

Student Number .....

Student ID.....

EE312 Macroeconomics, 2/2015 (Sec. 046402)  
Problem Sets 1 : Ch.3 A Closed Economy One-Period Macroeconomic Model

Please submit at the BE office, 5th floor department of Economics building.

Deadline of submission : February 4, 2014, before 15.00 hrs.

Late submission will not be accepted.

**\* Exam will consist of essay-type questions only.**

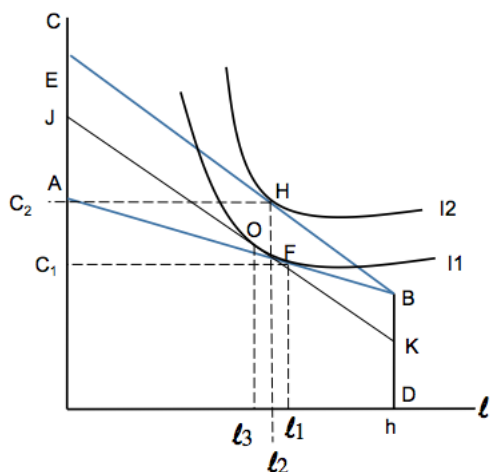
1. In a closed economy one-period model we have been studying, consumption ( $C$ ) is **.an endogenous variable..** and total time available ( $h$ ) is **an exogenous variable.**
2. A good is normal to a consumer if **its consumption rises when income rises.**
3. A good is inferior to a consumer if **its consumption falls when income rises.**
4. Time-constraint for the consumer is expressed as  $h = \ell + N^S$   
where  $h$  = total time available ,  $\ell$ = leisure time,  $N^S$  = time spent working
5. The real wage denotes **(i) the number of units of consumption goods that can be exchanged for one unit of labour time.**

6. The budget constraint of the consumer is expressed as

$$C = \dots w(h - \ell) + (\pi - T).. = (\text{wage income}) + (\text{dividend-tax}) = \text{disposable income}..$$

$$C + w\ell = \dots wh + (\pi - T) = \text{implicit disposable income}..$$

- (a) With consumption on the vertical axis and leisure on the horizontal axis, the slope of the budget line is equal to  $\dots -w\dots$
- (b) The vertical intercept of the budget line is equal to  $\dots wh + (\pi - T)\dots$
- (c) How does an increase in the taxes affect the budget constraint? **.(i).a parallel move down...**
- (d) The household budget constraint may have a kink because **...leisure is limited by the number of available hours.... (When  $\pi > T$  , from the budget constraint the maximum  $\ell$  will be  $\left(h + \frac{\pi - T}{w}\right)$ . Putting together, since  $\ell \leq h$ , the budget constraint has a kink at  $\ell = h$ ,  $C = \pi - T$ )**
- (e) At the optimal consumption bundle, the marginal rate of substitution of labour for consumption ( $MRS_{\ell,C}$ ) is equal to **..the real wage ( $w$ ).... (the relative price between leisure and consumption)....**
- (f) The substitution effect measures **...(i) the response of quantities to changes in the relative price of goods.....**
- (g) When the real wage increases, the substitution effect in the consumer's choices leads to **..an increase... in consumption and ...a decrease.... in leisure.**
- (h) When the real wage increases, the income effect in the consumer's choices leads to **...an increase... in consumption and ...an increase... in leisure.**
- (i) The labor supply is increasing in the wage because **the substitution effect is larger than the income effect.**
- (j) Suppose the substitution effect is larger than the income effect. How does an increase in the real wage affect consumption and labour supply? Graphically illustrate the consumer's optimization problem and labour supply curve. Explain.



[“In considering how the behaviour of the consumer changes in response to a change in the real wage ( $w$ ), we hold constant real dividends and real taxes ( $T$ ).]

Initially, the consumer’s budget constraint is ABD and the consumer **initially chooses point F**, which is the tangency point of the highest possible indifference curve I1 and the budget line ABD.

An increase in real wage ( $w$ ) will shift the budget line from ABD to EBD. Wage-income increases.

The budget line rotates clockwise [the slope increases (from  $w_1$  to  $w_2$ ) and the vertical intercept increases (from  $w_1h + (\pi - T)$  to  $w_2h + (\pi - T)$ ]. The new budget line (EB) is steeper than the original one (AB) and the vertical intercept is higher. For  $l = h$ , the consumer’s budget line remains the same since non-wage income ( $\pi - T$ ) remains unchanged.

**The new bundle chosen by the consumer is H.**  $l \downarrow$  and  $C \uparrow$ .

(The optimal point changes from F to H.)

- Draw an “imaginary” budget line (JKD), attempting to hold real income fixed so we can isolate the substitution effect.

The imaginary budget line (JK) is parallel to the new budget line (EB) (using the new relative price/ slope, to capture the effect of the change in relative price) and is just tangent to the initial indifference curve (holding the real income constant).

- **The substitution effect is the movement from point F to point O.** The substitution effect is the effect due only to the relative price change, controlling for the change in real income.

[In order to compute the substitution effect, we ask what is the bundle that would make the consumer just as happy as before the price change, but if they had to make their choice faced with the new prices. To find this point we consider a budget line characterized by the new prices but with a level of income such that it is tangent to the initial indifference curve.]

As the price of leisure rises, the consumer consumes less leisure ( $C \downarrow$ ) and consume more consumption goods ( $l \downarrow$ ).  $l \downarrow$  from  $l_1$  to  $l_3$ .

Note that substitution effect is always non-positive (as the good price increases, consumer will consume less of the good.)

- **The income effect is the movement from point O to point H.**

From point O to point H, the budget line moves from JKD to EBD. The slopes are the same. Non-wage income increases. The consumer can consume more for all  $l$ .

$C \uparrow$  and  $l \uparrow$ .  $l \uparrow$  from  $l_3$  to  $l_2$ . Income effect is positive because we assume that both consumption and leisure are normal goods.

- **Substitution effect is stronger than income effect.**

$$\begin{aligned} w \uparrow &\Rightarrow \text{Substitution Effect} \Rightarrow l \text{ becomes relatively more expensive} \Rightarrow C \uparrow, l \downarrow : l \downarrow \text{ by } l_1 l_3 \\ &\Rightarrow \text{Income Effect} \Rightarrow \text{wage income} \uparrow \Rightarrow \text{income} \uparrow \Rightarrow C \uparrow, l \uparrow : l \uparrow \text{ by } l_3 l_2 \end{aligned}$$

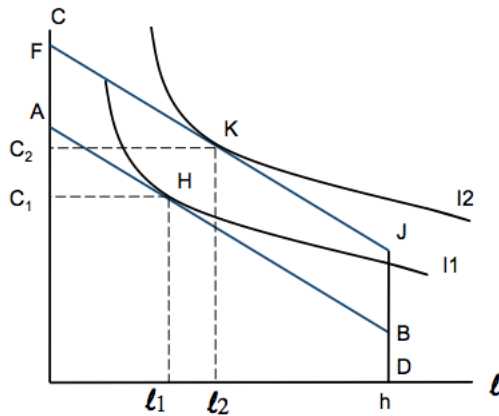
Consumption increases for sure.

Since substitution effect is stronger than income effect  $l_1 l_3$  is greater than  $l_3 l_2$ .

As real wage rises, leisure falls and  $N^s$  rises. We have an **upward sloped labour supply curve**.

an increase in real wage ( $w$ ) represents .....**a combination of income effect and substitution effect** .....

- (k) Suppose the substitution effect is larger than the income effect. How does an increase in real dividend income minus taxes ( $\pi - T$ ) affect consumption and labour supply? Graphically illustrate the consumer's optimization problem and labour supply curve. Explain.



[“an increase in real dividend minus taxes ( $\pi - T$ ) could be caused by either an increase in dividend ( $\pi$ ) or a decrease in tax ( $T$ ).

An increase in dividend ( $\pi$ ) could be caused by an increase in productivity of firms which in turn result in an increase in the dividends that paid to consumer. ”]

Initially, the consumer's budget constraint is ABD and the consumer initially chooses point H, which is the tangency point of the highest possible indifference curve I1 and the budget line ABD.

An increase in real dividend minus taxes ( $\pi - T$ ) (by JB) implies an increase in non-wage income.

Disposable income increases by JB for all levels of  $\ell$ .

Holding real wage  $w$  constant (the real wage is the slope of the budget line remains constant), An increase in ( $\pi - T$ ) shifts the budget constraint out in a parallel fashion (from ABD to FJB).

The consumer will choose point K, which is the tangency point of the highest possible indifference curve I2 and the budget line FJB.

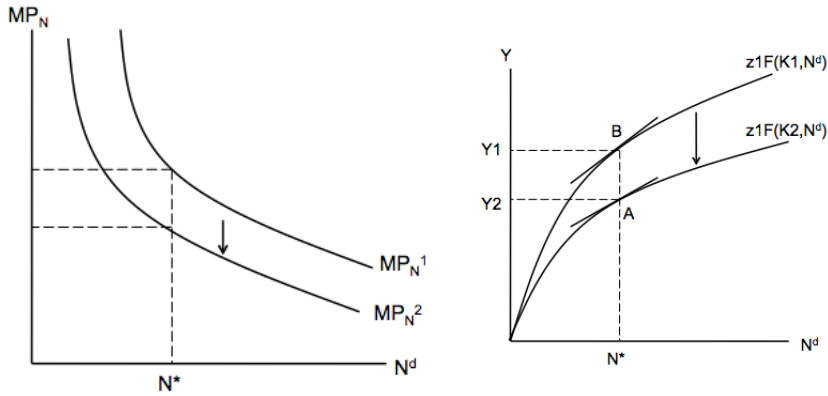
The consumer increases both  $C$  and  $\ell$ .

For a given real wage,  $(\pi - T) \uparrow \Rightarrow C \uparrow$  (from  $C_1$  to  $C_2$ ) and  $\ell \uparrow$  (from  $\ell_1$  to  $\ell_2$ ). Both consumption and leisure are assumed to be normal goods.

This is called **..pure income..** effect.

An increase in real dividend income minus taxes ( $\pi - T$ ) represents **...a pure income effect ...**

7. Marginal product of a factor of production is equal to..(iii)..**the amount of additional outputs that can be produced with one additional unit of that factor input, holding constant the quantities of other inputs ...**
8. Constant return to scale means that for any constant  $x > 0$ ,  $xY = zF(xN^s, xK)$ , where  $Y = zF(N^s, K)$ .
9. As the quantities of labour input increases, the marginal product of labour ( $MP_N$ ) **...decreases..** Hence, a production function is **...concave...** in labour.
10. The profit maximising quantity of labour equates the marginal product of labour with **...the real wage...**
11. Suppose the representative firm suddenly has more capital. What will happen to the production function and labour demand? Graphically illustrate.



The quantity of capital decreases from  $K_1$  to  $K_2$ . Because we use less capital, less output can be produced for each labor input. and marginal product of labor decreases for each quantity of labor. Production function shifts down from  $Z1F(K1, N^d)$  to  $Z1F(K2, N^d)$ . The marginal product of labor shifts down from  $MP_N^1$  to  $MP_N^2$ .

$MP_N$  is the slope of the production function which falls at any given amount of  $N$ . For example, at  $N^*$ , the new  $MP_N$  ( the slope of the production function  $Z1F(K2, N^d)$  at point A) is lower than the original  $MP_N$  ( the slope of the production function  $Z1F(K1, N^d)$  at point B).