Chapter 3 :A Closed Economy One-Period Macroeconomic Model (supplement)

EE312

Macroeconomics, Stephen Wiliamson, Chapter 4,5

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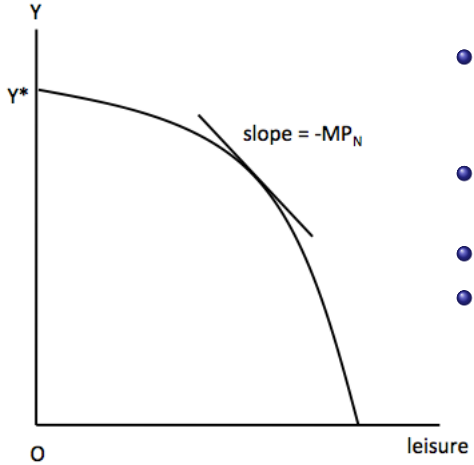
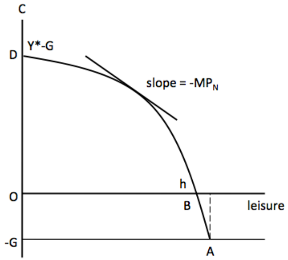
1. PPF (Y, ℓ) : output as a function of leisure



- Y = zF(K, h-ℓ), which is a relationship between output and leisure.
- Y* is the level when ℓ = 0, and it is the maximum output level.
- Y* = zF(K , h)
- The relation between Y and ℓ is a mirror image of the production function with slope = - MP_N.

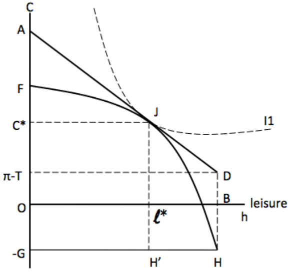
2. PPF(C, ℓ)



- PPF gives the trade-off between consumption and leisure, given technology.
- DB is feasible ($C \geq 0$); 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.

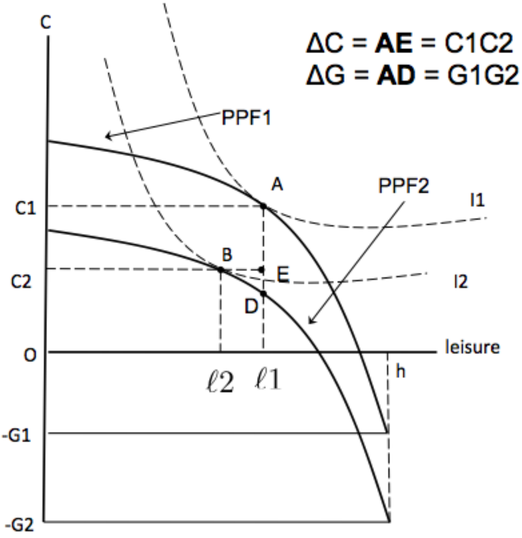
$$MRT_{\ell,C} = MP_N = -\text{slope of PPF}$$

3. Put the PPF (C, ℓ) together with the consumer's indifference curve.



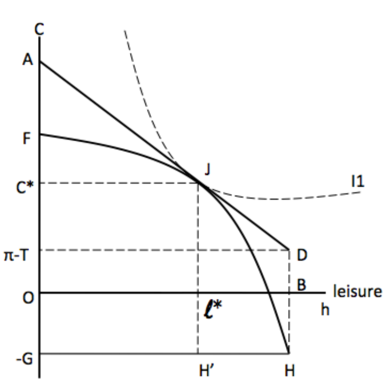
- J is the equilibrium consumption bundle (C^*, ℓ^*) where $MRS_{\ell,C} = w$
- In equilibrium,
$$\begin{aligned} MP_N &= w = MRT_{\ell,C} \\ &= MRS_{\ell,C} \end{aligned}$$
- The firm and the consumer both optimize at J.
- The firm demands labor equal to $h - \ell^*$ and produces $Y* = zF(K, h - \ell)$.
- Max. profit: $\pi^* = zF(K, h - \ell) - w(h - \ell^*) = DH$.
- DB = $\pi^* - G = \pi^* - T$.

- 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.
- C* = consumption goods demanded by the consumer = quantity of consumption goods produced by the firm.
- h-ℓ^* = quantity of labor supplied by the consumer = quantity of labor demanded by the firm;
- ℓ^*= leisure desired by the consumer.

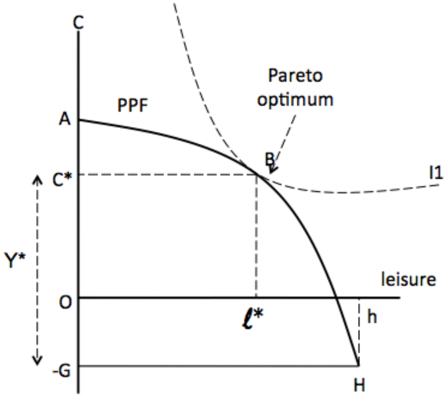

C
ΔC = AE = C1C2
ΔG = AD = G1G2
PPF1
A
PPF2
I1
C1
B
E
C2
I2
D
O
leisure
ℓ2
ℓ1
h
-G1
-G2

4. Competitive Equilibrium VS. Social Planner Problem

Competitive Equilibrium



Social Planner

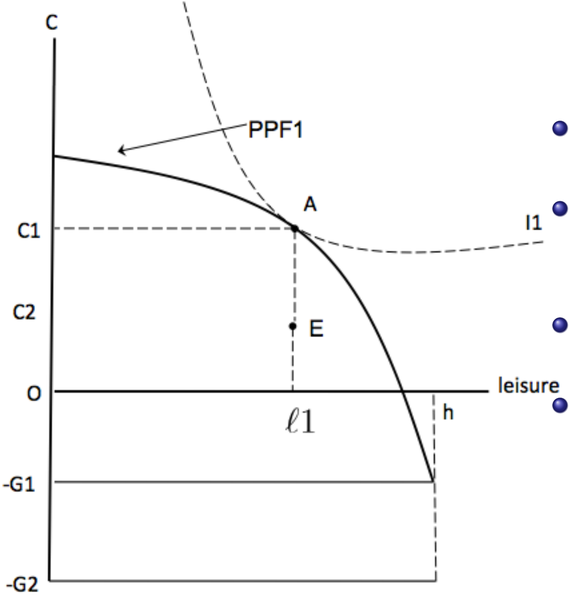


- In equilibrium,
  $$MP_N \;=\; w = MRT_{\ell,C} \;= MRS_{\ell,C}$$
- $\pi^* = zF(K, h-\ell) - w(h-\ell^*) = DH$.
- DB = $\pi^* - G = \pi^* - T$.
- C^* , ℓ^*

- The Pareto optimum is at B where the equality holds
- $MRS_{\ell,C} = MRT_{\ell,C} = MP_N$
- Note that we have the same condition for a competitive equilibrium.

- **The first fundamental theorem of welfare economics** :
- Under certain conditions, a competitive equilibrium is Pareto optimal.
  - Adam Smith's "Indivisible hand": an unrestricted, free market economy can produce socially optimal outcome.
- **The second fundamental theorem of welfare economics**
  - Under certain conditions, a Pareto optimum is a competitive equilibrium.
- Remark: Pareto optimality ignores the distribution issue among individuals and is thus a narrow concept of social optimality.
- One result of the model is the equivalence between competitive equilibrium and the Pareto optimum.
- In the real-world social inefficiencies may arise from many possible sources; for example, externalities, distorting taxes, imperfect competition, imperfect information, etc.

5. Model application : Effects of an increase in G



- Consider an $\uparrow$ in G from G_1 to G_2 .
- Since G = T, G $\uparrow$ must be followed by T $\uparrow$ of the same amount.
- G $\uparrow$, the PPF shifts from PPF_1 to PPF_2.
- This shift leaves the slope of the PPF constant for each ℓ.

- The new Pareto optimum is at point ......
- Thus, G $\uparrow$ leads to a negative .... effect on C and ℓ.
- Two effects

$$
\begin{array}{cccc}
G\uparrow & \Rightarrow & (1)\,Y_d..... & \rightarrow & C..... \\
 & & & & \text{(the distance ....)} \\
 & & (2)\ell....... & \rightarrow & (h-\ell)\,..... \\
 & & & & \downarrow \\
 & & & & Y......\text{and } Y_d = (Y-T)\,..... \\
 & & & & \downarrow \\
 & & & & C..... \\
 & & & & \text{(the distance ....)}
\end{array}
$$

- Total effect is shown by the distance .... $G\uparrow \Rightarrow C.....$
  Private consumption is **crowded out** by government purchases.
  The decrease in C is smaller than the increase in G.

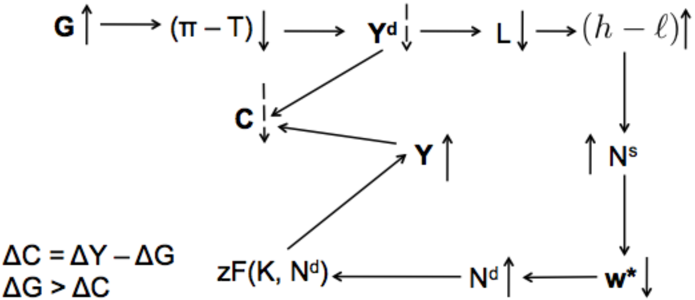
$$
\begin{aligned}
\Delta C &= C1C2 = ... \\
\Delta G &= G1G2 = ... \\
\Delta Y &= Y1Y2 = ...
\end{aligned}
$$

- What happens to the real wage?
  - The slope of PPF_2 at B is .... steep than PPF_1 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).

$$\ell\ldots\ldots \Rightarrow \quad N\ldots\ldots \quad \Rightarrow \quad MP_N\ldots\ldots\ldots \left(\text{Since } \bar{K}.\right) \Rightarrow w\ldots\ldots\ldots$$
$$: w_{new} = \text{slope of } PPF_{\ldots\ldots}\text{at}\ldots$$
$$: w_{original} = \text{slope of } PPF_{\ldots\ldots}\text{at}\ldots$$

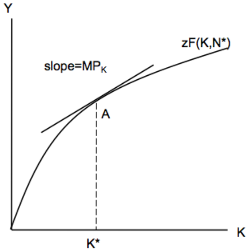
- The consumer works more, receives a lower real wage and consume less.
- Y..... but C...... This means that when government increases its spending, the firm produces more. The government takes a .... share of total output while the consumer takes a .... share of total output.
- In sum, The consumer's utility .... as the governmet expenditure increases.

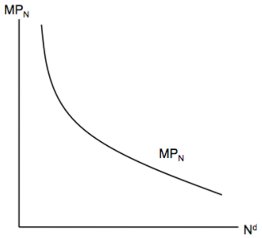
- Chained effect : an increase in G

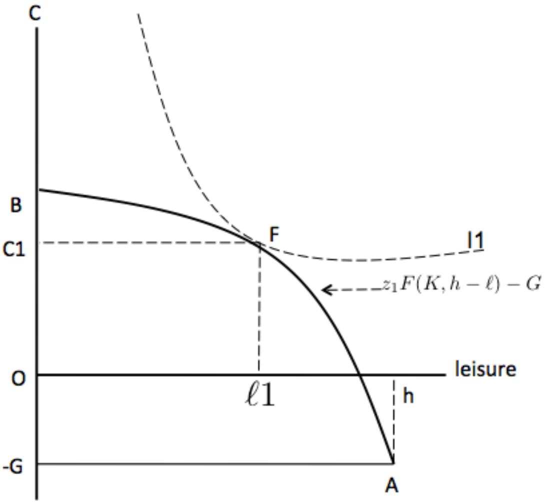


6. Application : (2) Effects of an increase in z (or K)

- Increases in z = better technology or organization.
- The production function rotates upwards with higher MP_N, given N.
- Not only more Y can be produced given N, but the MP_N i.e. the slope of the production function also increases for each N.



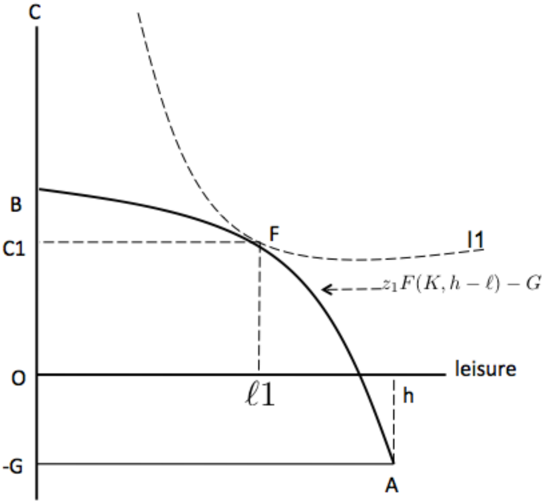




- The PPF rotates upwards.
- The new PPF is steeper than the original one.
- The PPF rotates upwards.
- MP_N..... for all N , ℓ

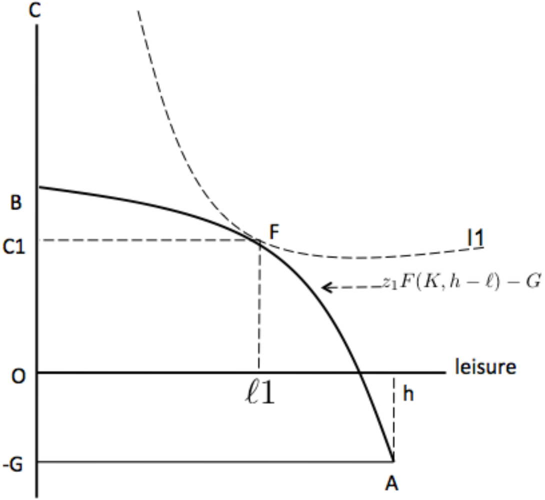
- Production function is steeper for all N , $\ell \rightarrow MP_N$ **......** for all N , ℓ
  This means that wage **......** for all N , ℓ
- **substitution effect and income effect**
  substitution effect : ℓ **......** and C........
  leisure is **..........** costly.
  income effect : ℓ **......** and C........
  higher wage implies higher income.
- C.................. (for sure)
- ℓ **..................**
  - substitution effect is equal to income effect, ℓ ....
  - substitution effect is greater than income effect, ℓ ....
  - substitution effect is less than income effect, ℓ ....

Equal Effect



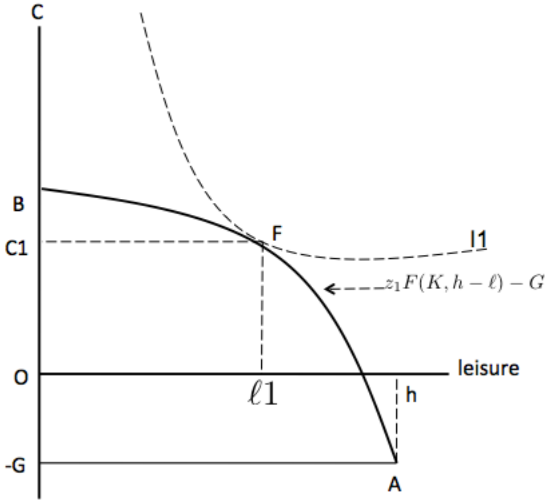
- .... = substitution effect (rising C and N, falling ℓ).
- .... = income effect (rising C and ℓ).
- Equal effects: ℓ .... and N..........
- Wage ....

Stronger Substitution Effect



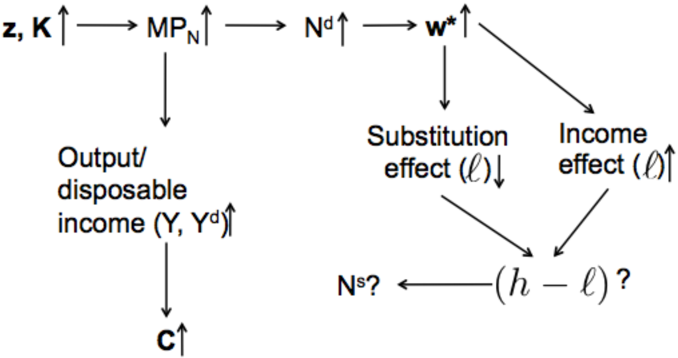
- .... = substitution effect (rising C and N, falling ℓ).
- .... = income effect (rising C and ℓ).
- Stronger substitution effects: ℓ .... and N..........
- Wage ....

Stronger Income Effect



- .... = substitution effect (rising C and N, falling ℓ).
- .... = income effect (rising C and ℓ).
- Stronger income effects: ℓ .... and N..........

- **Chained Effect : an increase in total factor productivity**



If SE = IE, N^s ....
If SE > IE, N^s ....
If SE < IE, N^s ....