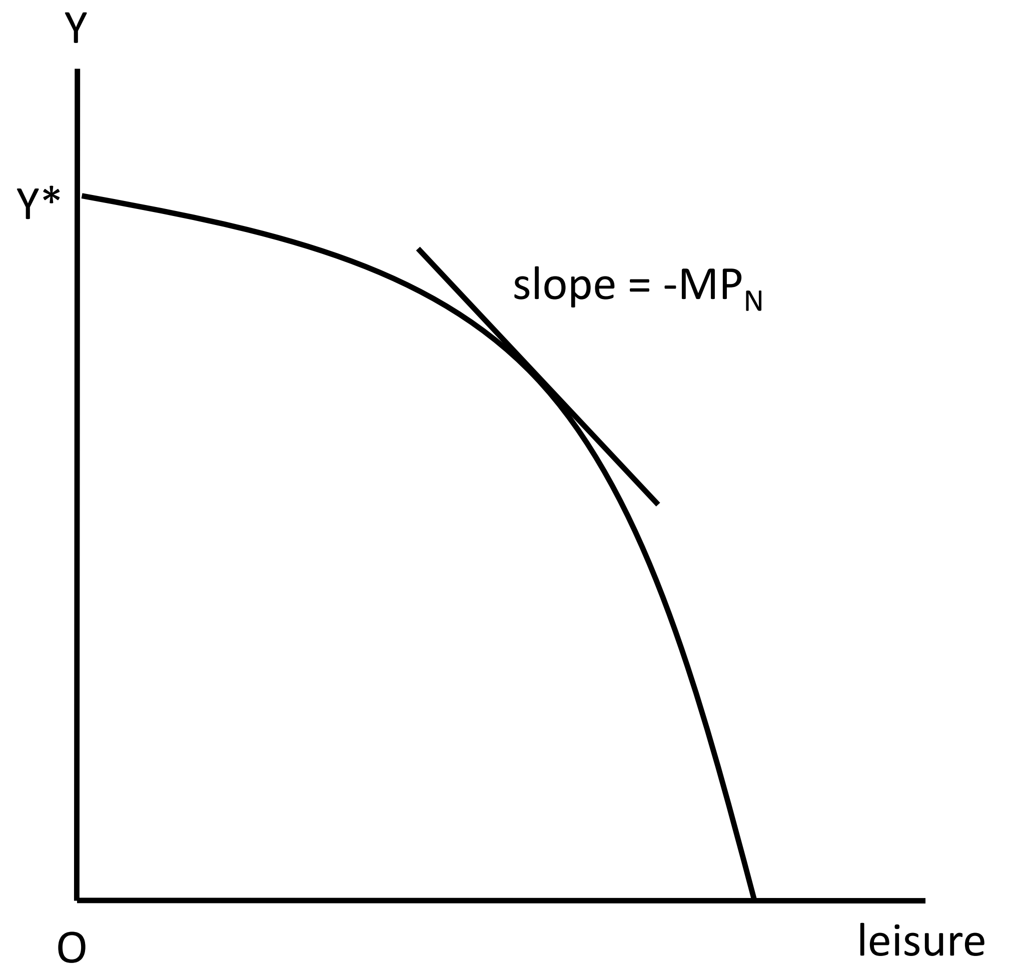
The production function

- $Y = zF(K, N)$.
- h = maximum labor supply available.
- ON1 = labor input.
- N1h = leisure.



Output as a function of leisure

- $Y = zF(K, h\text{-}L)$.
- The relation between Y and L is **a mirror image** of the production function with slope = $-MP_N$.



Consumption as a function of leisure

$$Y = zF(K, h - l)$$

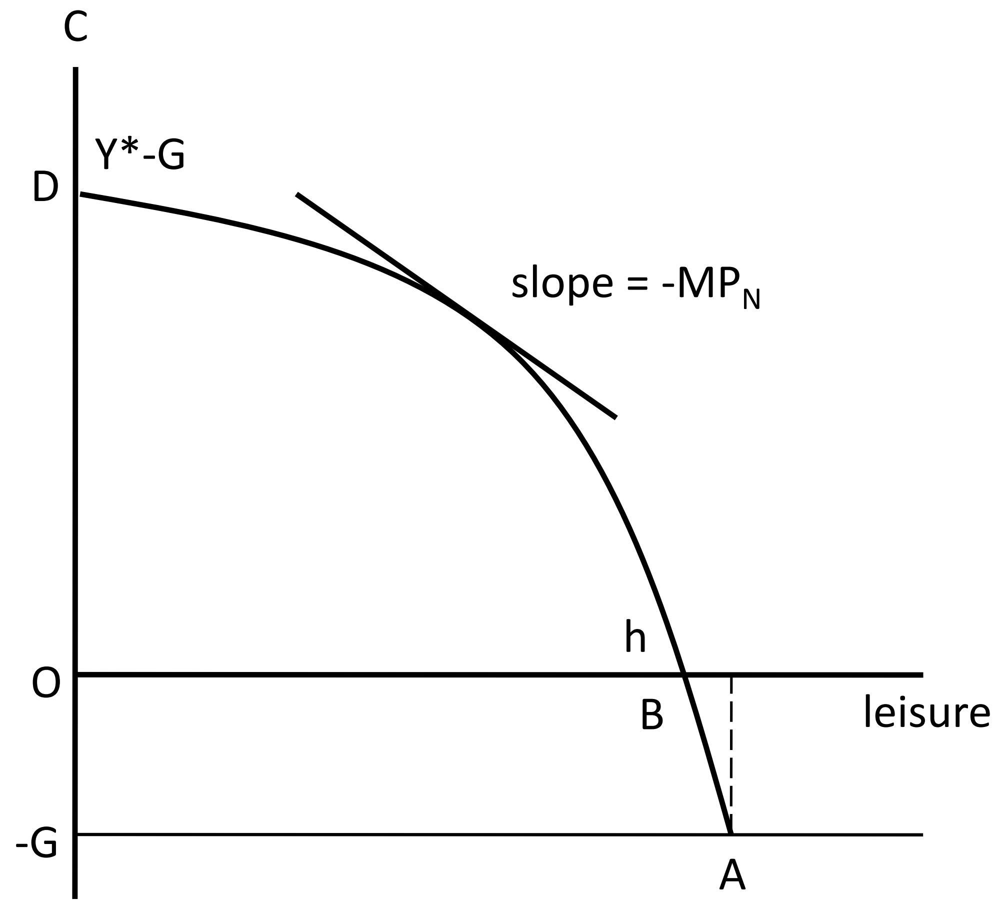
$$as\ C = Y - G$$

$$C = zF(K, h - l) - G$$

- The relation between C and L, given z, K, G.
- Total output is deducted by G to give the net amount available for consumption --- **the PPF**.

The production possibilities frontier

- PPF gives the **trade-off** between **consumption goods and leisure**, given technology.
- BD is feasible; AB is not feasible (C is negative).

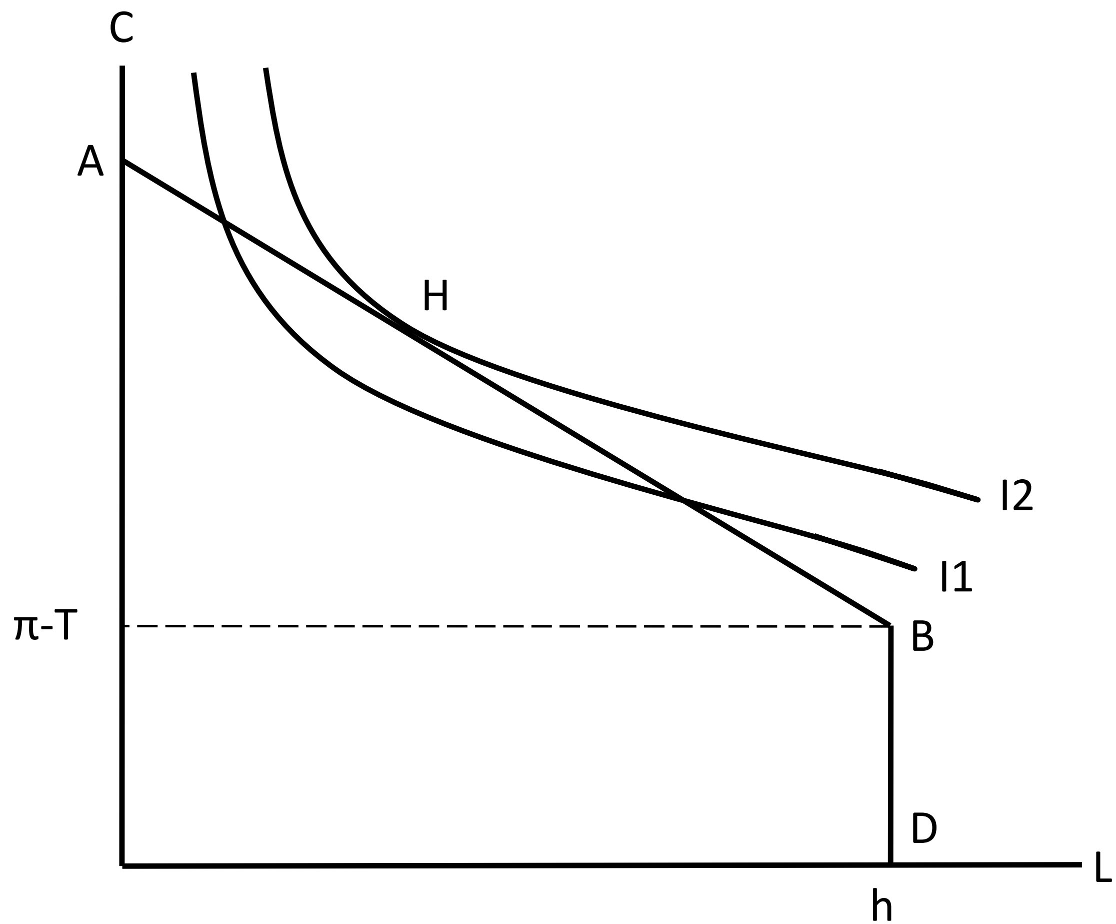


- The slope of PPF is **the marginal rate of transformation** (MRT) of L to C, the rate at which leisure is converted to consumption through work, given technology.

$$MRT_{l,c} = -MP_N = -\,slope\ of\ \ PPF$$

The consumer's max. utility

- The consumer trades off between C and L to maximize utility, given w.

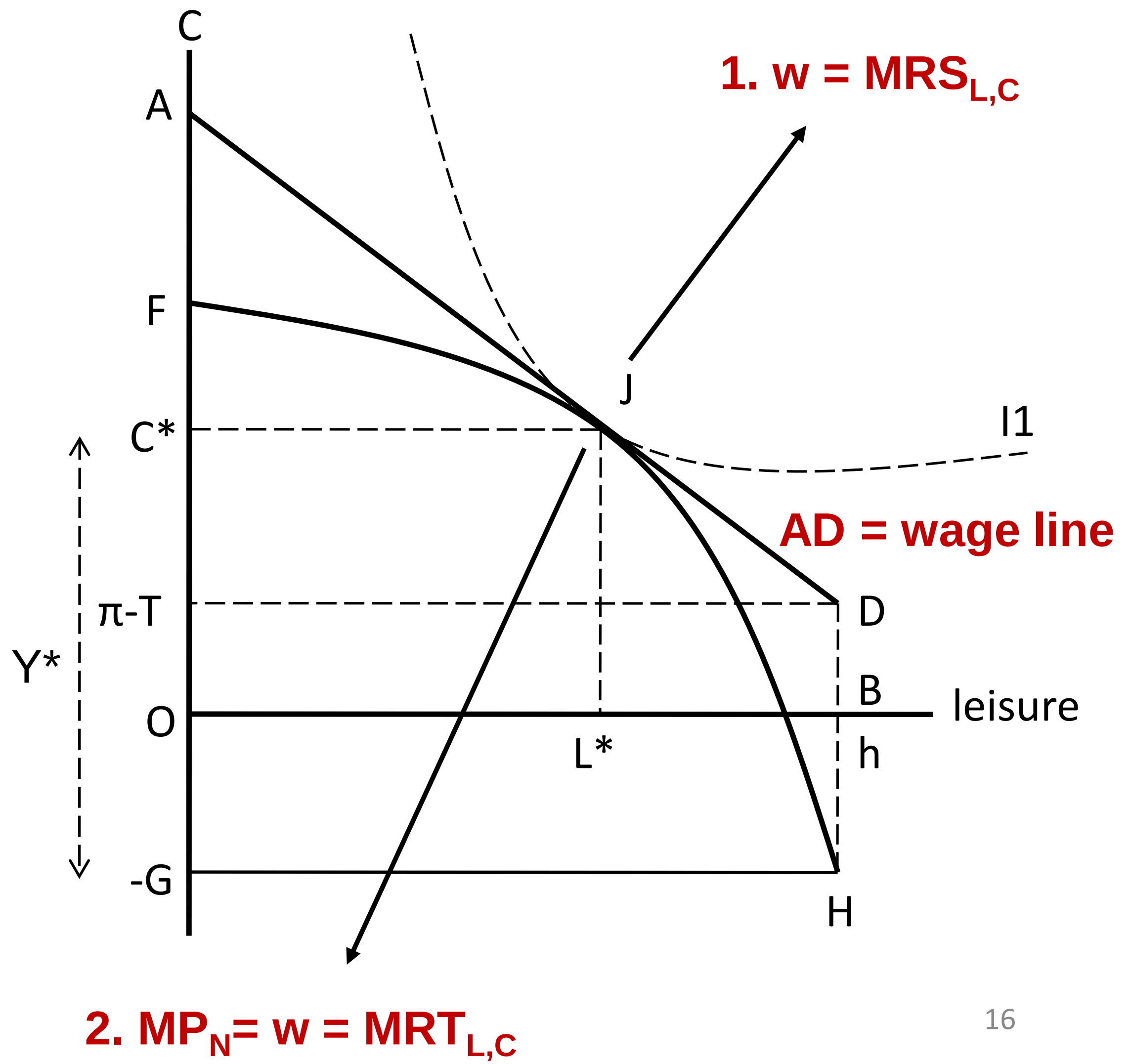


PPF and the consumer

- The firm chooses the point on PPF which maximizes profits.
  - $MRT_{L,C} = -MP_N = -w$
- The consumer's budget constraint has a slope $MRS_{L,C} = -w$.
- That point is on the firm's PPF and on the consumer's budget constraint --- tangent point.

Competitive equilibrium

- J is the equilibrium consumption bundle (C*, L*) where:
- **MP_N= w = $MRT_{L,C}$= $MRS_{L,C}$**
- **The firm and the consumer both optimize at J.**
- **Demand = Supply**



Properties of competitive equilibrium

- The values of C, Y, N^d, N^s, w and T at which, given z, K and G:
  - **The representative consumer** chooses C and N^s so that **utility is maximized**, given w, T and π.
  - **The representative firm** chooses Y and N^d so that **profit is maximized**, given w, z and K.
  - **The labor market** clears: $N^d = N^s$.
  - **The government budget constraint**: G = T.

The firm’s optimization

- **The firm maximizes profits at J,** given technology:
  - **MP_N= w = $MRT_{L,C}$ = slope of the budget line AD**.
  - The firm pays the real wage = w = the real wage received by the consumer.
  - The firm demands labor equal to h-L* and produces Y*= zF(K, h-L*).
  - Max. profit: $\pi^* = zF(K, h-L^*) - w(h-L^*) = DH$
  - DB = π^*- G = π^*- T.

The consumer's optimization

- **The consumer maximizes utility at J** subject to the budget constraint:
  - ADB is the budget constraint; the slope = –w.
  - DB = the consumer's dividend income minus taxes = π^*- T = π^*- G = the firm's max. profit minus G.
  - OC* = consumption goods obtained by the consumer = quantity of consumption goods supplied by the firm to the consumer.
  - OG = consumption goods taken by government.

- h-L* = quantity of labor supplied by the consumer = quantity of labor demanded by the firm;
- L*= leisure desired by the consumer.

- Point J on AD is also tangent to the consumer's highest indifference curve where $MRS_{L,C}$ = w.

Equilibrium in production and consumption

$$MRS_{l,C} = w = MRT_{l,C} = MP_N$$

- A competitive equilibrium is achieved when both the consumer and the firm optimize, given z, G and K.
- **The real wage** (w) is the price signal for both parties to adjust and achieve a simultaneous equilibrium.

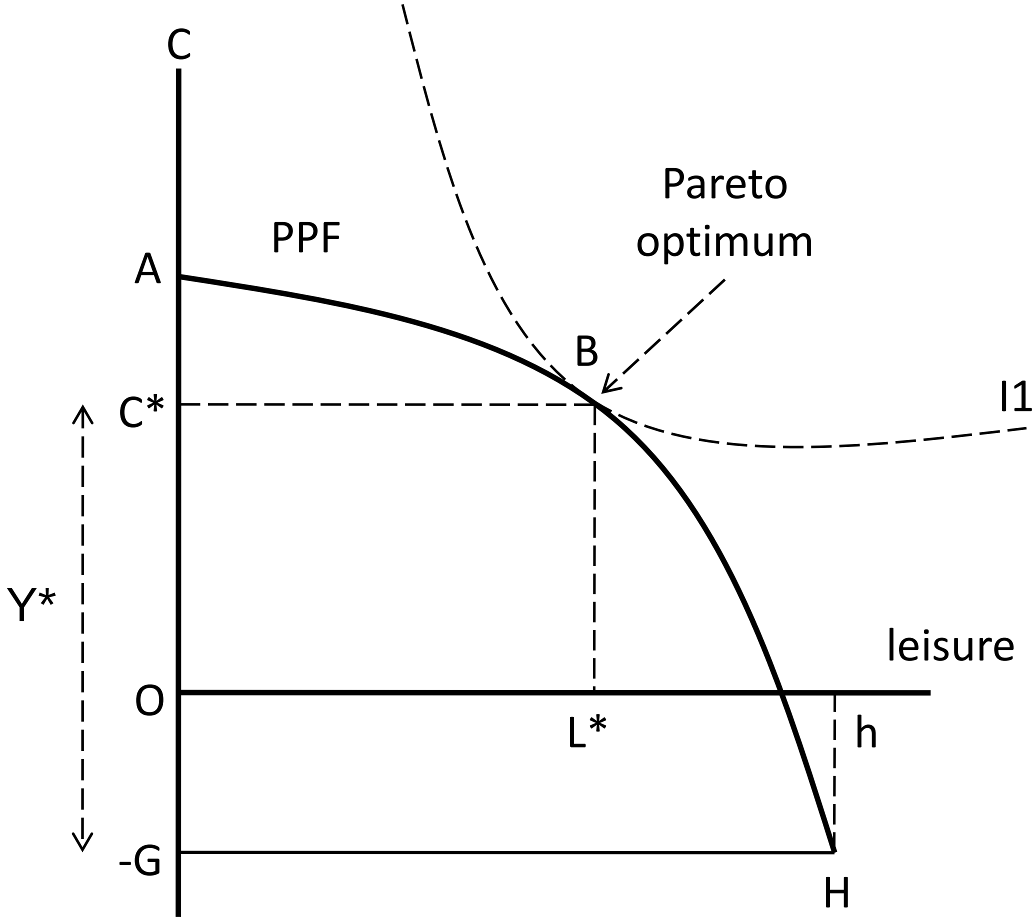
Pareto optimality

- An allocation of C, L (and Y) at which an increase in the utility of one agent **cannot be made without** reducing the utility of another agent.
- The maximum efficiency is achieved at the competitive outcome.

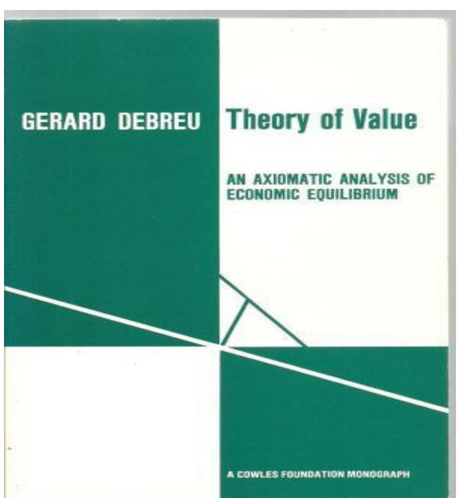
$$MRS_{l,C} = w = MRT_{l,C} = MP_N$$

Pareto optimality in production and consumption

- At B, the IC is tangent to the PPF.
- Highest consumer's utility, given technology.
- **(Benevolent) Social planner's problem**



Fundamental theorems in welfare economics



- Assuming **convex and monotone preferences and technologies**.
- **First welfare theorem**: Under certain conditions, a competitive equilibrium is Pareto optimal.
- **Second welfare theorem**: Under certain conditions, a Pareto optimum is a competitive equilibrium.
  - Public finance and Social choice issue

The invisible hand

- **First welfare theorem**: competition results in a socially efficient outcome.
- **Adam Smith**'s '*the Wealth of Nations*' (1776).
  - A competitive market economy with self-interested consumers and firms could achieve the allocation of resources and goods which is socially efficient.
  - Competition is '*the invisible hand*' which guides individuals to act in the way which benefit both themselves and society.

The price signals

- **Friedrich von Hayek** (1899-1992):
  - Market prices are sufficient signals for both consumers and firms to adjust to **changing scarcity**.
  - No detailed information on production technologies and consumers' preferences is needed.
  - **Consumers**: preferences, market prices.
  - **Firms**: technologies, market prices.

Friedrich von Hayek (1899-1992), Nobel Prize 1974.

Sources of inefficiency

- **Externalities:** all the benefits or costs are not captured by the price of the goods.
  - **Positive externalities**: social benefit > private benefit (e.g., education, innovation, health care).
  - **Negative externalities**: social cost > private cost (e.g., pollution, noise).
- **Distorting taxes,** e.g., proportional income tax (t) on wages:
  - $W(1\text{-}t) = MRS_{l,C} < W = MP_N = MRT_{l,C}$

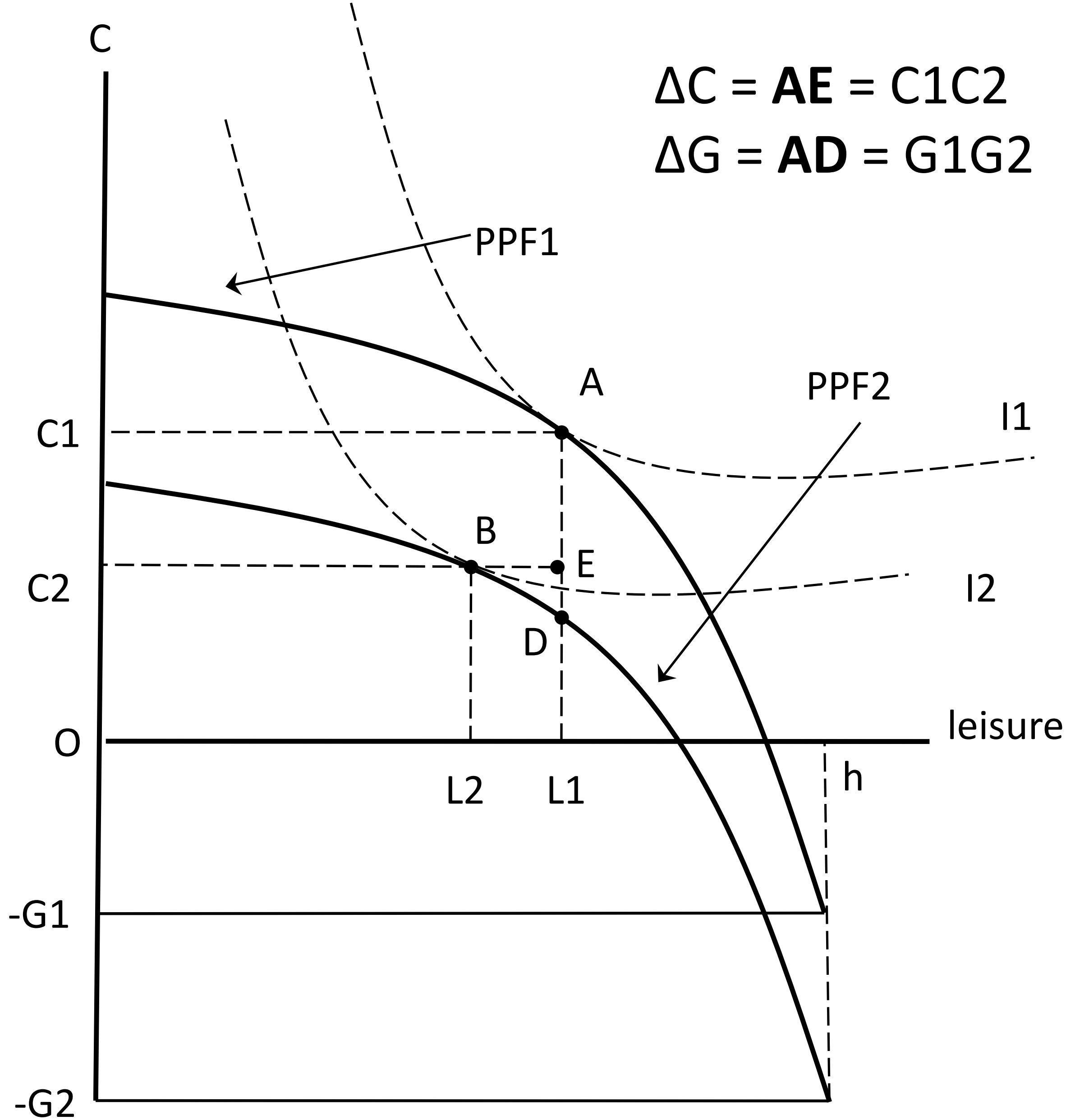
- **Imperfect competition**: firms which are not price-takers.
  - Undersupply of the goods: $P > MR = MC$.
- But government intervention to solve market failure may make the inefficiency worse.
- **The competitive model** is still very powerful.
  - A large number of real-world markets are close to perfect competition.
  - ***Benchmark for analysis of inefficiency and possible private solutions.***

Effects of an increase in G

- A pure neg. income effect (as $G=T$ increases).
- Dividend income (π-T) and disposable income fall.
- Both C and L decrease (normal goods).
- Employment ($N = h-L$) increases.
  - Output $Y = zF(K,N)$ rises.
- But what happens to *private* consumption?

$\Delta C = \mathbf{AE} = C1C2$

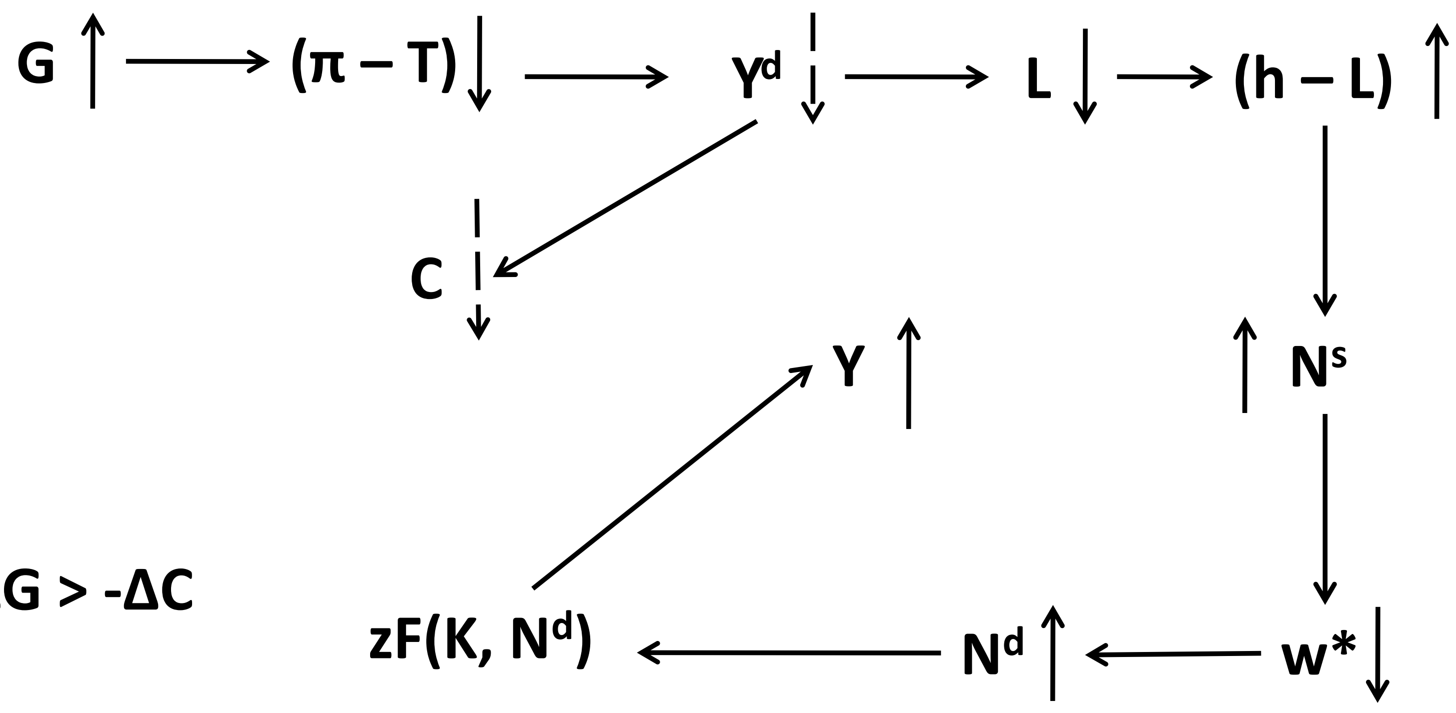
$\Delta G = \mathbf{AD} = G1G2$



- $\Delta G = AD > AE = -\Delta C$.
- C decreases, but does not drop as much as the increase in G.
- Private consumption is partially **crowded out** by the increase in government spending.

- What happens to **the real wage**?
  - The slope of PPF2 at B is less steep than PPF1 at A.
  - So **the real wage fall.**
  - The consumer supplies more labor (N=h-L increases).
  - Given K, more labor input causes MP_N to fall.
  - The firm optimizes by paying lower w = MP_N.
  - The lower real wage (w) induces the firm to raise employment (N).
- The consumer works more, receives a lower real wage and consumes less.

A higher G crowds out C



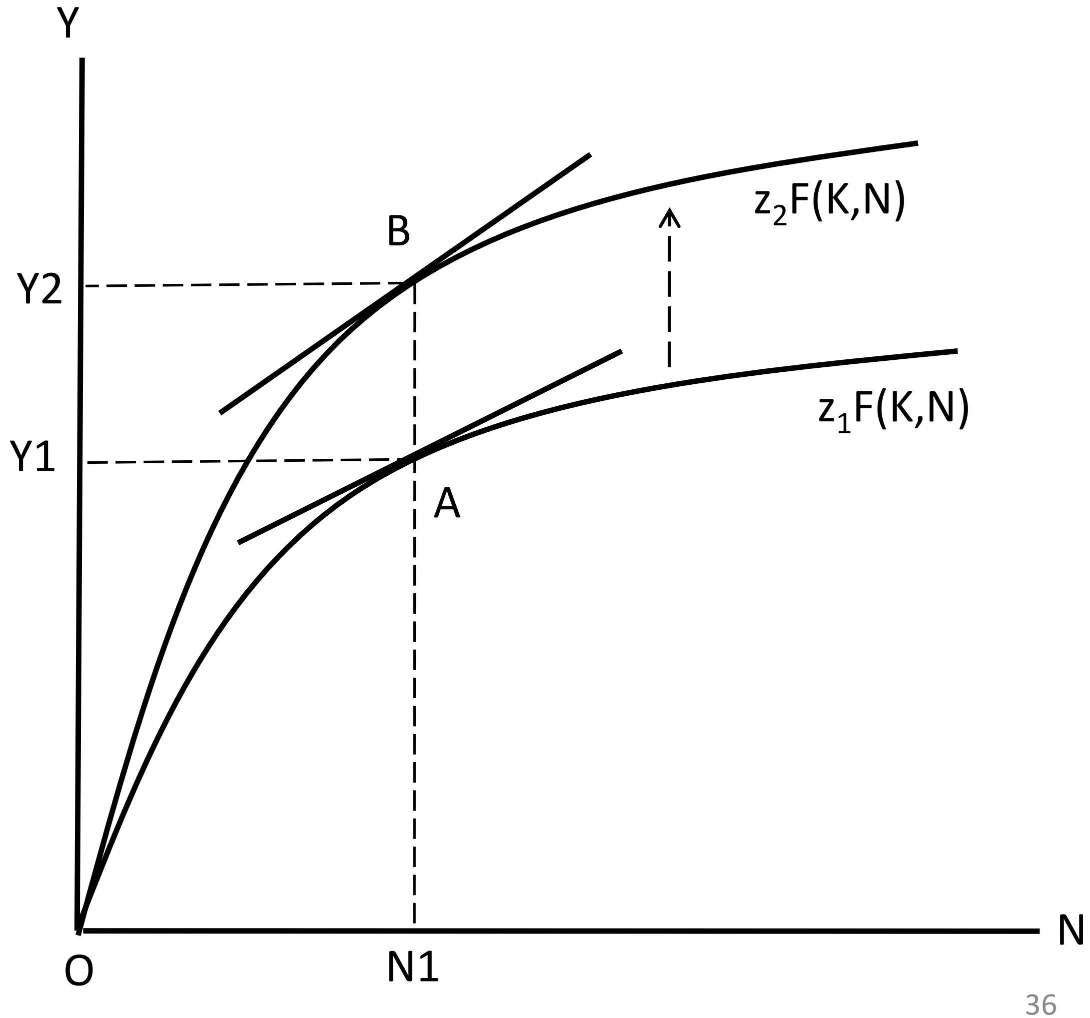
ΔG > -ΔC

Effects of an increase in z

- Increases in z = improved technology or organization.
  - The production function and PPF rotate upwards.
- Higher MP_N, given N with better technology.
  - More demand for labor by the firm.
  - The real wage increases ($MP_N = w$).
  - Employment and leisure ($N=h-L$) may rise or fall.
- Output and consumption increase, given G ($Y\uparrow = C\uparrow + G$); higher social welfare.

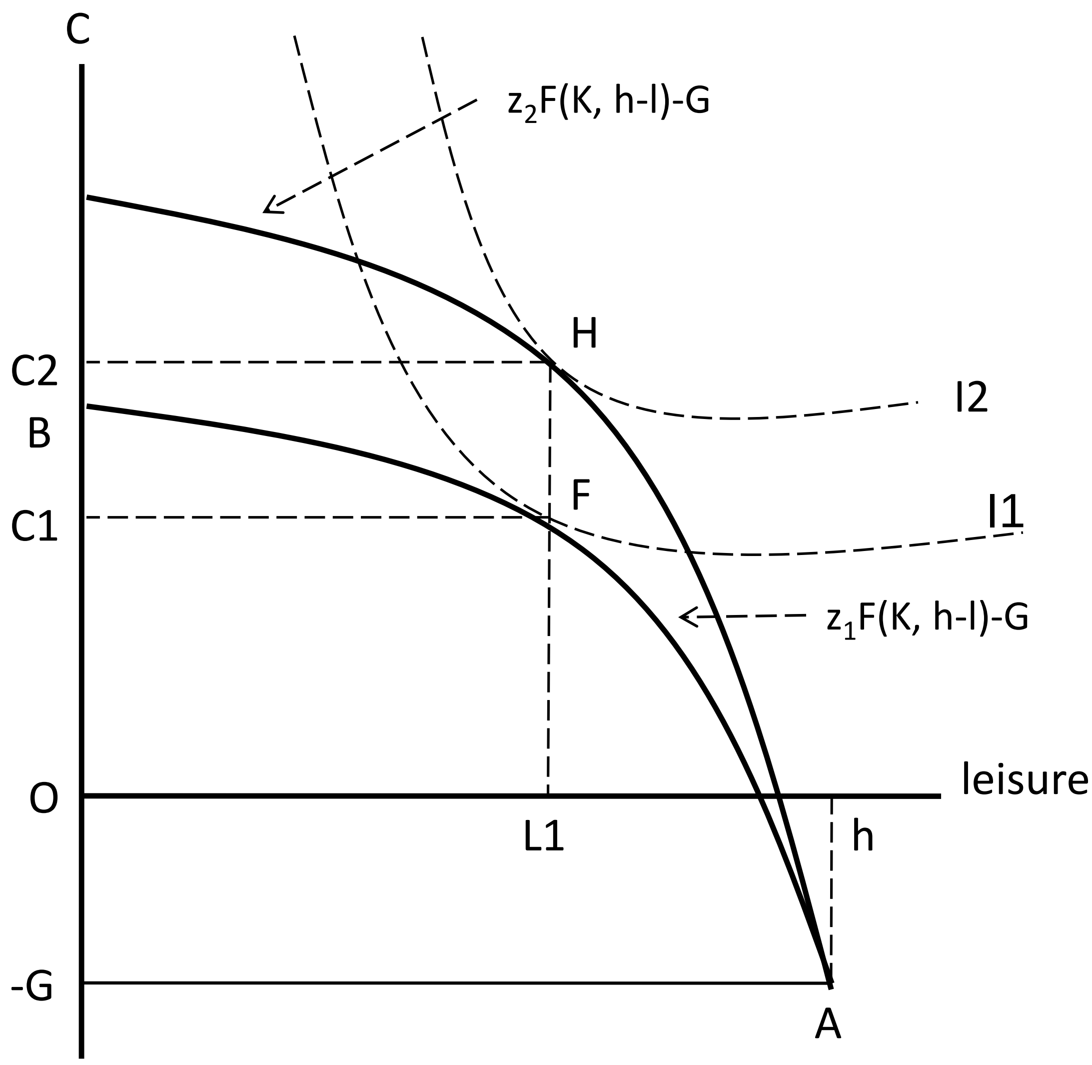
Effect of z on Production function

- The production function rotates upwards with higher MP_N at N1.



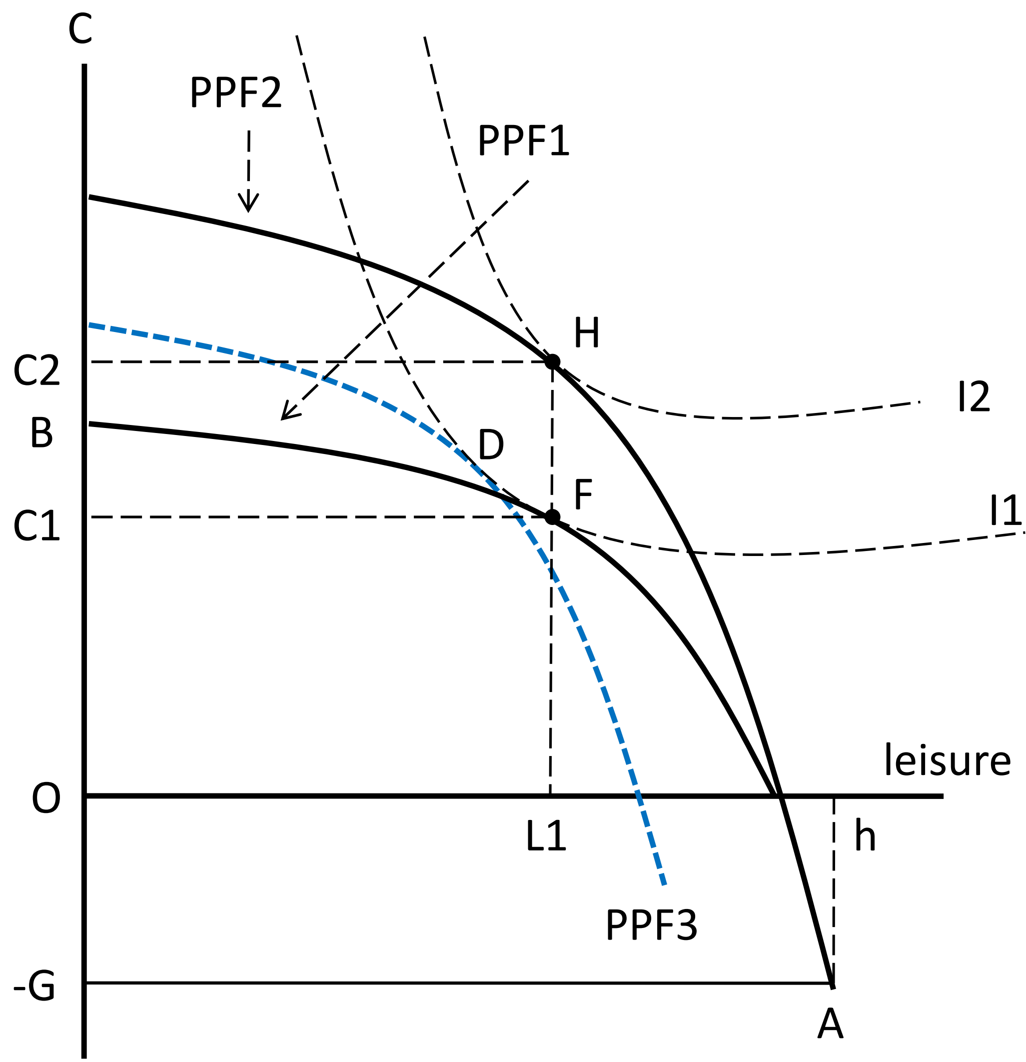
Effects of rising z on PPF

- The PPF rotates upwards.
- C, Y, MP_N and w increase.
- **N and L may rise or fall.**

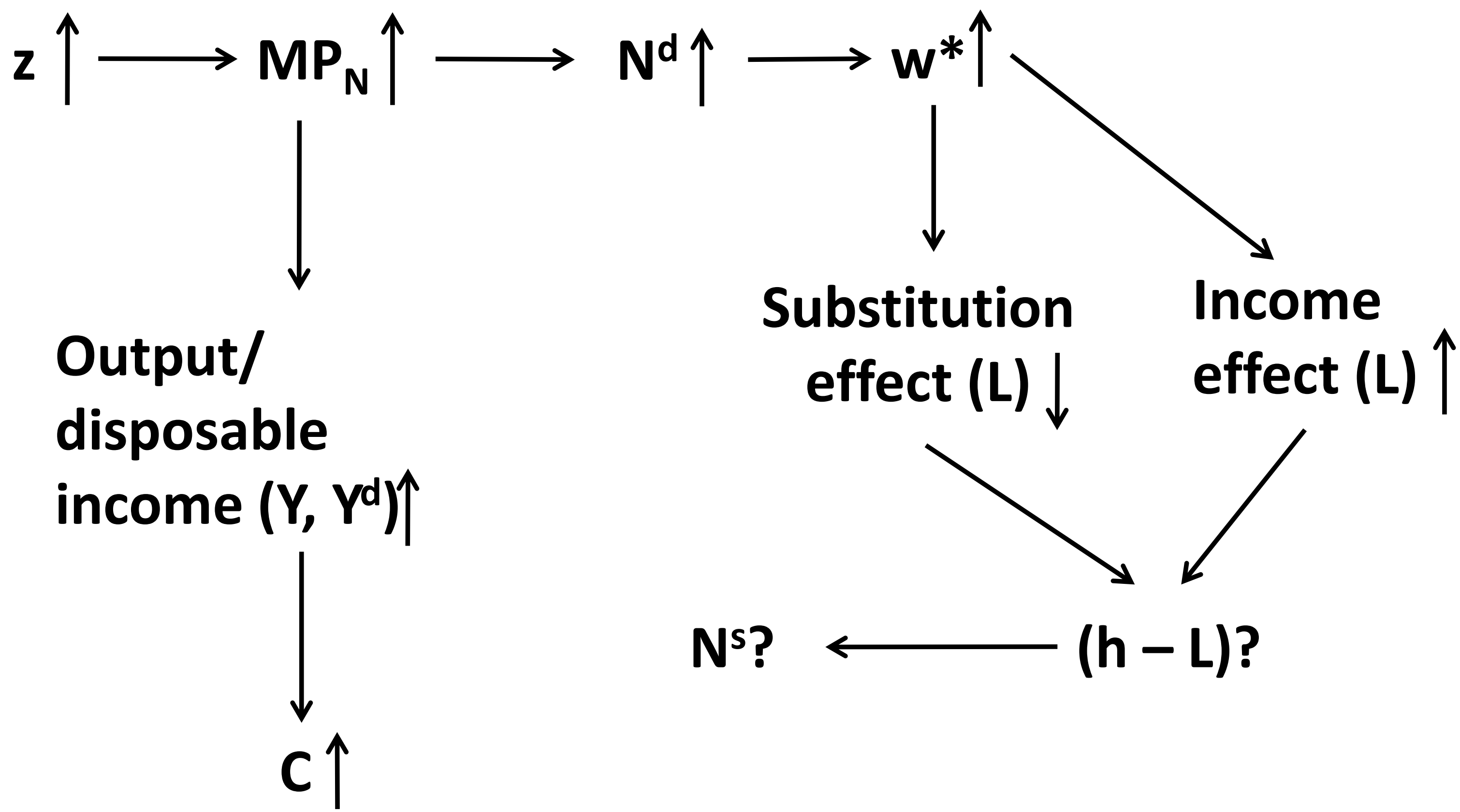


Income and substitution effects

- FD = **substitution effect** (rising C and N, falling L).
- DH = **income effect** (rising C and L).
- **Equal effects**: no change in L and N.

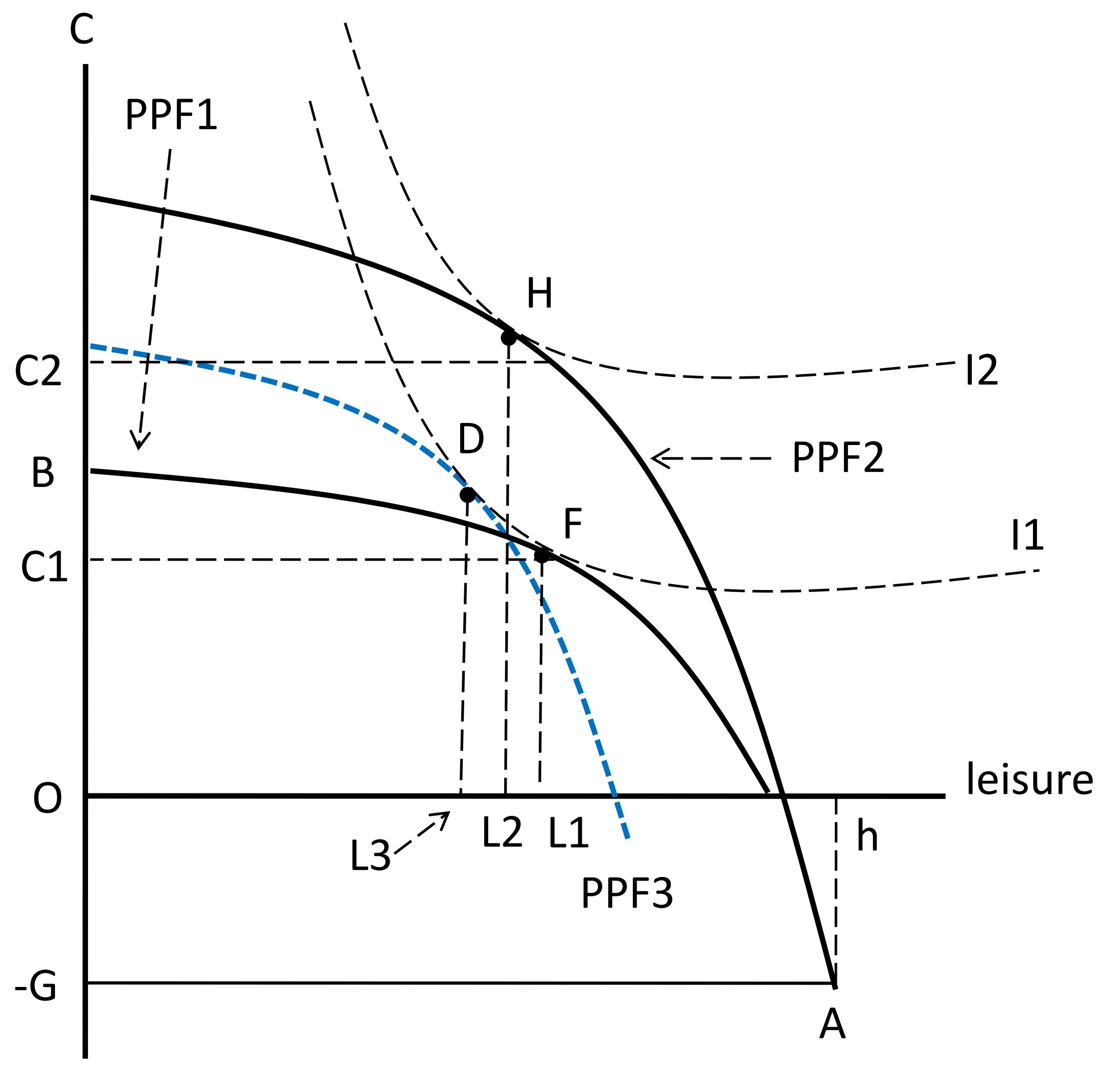


A higher z or K raises w, Y, C

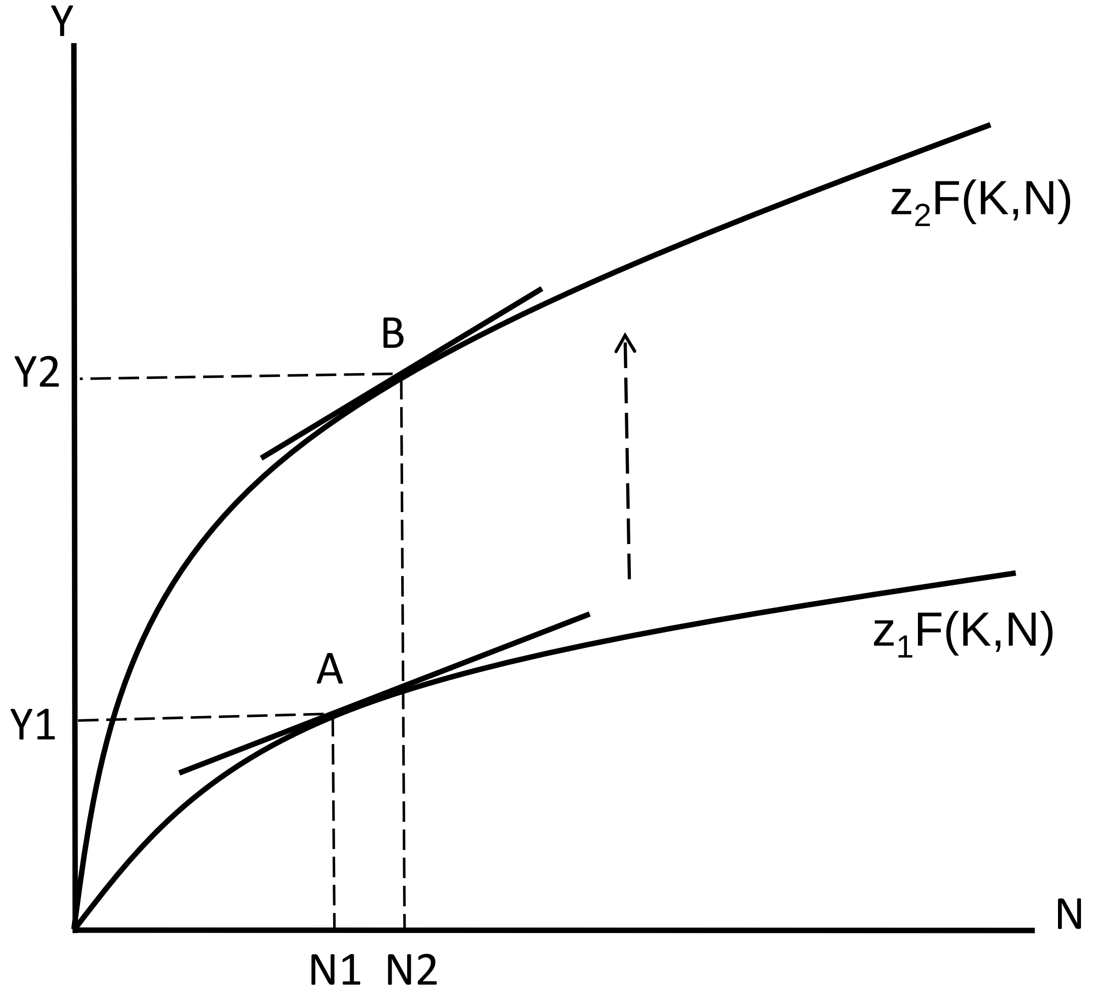


Stronger substitution effect

- FD = substitution effect (rising C, falling L).
- DH = income effect (rising C and L).
- Lower L and larger N.



Strong substitution effect on N



The role of technology in business cycles fluctuations

- Kyaland and presscott (1981) set out an example of technologically-driven business cycles.
- In his work, he claims that the effect of technology can predict most of key cyclical patterns in the data.