

Ch.7 A Closed-Economy One-Period Macroeconomic Model: Optimizing-agent decision

EE312 Topic 5, 6 (for Section 046402)

Read: Williamson Ch.4 - 5

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1 Introduction :

- Course outline

1. Macroeconomics Measurement, Business Cycles VS. Trend

Part I Business cycles and Economics fluctuations: Short-run analysis

2. IS-LM model and labour market
3. Open economy macroeconomics

Part II Business cycles and Economics fluctuations: Medium run analysis

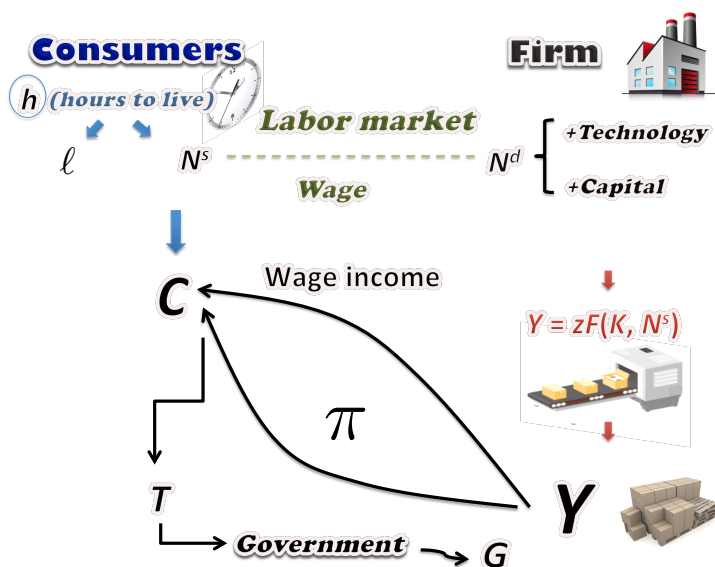
4. Keynes and Monetarist
5. New Classicals
6. New Keynesian

Part III Business cycles and Economics fluctuations: Micro-founded macroeconomic approach

7. A Closed-Economy One-Period Macroeconomic Model: Optimizing-agent decision
8. A Closed-Economy One-Period Macroeconomic Model: Equilibrium
9. Two-Period Model: the Consumption-Savings Decision
10. A Real Intertemporal Model with Investment
11. Long-term Economic Growth

2 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.



3 Consumer: work-leisure decision and labor supply

3.1 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.

3.2 The utility function

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

where U = the utility function;

C = amount of consumption;

ℓ = amount of leisure

$$U = U(C1, \ell1).$$

= level of utility derived from the consumption bundle of $C1$ and $\ell1$.

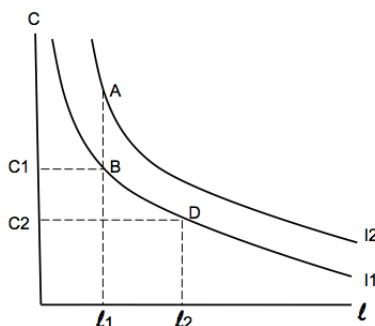
[consumption bundle $(C1, \ell1)$ is strictly preferred to consumption bundle $(C2, \ell2)$ if $U(C1, \ell1) > U(C2, \ell2)$.
consumption bundle $(C2, \ell2)$ is strictly preferred to consumption bundle $(C1, \ell1)$ if $U(C2, \ell2) > U(C1, \ell1)$.
and the consumer is indifferent between the two consumption bundles if $U(C1, \ell1) = U(C2, \ell2)$.]

3.2.1 Properties of consumer preference

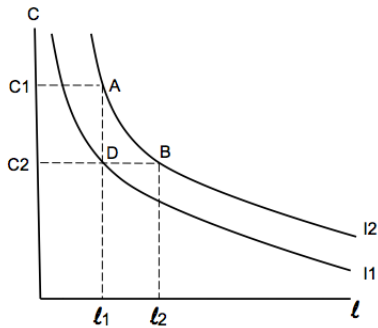
- ‘More is preferred to less.’
 - If $U(C2, \ell2) > U(C1, \ell1)$, then consumption bundle $(C2, \ell2)$ is strictly preferred to consumption bundle $(C1, \ell1)$.
- ‘The consumer has preference for diversity in his/her consumption bundle.’
 - $(C2, \ell1)$ is preferred to $(C3, 0)$
- ‘Consumption and leisure are normal goods’.
 - The consumer will demand more as income increases.

3.2.2 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.

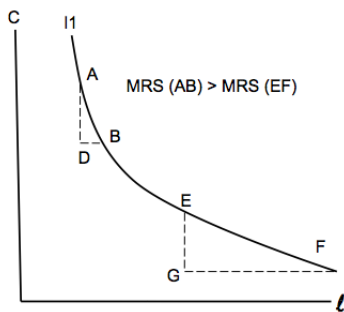


(1) “More is preferred to less”

- If C1 (at A) drops to C2 with the same l_1 , the consumer is on a lower I1.
- To get the initial I2 (with the same C2, raise l_1 to l_2 (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 ($MRS_{l,C}$) 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.
- $MRS_{l,C}$ 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.

3.3 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.

3.3.1 The consumer’s time constraint

h = hours of time available;
 l = time allotted to leisure;
 N^S = time spent working (labor supply)

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

3.3.2 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.

3.3.3 The consumer's budget constraint

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

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

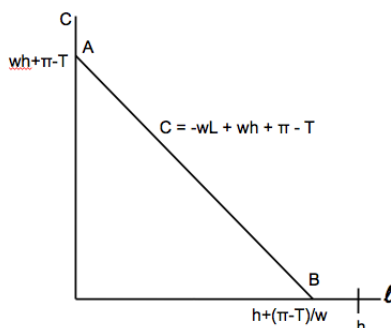
$$C = w(h - \ell) + \pi - T$$

$$C = w(h - \ell) + \pi - T$$

$$C = -w\ell + wh + \pi - T$$

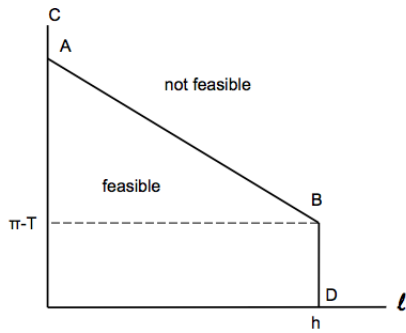
$$C + w\ell = wh + \pi - T$$

- 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 $\ell = 0$;
- The horizontal intercept is $C = 0$. Slope = $-w$

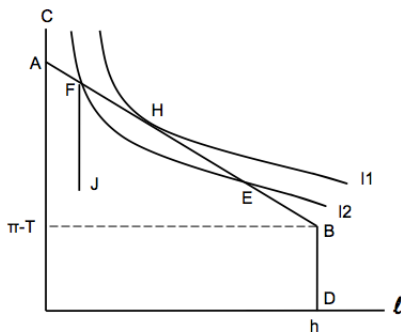


(2) **The budget constraint ($T < \pi$)**

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

3.4 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.



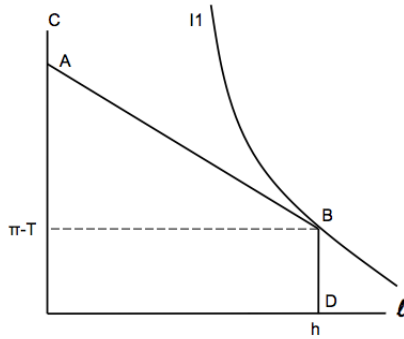
- H = optimal consumption bundle;
 - E and F are feasible but not optimal.
- (J lies inside the budget constraint.
Point F is clearly preferred by consumer to J.)

- 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



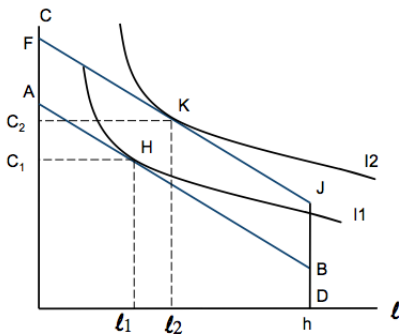
- The consumer chooses not to work at B.
- $\ell = h$
- This is a situation that cannot happen, taking into account consistency the actions of the consumer and of firms.
- “A rentier is a person or entity that receives income derived from economic rents, which can include income from patents, copyrights,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

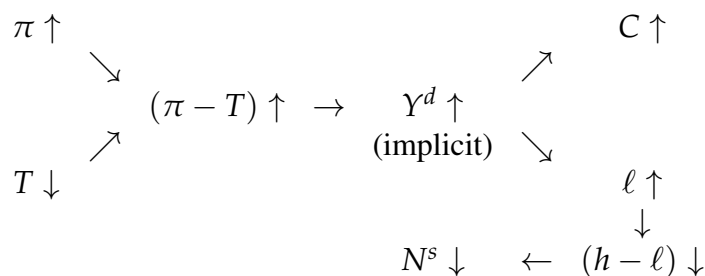
- Assuming consumption and leisure are both normal goods.
- An increase in dividends or a decrease in taxes ($\pi - T$)
- causes the consumer to increase both consumption and leisure (and to reduce the quantity of labor supply).
- The pure income effect.



An increase in $\pi - T$

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

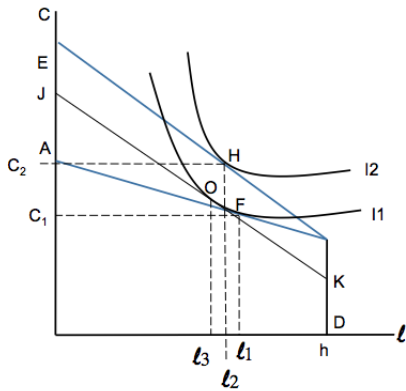
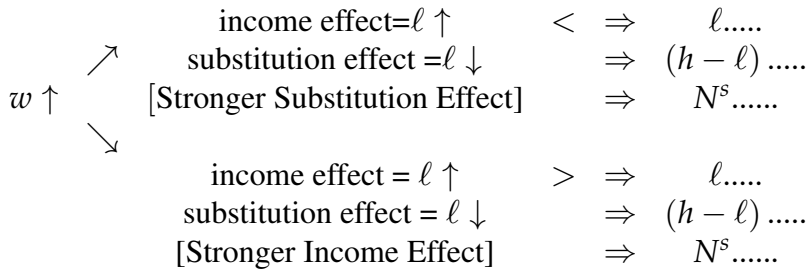
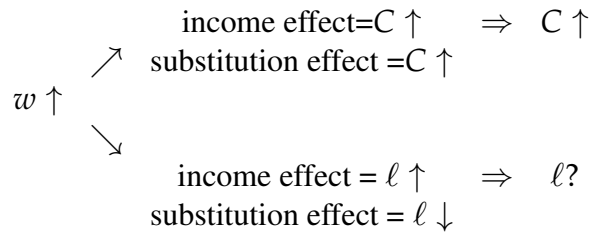
● A higher $\pi - T$ raises C and ℓ



An increase in the market real wage

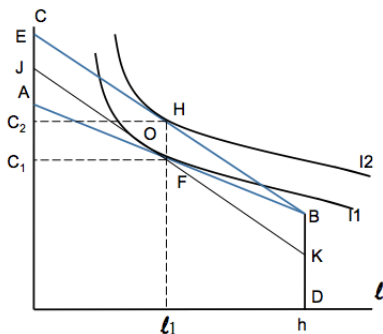
- **Substitution effect:** an increase in the real wage (the price of leisure) causes the consumer to substitute consumption for leisure.
- **Income effect:** the consumer's income increases, causing both consumption and leisure to increase.
- Consumption increases, but leisure may rise or fall.

A higher wage raises C



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.

3.5 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

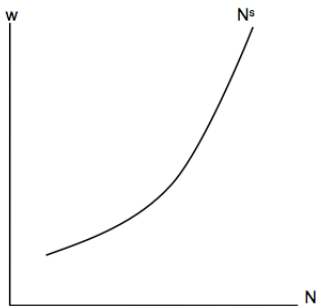
$$N^S(w) = h - \ell(w)$$

$$\frac{\partial N^S}{\partial w} > 0$$

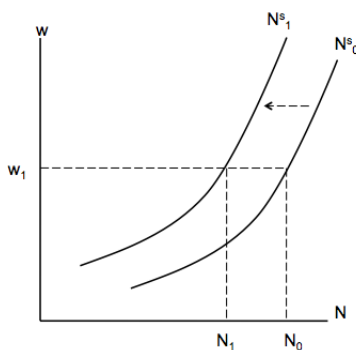
- N^S = the labor supply function
- h = the maximum hours available
- $\ell(w)$ = the leisure function, given the real wage. Assuming the stronger substitution effect.

[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).

4 Firm: profit maximization and labor demand

4.1 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.

4.2 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).

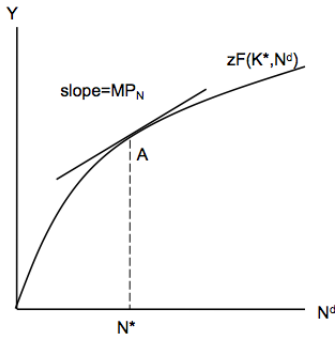
4.2.1 Total factor productivity (TFP)

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

4.2.2 Properties of the production function

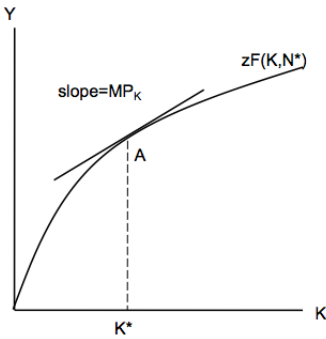
- Constant returns to scale:
 - $zF(xK, xN^d) = xzF(K, N^d)$
 - Increase each input by x times will raise the total output by x times.
- Output increases if either labor or capital increases.
 - $MP_N = \frac{\partial Y}{\partial N^d} > 0$;
 - $MP_K = \frac{\partial Y}{\partial K} > 0$.
 - Upward slope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



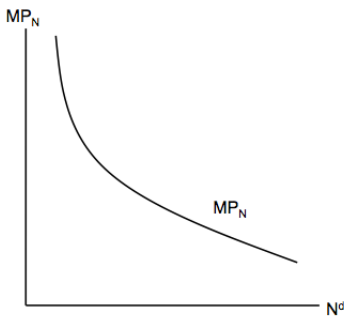
Production function, fixed capital

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



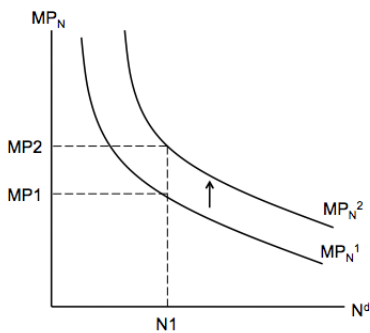
Production function, fixed labor

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



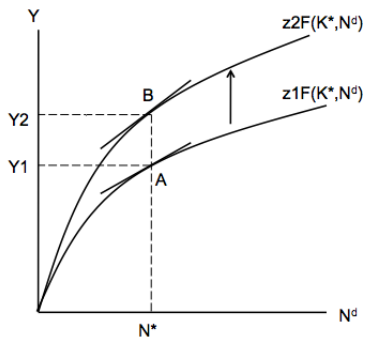
Marginal Product of Labor (MP_N)

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



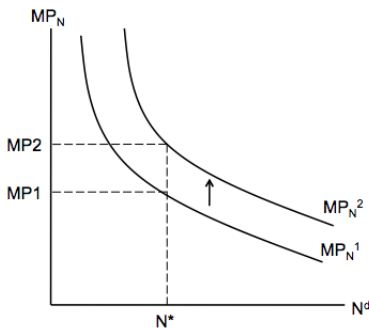
MP_N increases as K increases.

- 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^* .

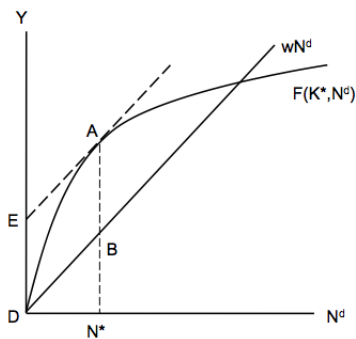


Effect of rising z on MP_N

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

4.2.3 The firm's profit maximization

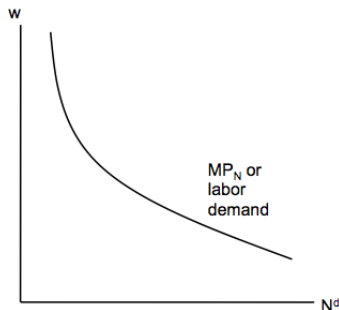
- $Y = \text{total revenue} = zF(K, N^d)$;
- $wN^d = \text{total variable cost}$;
- $\pi = zF(K, N^d) - wN^d$
- Maximized profit where
 - Slope of $Y = \text{slope of } wN^d$;
 - $MR = MC$
 - $MP_N = w$ or the firm's labor demand function.
 - The MP_N is the firm's labor demand curve.



Profit Maximization

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

4.2.4 The firm's labor demand curve



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

Labor input (workers)	Total product (number of goods)	Marginal product of labor
0	0	—
1	9	9
2	17	8
3	22	5
4	25	3
5	26	1

5 Government Sector

- The only action of the government is to implement “fiscal policy”.
- Fiscal policy refers to the government’s choices over its expenditures, taxes, transfers and borrowing.
- Suppose the government wishes to purchase a given quantity of consumption good, G .
- Since there is only one period, the government cannot borrow to finance G .
- Thus G is paid by taxing the representative consumer.
- The government must observe the **balanced budget constraint**, $G = T$.
- G is exogenous.
- Exogenous variables: values are determined outside the model.
- Endogenous variables: values are determined inside the model.