

EE312 Macroeconomic Theory

Chapter 4

A Closed-Economy One-Period Macroeconomic Model

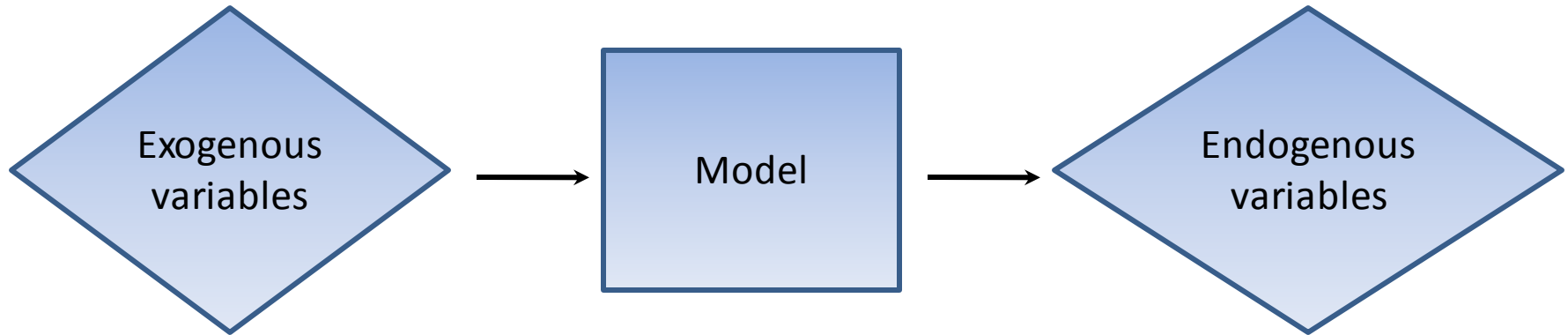
Closed-economy one-period model

- 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

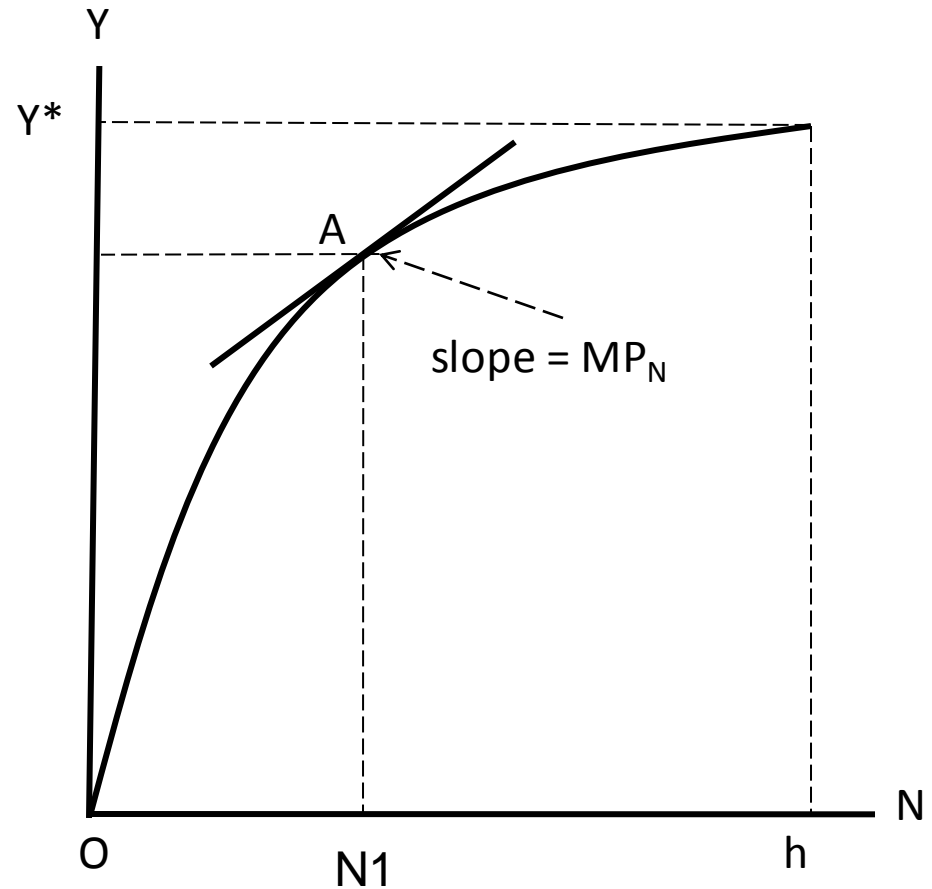
- In equilibrium, $N^d = N^s = N$; and $N = h - L$, therefore:

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

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

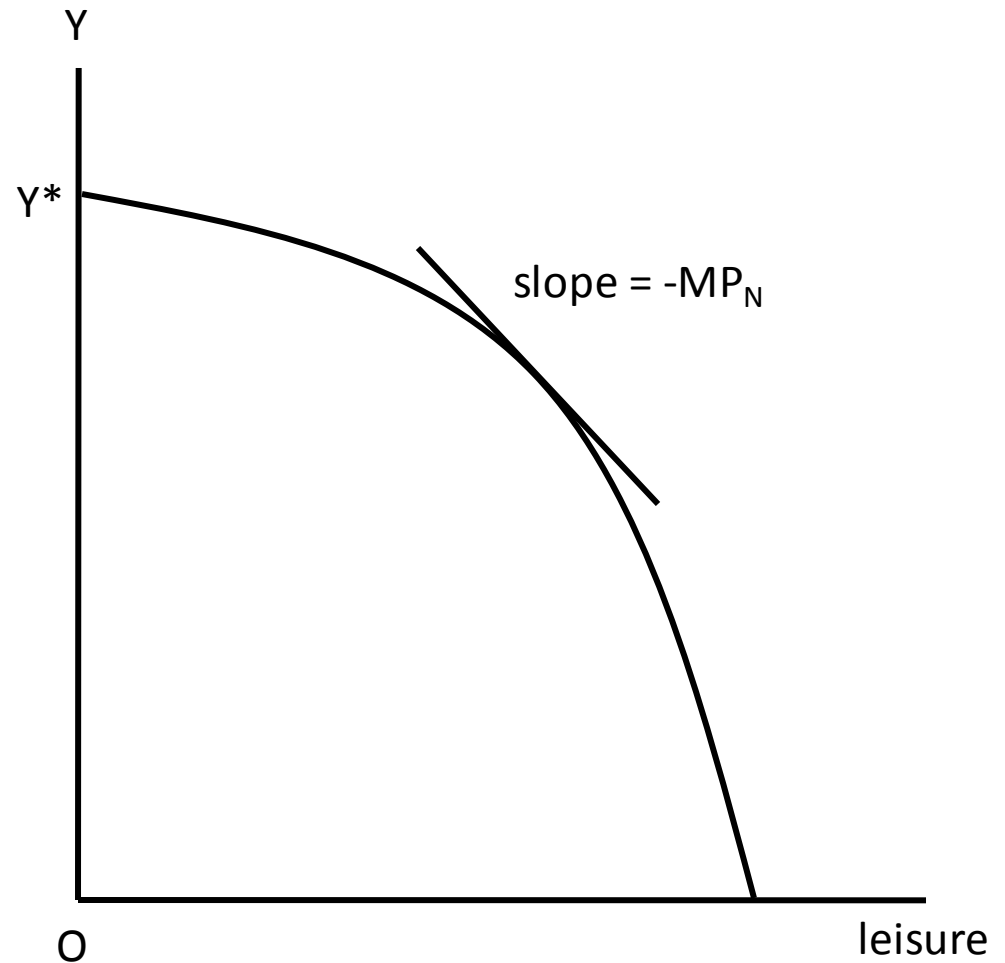
The production function

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



Output as a function of leisure

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



Consumption as a function of leisure

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

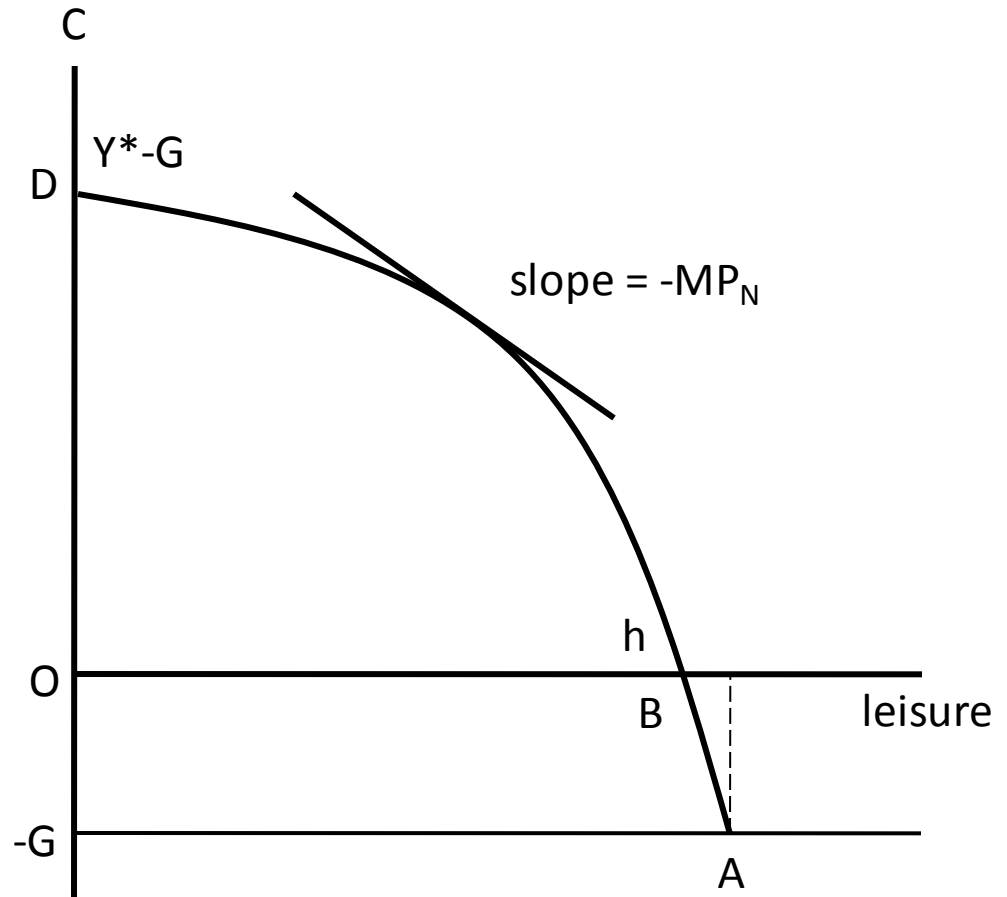
$$\text{as } C = Y - G$$

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

- 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).

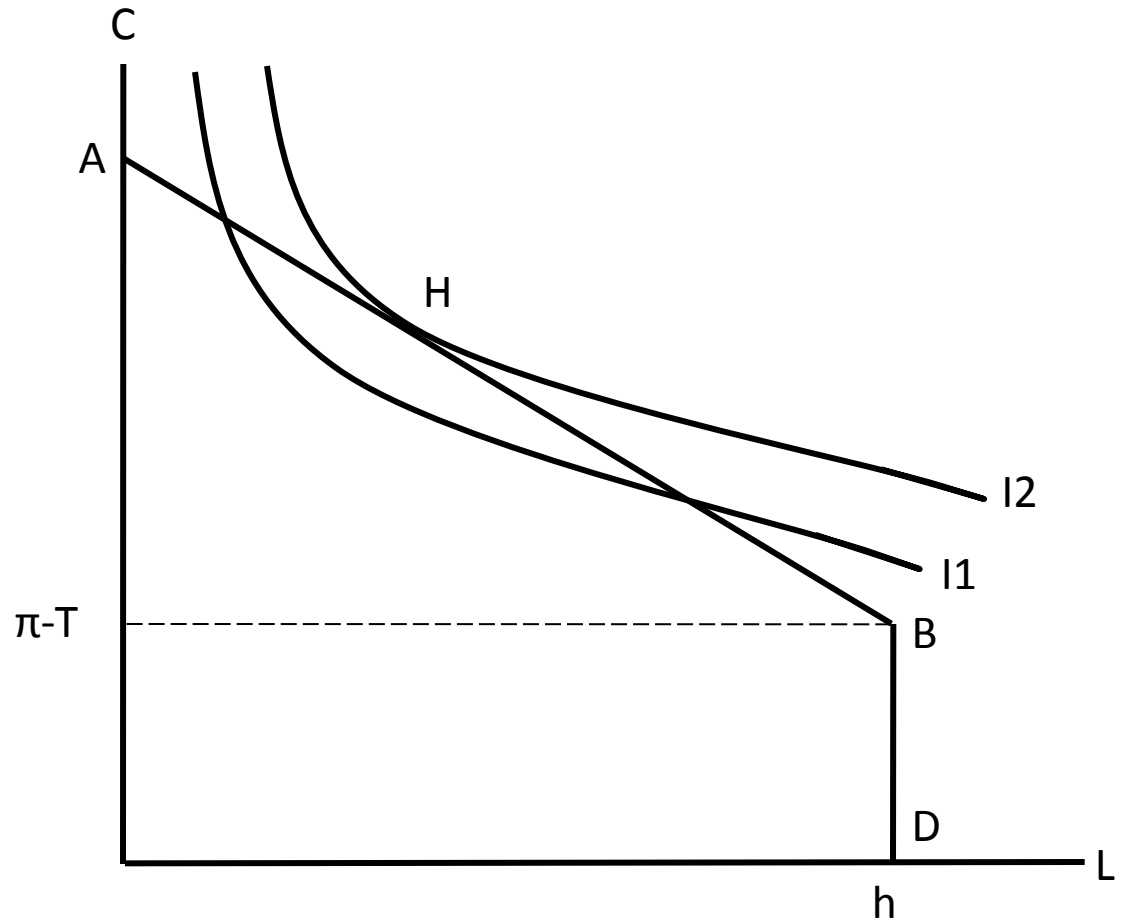


- The slope of PPF is **the marginal rate of transformation** (MRT) of L to C, the rate at which leisure is converted to consumption through work, given technology.

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

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.

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:**
 - **$MP_N = w = MRT_{L,C} = \text{slope of the budget line AD.}$**
 - 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: $\pi^* = zF(K, h-L^*) - w(h-L^*) = DH$
 - $DB = \pi^* - G = \pi^* - T.$

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 = $\pi^* - T = \pi^* - G$ = 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.

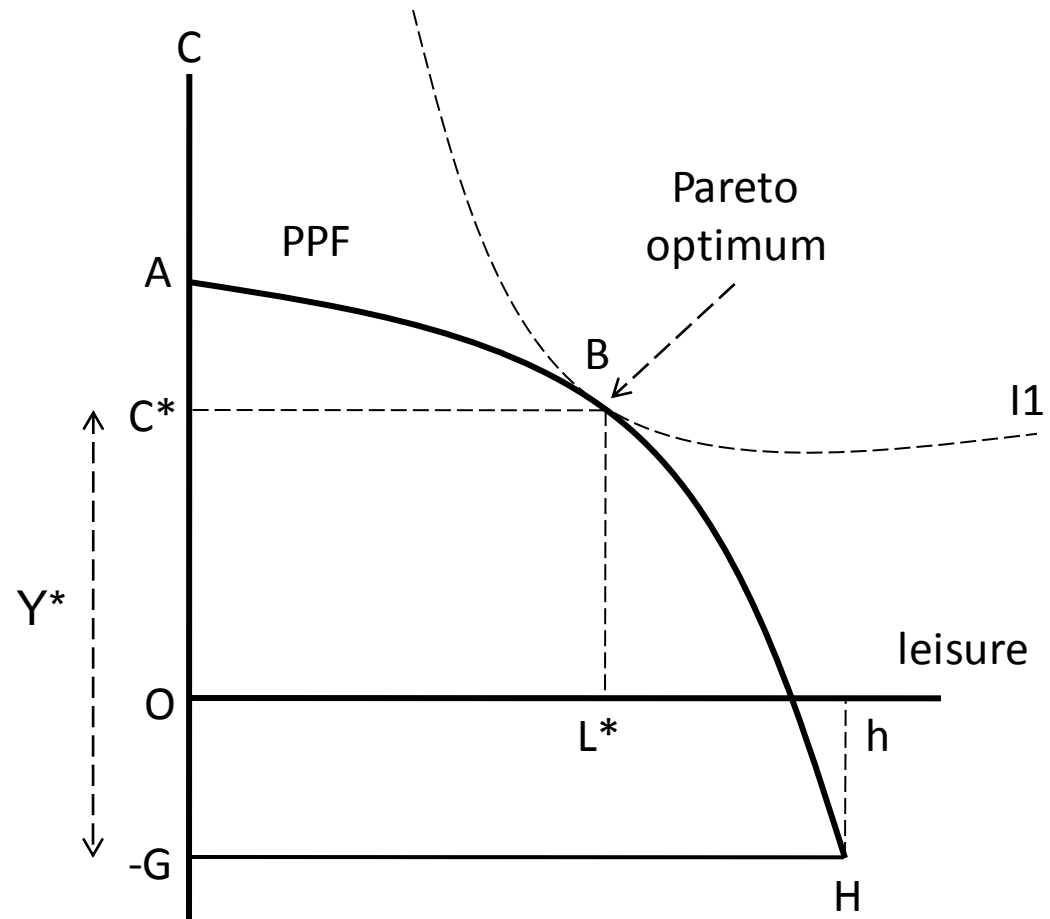
Pareto optimality

- 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.



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.

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

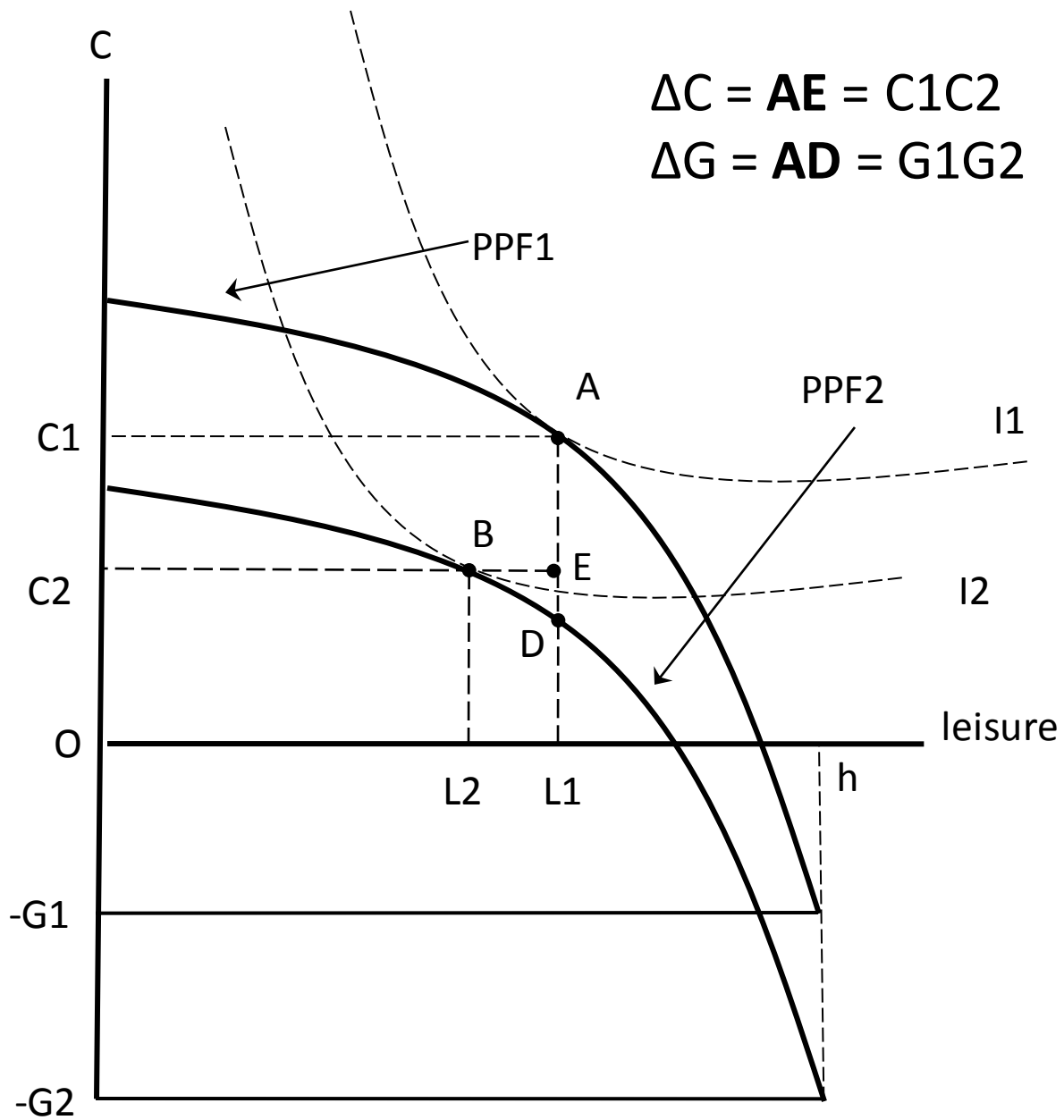
- **Externalities:** all the benefits or costs are not captured by the price of the goods.
 - **Positive externalities:** social benefit > private benefit (e.g., education, innovation, health care).
 - **Negative externalities:** social cost > private cost (e.g., pollution, noise).
- **Distorting taxes,**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

- **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

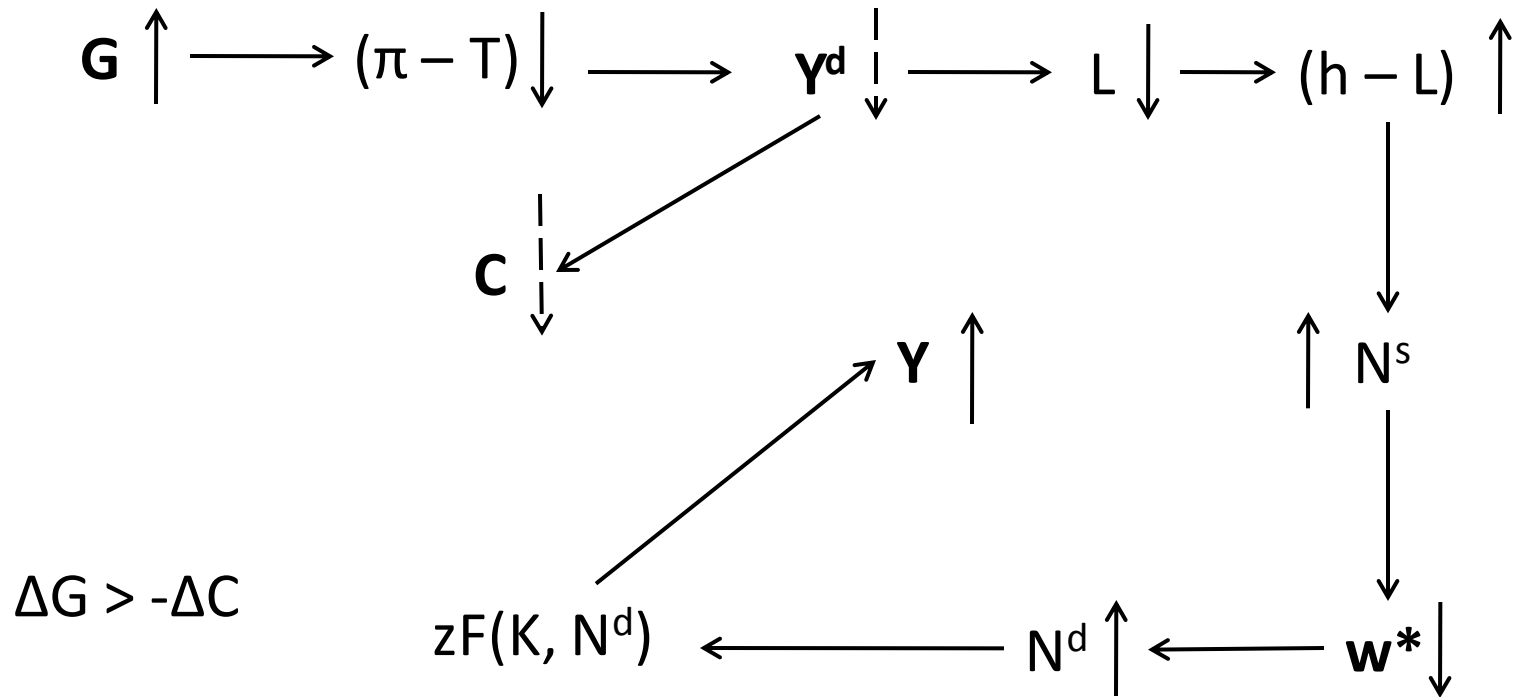
- A pure neg. income effect (as $G=T$ increases).
- Dividend income ($\pi-T$) and disposable income fall.
- Both C and L decrease (normal goods).
- Employment ($N = h-L$) increases.
 - Output $Y = zF(K,N)$ rises.
- But what happens to private consumption?

- $\Delta G = \Delta D > \Delta E = -\Delta C$.
- 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

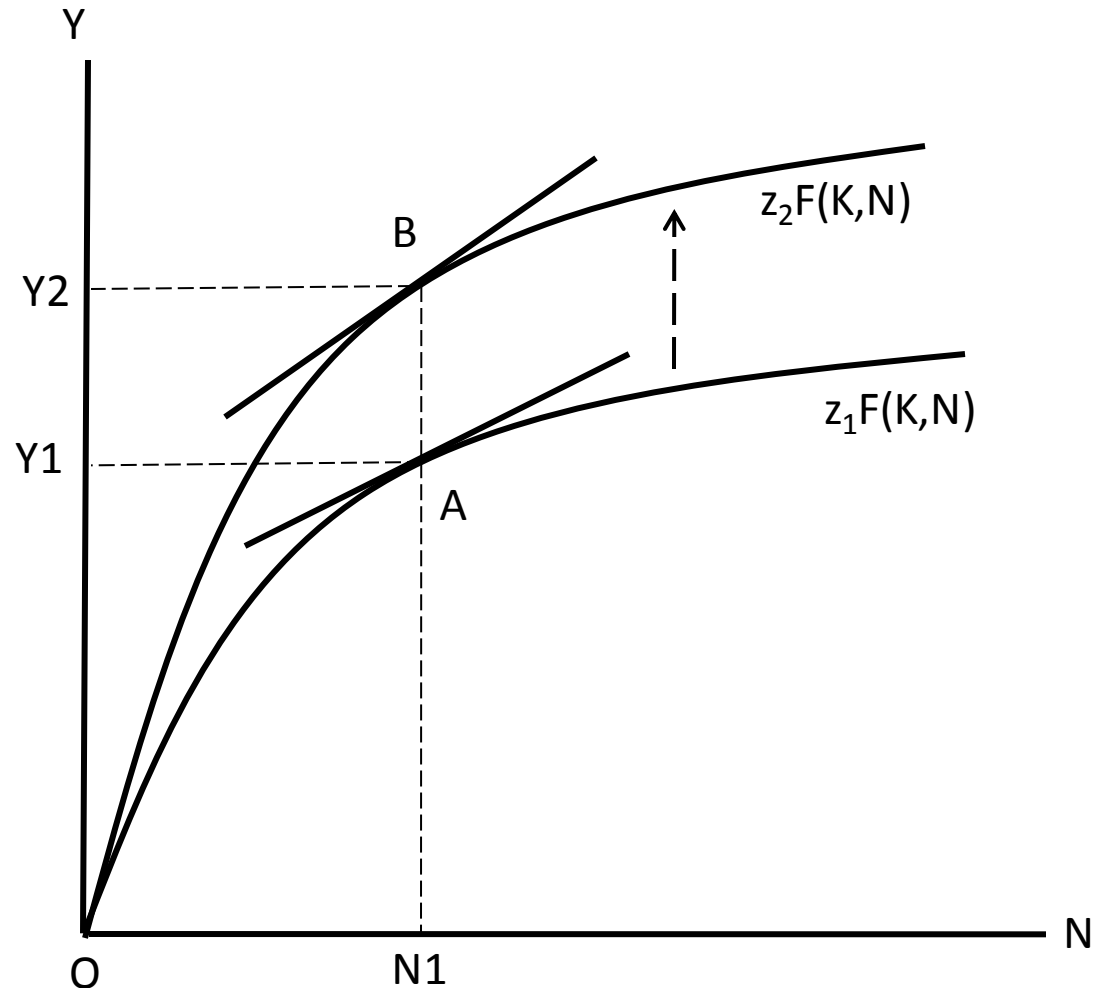


Effects of an increase in z

- 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.

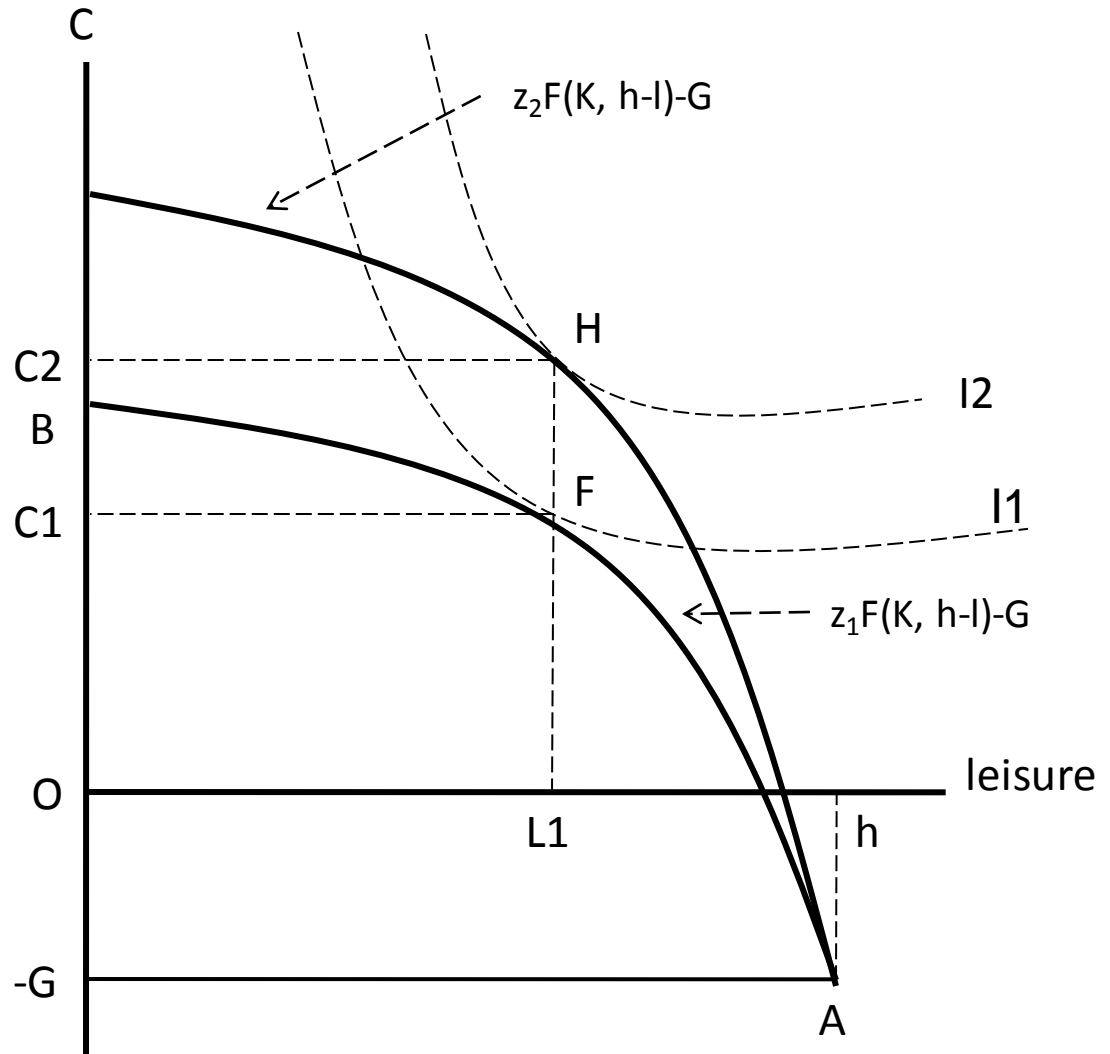
Effect of z on Production function

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

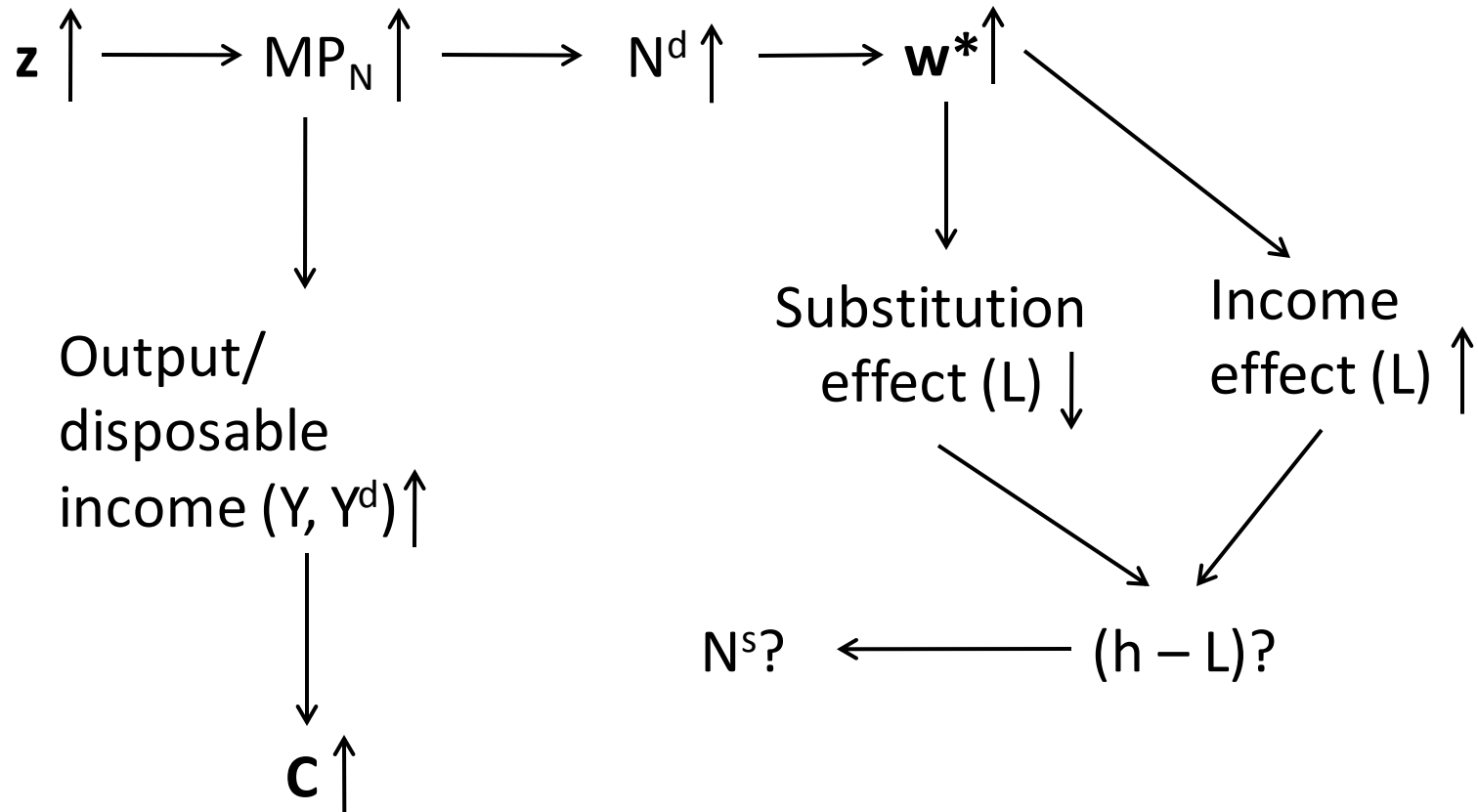


Effects of rising z on PPF

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



A higher z or K raises w , Y , C



Strong substitution effect on N

