Chapter 3 :A Closed Economy One-Period Macroeconomic Model (Part 1. Consumer and Firm Behavior)

EE312

Macroeconomics, Stephen Wiliamson, Chapter 4,5

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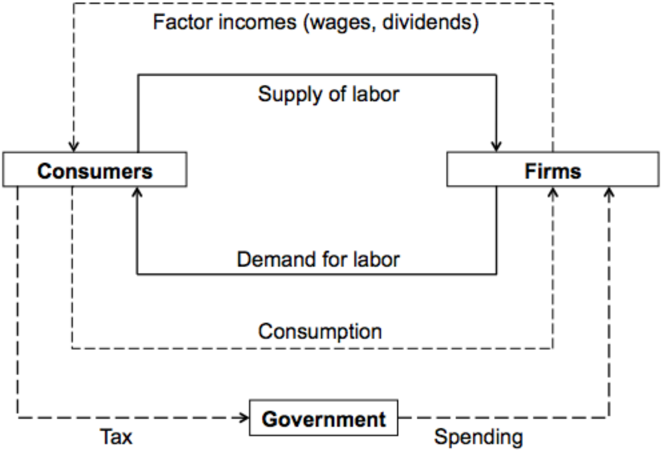
Outline

1. One-period decisions (Part 1)
2. Consumer: work-leisure decision and labor supply (Part 1)
3. Firm: profit maximization and labor demand (Part 1)
4. Government sector (Part 2)
5. Competitive equilibrium and Pareto optimality (Part 2)
6. Model application: Changes in government spending and total factor productivity (Part 2)

1. One-period decisions

- Optimization by consumers and firms.
- One period decisions; static analysis:
  - Consumers: consumption demand and labor supply.
  - Firms: supply of goods and demand for labor.
  - No investment, no saving.
- Government collects taxes and spends (G = T).
- No foreign trade; a barter economy.
- The foundation of all macro analysis.

- Circular flow



2.1. Representative Consumer

- Preference over consumption and leisure represented by indifference curves.
- A budget constraint of wage and non-wage incomes.
- Combination of consumption and leisure which maximizes utility, given the budget constraint.
- Effects of an increase in non-wage income and the real wage rate.

2.2. The utility function

$$U = U(C, \ell),$$

where U = the utility function;
C= amount of consumption;
ℓ = amount of leisure

$U = U(C1, \ell 1)$.

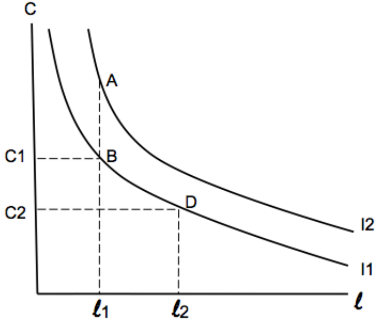
= level of utility derived from the consumption bundle of C1 and $\ell 1$.
[consumption bundle $(C1, \ell 1)$ is strictly preferred to consumption bundle $(C2, \ell 2)$ if $U(C1, \ell 1) > U(C2, \ell 2)$.
consumption bundle $(C2, \ell 2)$ is strictly preferred to consumption bundle $(C1, \ell 1)$ if $U(C2, \ell 2) > U(C1, \ell 1)$. and the consumer is indifferent between the two consumption bundles if $U(C1, \ell 1) = U(C2, \ell 2)$.]

2.2.1 Properties of consumer preference

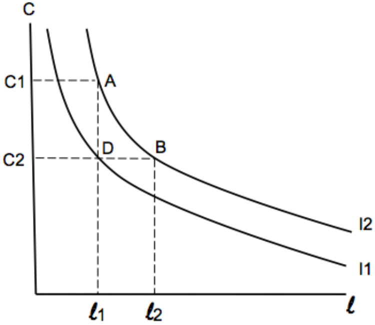
- **‘More is preferred to less.**’
  - If $U(C2, \ell 2) > U(C1, \ell 1)$, then consumption bundle $(C2, \ell 2)$ is strictly preferred to consumption bundle $(C1, \ell 1)$.
- ‘**The consumer has preference for diversity in his/her consumption bundle.’**
  - $(C2, \ell 1)$ is preferred to $(C3, 0)$
- **‘Consumption and leisure are normal goods’.**
  - The consumer will demand more as income increases.

2.2.2 The indifference curves

- The indifference curve (IC) gives different bundles of the two goods which the consumer is indifferent (equal utility).
  - (1) ‘More is preferred to less.’: ICs slope downwards.
  - (2) ‘Preference for diversity’: ICs are convex towards the origin.
- The indifference map: a set of ICs for the representative consumer.



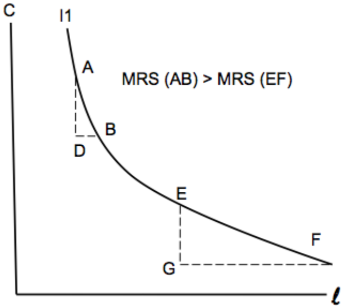
- A is strictly preferred to B.
- The consumer is indifferent between B and D.



(1) "More is preferred to less"

- If C1 (at A) drops to C2 with the same ℓ1, the consumer is on a lower I1.
- To get the initial I2 (with the same C2, raise ℓ1 to ℓ2 (at B).
- Same C, more ℓ is preferred.
- Same ℓ, more C is preferred.

- ***Marginal rate of substitution (MRS)***
  - The marginal rate of substitution of leisure for consumption ($MRS_{\ell,C}$) is the rate at which the consumer is willing to substitute leisure for consumption goods.
  - The slope of the IC passing through a given (C, ℓ).
  - Willingness to sacrifice given consumption for more leisure.
  - $MRS_{\ell,C}$ is decreasing as the consumer moves from consumption to more leisure.



(2) "Preference for diversity"

- From A to B, a small amount of L (BD) is needed for a given sacrifice (AD) of C to make the consumer indifferent.
- From E to F, larger leisure (FG) is needed for the same (EG=AD) amount of consumption.

2.3. Consumer's budget constraint

- The consumer is subject to competition.
  - The consumer is a price-taker.
  - The market prices are given.
  - Individual action has no influence on the market price.
- The consumer allocates time between leisure and work.
  - He/She receives wages from work and non-wage incomes from non-labor services.

2.3.1 The consumer's time constraint

h = hours of time available;

ℓ= time allotted to leisure;

N^S= time spent working (labor supply)

$$\ell + h = N^s$$

2.3.2 Real disposable income

$$Y^d = WN^S + \pi - T$$

- The real disposable income is the sum of wage and dividend incomes minus taxes.
  - Y^d = Disposable Income
  - W= the real wage in the units of consumption goods;
  - π= real dividend income (profits) in the unit of consumption goods received from the firm;
  - T = a lump-sum tax.

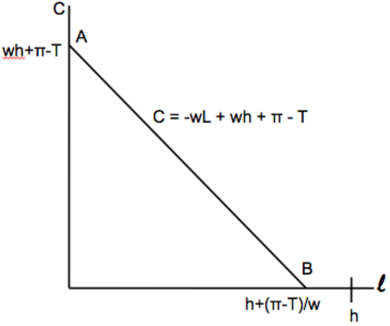
2.3.3 The consumer's budget constraint

- The consumer's disposable income is spent on consumption goods.
- Disposable income (Y^d) = consumption expenditure (C);

$$\begin{aligned} C &= wN^S + \pi - T \\ C &= w(h - \ell) + \pi - T \end{aligned}$$

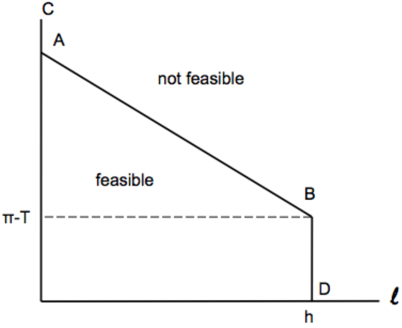
$$
\begin{aligned}
C &= w(h-\ell)+\pi-T \\
C &= -w\ell+wh+\pi-T \\
C+w\ell &= wh+\pi-T
\end{aligned}
$$

- The implicit real disposable income ($wh+\pi-T$) is split into expenditures on consumption goods and leisure ($C+w\ell$).
- W = the market price of leisure.
- The slope = – w; the intercept = ($wh+\pi-T$)



(1) The budget constraint ($T > \pi$)

- AB = the budget line.
- The vertical intercept is ℓ = 0;
- The horizontal intercept is T = 0. Slope = -w

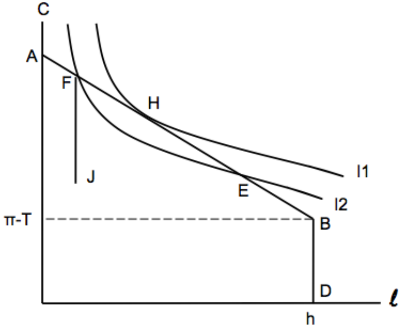


(2) **The budget constraint ($T < \pi$)**

- The budget line is kinked at B.
- Along BD, works = 0;
- $\ell = h$, and $C \leq \pi - T > 0$.

2.4 Consumer optimization

- The consumer is rational.
  - Knowledge of his/her own preferences and budget constraint.
  - Combination of consumption and leisure (consumption bundle) which maximizes utility.
- The consumer chooses the consumption bundle that is on his/her highest indifference curve subject to his/her budget constraint.



- H = optimal consumption bundle;
- E and F are feasible but not optimal.

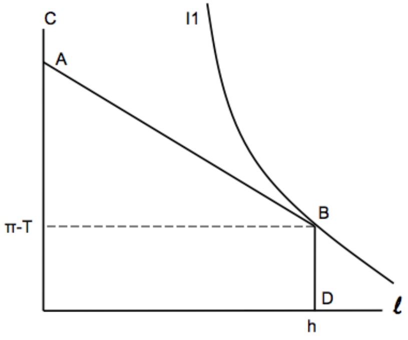
(J lies inside the budget constraint. Point F is clearly preferred by consumer to J.)

- Optimization condition
  - The rate of marginal substitution of leisure for consumption is equal to the real wage.
  - The real wage is the relative price of leisure in terms of consumption goods.

$$MRS_{\ell,C} = w$$

Marginal Rate of Substitution of leisure for consumption	=	the real wage

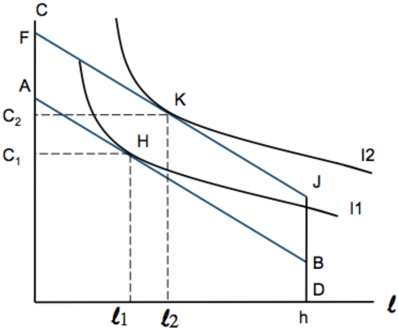
- Corner solution



- The consumer chooses not to work at B.
- $\ell = h$
- This is a situation that cannot happen, taking into account consistency the actions of the consumer and of firms.
- "A rentier is a person or entity that receives income derived from economic rents, which can include income from patents, copyrights, brand loyalty, real estate ..."

- Corner solution: impossible
  - The consumer may choose not to work and consume only leisure.
  - Impossible solution:
    - No labor service to the firm, no incomes.
    - No production by the firm, no consumption goods.
    - The consumer's preference for diversity.
  - Real life? Consumers do not repeat their mistakes.

- Changes in dividends or taxes
  - Assuming consumption and leisure are both normal goods.
  - An increase in dividends or a decrease in taxes ($\pi - T$)
  - causes the consumer to increase both consumption and leisure (and to reduce the quantity of labor supply).
  - The pure income effect.



An increase in $\pi - \text{T}$

- An increase in $\pi - \text{T}$ (by JB) causes the consumer to increase both C and L.

- A higher $\pi-$T raises C and ℓ

$$
\begin{array}{ccccccc}
\pi\uparrow & & & & & & C\uparrow \\
& \searrow & & & & \nearrow & \\
& & (\pi-T)\uparrow & \rightarrow & Y^d\uparrow & & \\
& \nearrow & & & & \searrow & \\
T\downarrow & & & & & & \ell\uparrow \\
& & & & & & \downarrow \\
& & & & N^s\downarrow & \leftarrow & (h-\ell)\downarrow
\end{array}
$$

An increase in the market real wage

- **Substitution effect**: an increase in the real wage (the price of leisure) causes the consumer to substitute consumption for leisure.
- **Income effect**: the consumer's income increases, causing both consumption and leisure to increase.
- Consumption increases, but leisure may rise or fall.

A higher wage raises C

$$
w \uparrow \quad
\begin{array}{l}
\nearrow \quad \begin{array}{c} \text{income effect} = C \uparrow \\ \text{substitution effect} = C \uparrow \end{array} \quad \Rightarrow \quad C \uparrow \\[2em]
\searrow \quad \begin{array}{c} \text{income effect} = \ell \uparrow \\ \text{substitution effect} = \ell \downarrow \end{array} \quad \Rightarrow \quad \ell ?
\end{array}
$$

$$
w \uparrow \quad
\begin{array}{l}
\nearrow \quad
\begin{array}{ccc}
\text{income effect=}\ell \uparrow & < \Rightarrow & \ell..... \\
\text{substitution effect =}\ell \downarrow & \Rightarrow & (h-\ell)..... \\
\text{[Stronger Substitution Effect]} & \Rightarrow & N^s......
\end{array} \\
\searrow \quad
\begin{array}{ccc}
\text{income effect = }\ell \uparrow & > \Rightarrow & \ell..... \\
\text{substitution effect = }\ell \downarrow & \Rightarrow & (h-\ell)..... \\
\text{[Stronger Income Effect]} & \Rightarrow & N^s......
\end{array}
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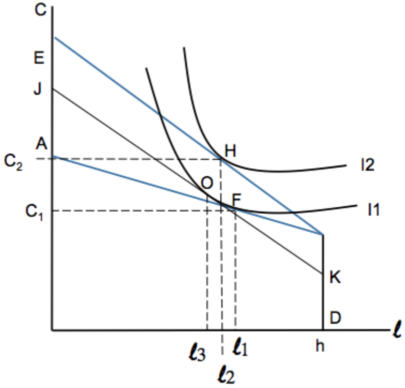
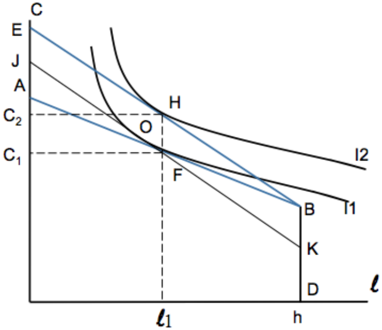


Stronger substitution effect

- Substitution effect = FO.
- Income effect = OH.
- FO > OH, C increases and ℓ decreases.
- So N increases.



Equal effect

- Substitution effect = FO.
- Income effect = OH.
- FO = OH, C increases; but ℓ (and N) is the same.

2.5 The labor supply function

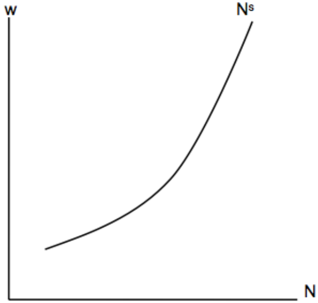
- $\ell(w)$ is a function that tells us how much leisure the consumer wishes to consume, given the real wage rates.
- Then, the labor supply curve is given by

$$\begin{aligned} N^S(w) &= h - \ell(w) \\ \frac{\partial N^S}{\partial w} &> 0 \end{aligned}$$

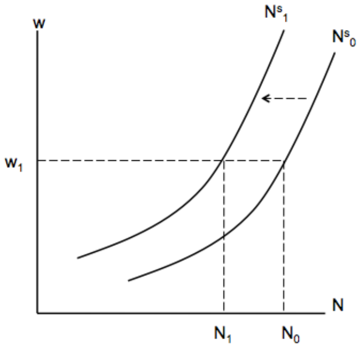
- $N^S =$ the labor supply function
- h = the maximum hours avaiable
- $\ell(w)$ = the leisure function, given the real wage. Assuming the stronger substitution effect.

[We typically assumes that the substitution effect of an increase in real wage dominates the income effect, so that the labor supply curve is upward-sloping.]

The labor supply curve



- The quantity of labor supply is a positive function of the real wage.
- Assuming the stronger substitution effect.



Effect of an increase in $(\pi - T)$.

- A rise in $(\pi - T)$ causes the consumer to reduce labor supply, given the real wage (positive income effect).

3.1. Representative firm

- The firm demands labor and supplies consumption goods.
  - Source of wage and dividend incomes for the consumer.
  - The production function combines labor service to produce consumption goods.
- Profit maximization and labor demand function.

3.2. The firm's production function

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

where:

- Y = output of consumption goods;
- K = capital input;
- N^d= labor input (hours);
- z = total factor productivity (TFP).

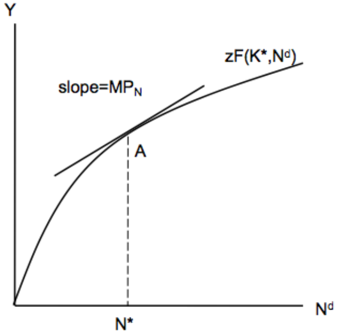
3.2.1 Total factor productivity (TFP)

- z = the degree of sophistication of the production process.
- A production function with the same K and Nd as another but with a larger z will produce more output.
  - Production organization;
  - Managerial input;
  - Social and physical infrastructures.

3.2.2 Properties of the production function

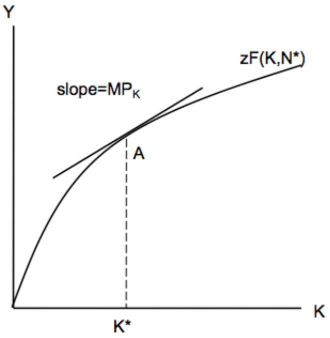
- Constant returns to scale:
  - $zF(xK, xN^d) = xzF(K, N^d)$
  - Increase each input by x times will raise the total output by x times.
- Output increases if either labor or capital increases.
  - $MP_N = \dfrac{\partial Y}{\partial N^d} > 0$;
  - $MP_K = \dfrac{\partial Y}{\partial K} > 0$.
  - Upward slope of the production function.

- The marginal product of labor (MP_N) decreases as the labor input increases, given the capital input.
  - The production function is concave; the slope is decreasing as output increases.
- The marginal product of capital (MP_K) decreases as the capital input increases, given the labor input.
- The marginal product of labor increases as the quantity of the capital input increases.



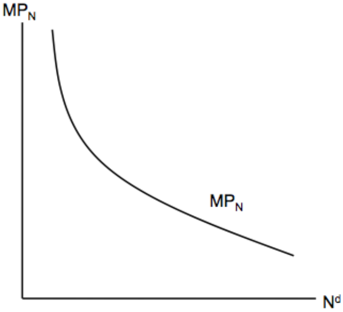
Production function, fixed capital

- The slope at A is MP_N when N = N*.
- MP_N is falling as the labor input increases, given the capital input.



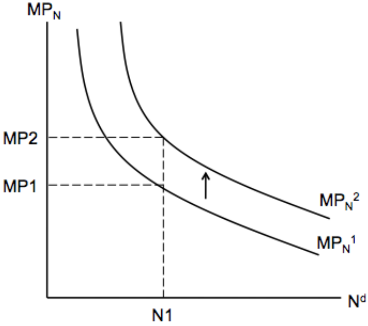
Production function, fixed labor

- The slope at A is MP_K when K = K*.
- MP_K is falling as the capital input increases, given the labor input.



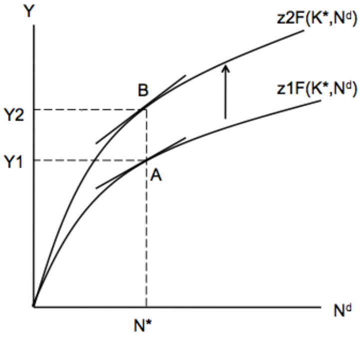
Marginal Product of Labor (MP_N)

- The marginal product of labor decreases as the labor input increases.
- Downward slope MP_N.



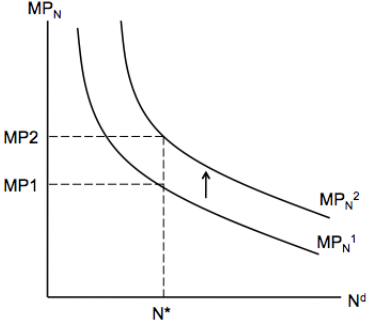
MP_N increases as K increases.

- The marginal product of labor increases as the capital input increases.



Increases in total factor productivity (z)

- An increase in z causes MP_N and output (Y) to rise at N^*.

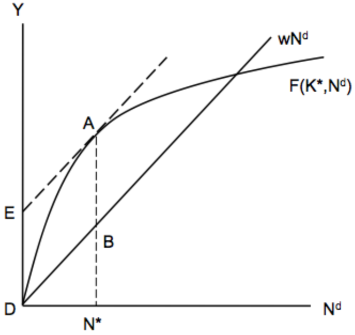


Effect of rising z on MP_N

- An increase in z causes MP_N at N^* to rise.

3.2.3 The firm's profit maximization

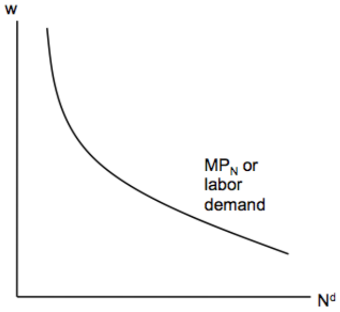
- Y = total revenue = $zF(K, N^d)$;
- wN^d = total variable cost;
- $\pi = zF(K, N^d) - wN^d$
- Maximized profit where
  - Slope of Y = slope of wN^d;
  - MR = MC
  - $MP_N = w$ or the firm's labor demand function.
  - The MP_N is the firm's labor demand curve.



Profit Maximization

- Y = revenue;
- MP_N = marginal revenue;
- wN^d = variable cost;
- w = marginal cost;
- Profit = $Y - wN^d$;
- Max profit = AB where $MP_N = w$.

3.2.4. The firm's labor demand curve



- Profit-max: the firm hires labor up to the point where $N^d = w$.