EE312 Macroeconomics, 2/2014 (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 avaialbe (h) is **an exogenous variable.**
2. An economy without monetary exchange is called **a barter economy**.
3. A good is normal to a consumer if **its consumption rises when income rises**.
4. A good is inferior to a consumer if **its consumption falls when income rises**.
5. A lump-sum tax is the tax that **(ii) does not depend on the economic behaviour of the agent being taxed**.
6. Time-constaint for the consumer is expressed as $h = \ell + N^S$

   where h = total time available , ℓ= leisure time, N^S = time spent working
7. The real wage denotes **(i) the number of units of consumption goods that can be exchanged for one unit of labour time.**
8. The budget constraint of the consumer is expressed as

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

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

   (a) With consumption on the vertical axis and leisure on the horizontal axis, the slope of the budget line is equal to ...$-w$...

   (b) The vertical intercept of the budget line is equal to ...$wh + (\pi - T)$...

   (c) How does an increase in the taxes affect the budget constraint? .**(i)**.**a paralell 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 ℓ 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).....

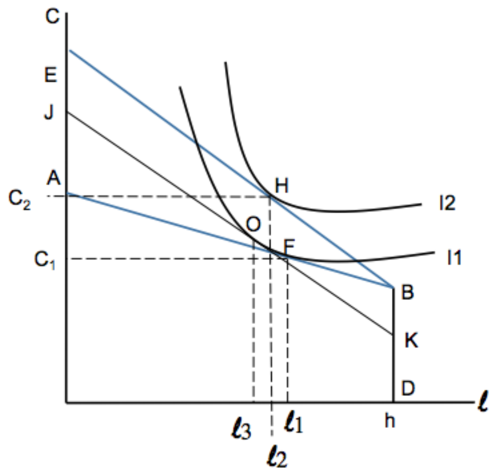
   (f) The substitution effect measures ...**(i) the response of quantities to changes in the relative price of goods**.......

   (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 indfference 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 $\ell = h$, the consumer’s budget line remains the same since non-wage income ($\pi - T$) remains unchanged.

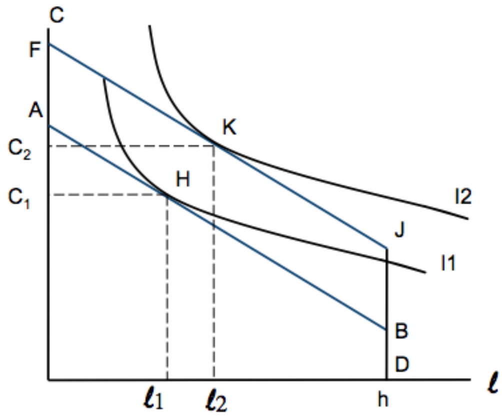
The new bundle chosen by the consumer is H. $\ell \downarrow$ and $C \uparrow$.

(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 paralell 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 ($\ell \downarrow$). $\ell \downarrow$ 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 $\ell \uparrow$. $\ell \uparrow$ 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.**
  $\mathbf{w}\uparrow \Rightarrow$ Substitution Effect $\Rightarrow$ ℓ becomes relatively more expensive $\Rightarrow C\uparrow, \ell\downarrow \;:\ell\downarrow$ by$\ell_1\ell_3$
  $\Rightarrow$ Income Effect $\Rightarrow$ *wage income* $\uparrow\Rightarrow$ *income* $\uparrow$ $\Rightarrow C\uparrow, \ell\uparrow \;:\ell\uparrow$ by$\ell_3\ell_2$
  Consumption increases for sure.
  Since substitution effect is stronger than income effect $\ell_1\ell_3$ is greater than $\ell_3\ell_2$.
  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 affect consumption and labour supply? Graphically illustrate the consumer's optimization problem and labour supply curve. Explain.



["an increase in real dividend minus taxes(π − T) could be caused by either an increase in dividend (π) or a decrease in tax (T).
An increase in dividend (π) 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 indfference curve I1 and the budget line ABD.
An increase in real dividend minus taxes(π − T) (by JB) implies an increase in non-wage income.
Disposable income increases by JB for all levels of ℓ.
Holding real wage w constant (the real wage is the slope of the budget line remains constant), An increase in (π − T) shifts the budget constraint out in a paralell fashion (from ABD to FJD).
The consumer will choose point K, which is the tangency point of the highest possible indifference cuve I2 and the budget line FJB.
The consumer increases both C and ℓ.
For a given real wage, $(\pi - T) \uparrow \Rightarrow C \uparrow$ (from C_1 to C_2) and $\ell \uparrow$(from ℓ_1 to ℓ_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** ...

9. 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** ...

10. Contant return to scale means that for any constant $x > 0$, xY..=.. $zF(xN^s, xK)$, where $Y = zF(N^s, K)$.

11. As the quantities of labour input increases, the marginal product of labour (MP_N) ...**decreases**.. Hence, a production function is ...**concave**... in labour.

12. The profit maximising quantity of labour equates the marginal product of labour with ...**the real wage**...

13. The questions below deal with the Widget Company, which produces widgets according to the following table.

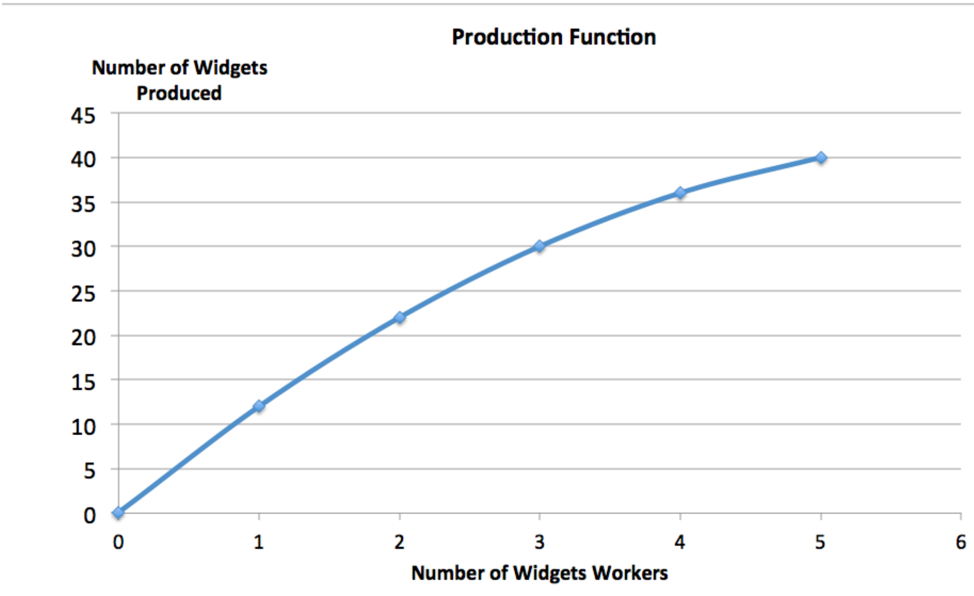
Number of Widget Workers	Number of Widgets Produced
0	0
1	12
2	22
3	30
4	36
5	40

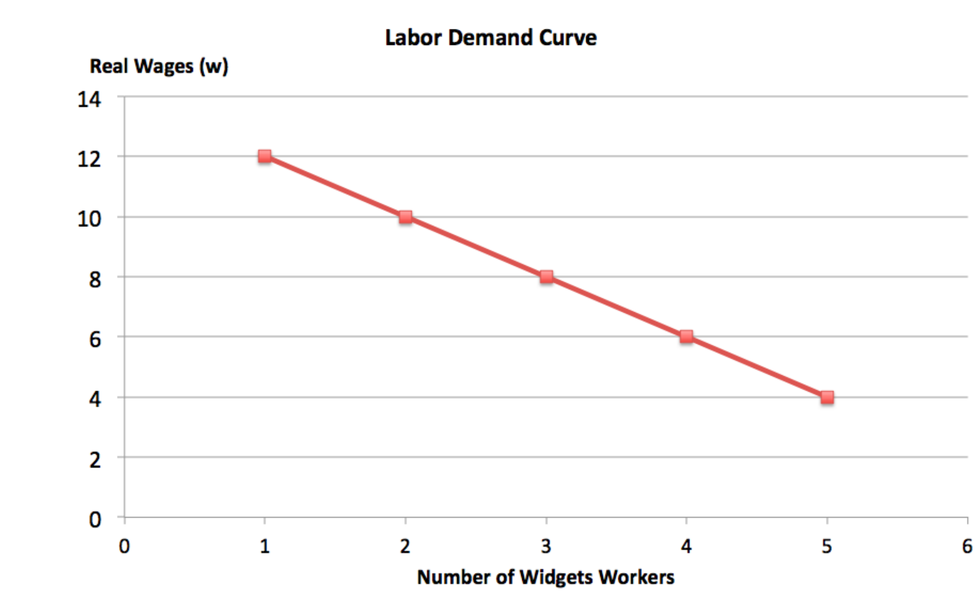
(a) The marginal product of the second widget worker hired is ..10.. Widgets

(b) If the real wage is equal to 8 widgets, and only an integer number of workers can be hired, the Widget company should hire ...3... workers.

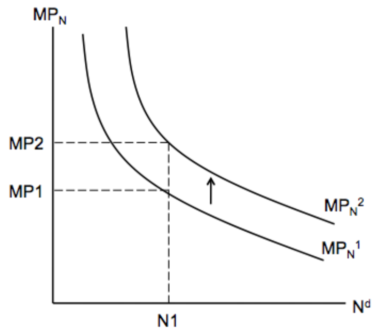
(c) Labor demand is decreasing in the wage because ..the production function is concave in labor input. Marginal product of labor is decreasing as more labor is used.

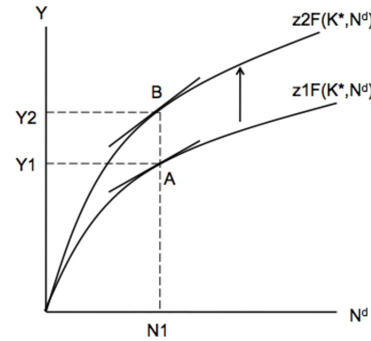
(d) Draw a labour demand curve.





14. Suppose the representative firm suddenly has more capital. What will happen to the production function and labour demand? Graphically illustrate.





The quantity of capital inceases from K_1 to K_2. Because we use more capital, more outputs can be produced for each labor input. and marginal product of labor increases for each quantity of labor. Production function rotates counter clockwise from ZF(K1,N^d) to ZF(K2,N^d). The marginal product of labor shifts up from MP_N^1 to MP_N^2.

MP_N is the slope of the production function which rises for any given amount of N. For example, at N_1, the new MP_N (the slope of the production function ZF(K2,N^d) at point B) is higher than the original MP_N (the slope of the production function ZF(K1,N^d) at point A).

Note:

1. Please note that w in this chapter denotes "real wage". In some other macroeconomic models with the money, there are both "real wage" (w) and "nominal wage" (W).

2. According to overall performance of the students for this problem set, many students may need to review for the firm's maximization problem.

   The firm's profit is maximized when MPN = w. Since the production function is concave due to the law of diminishing returns, MPN is decreasing. As labor(N) input increases, MPN decreases.

   The firm adjusts their labor input until MPN = w. As w increases, the firm employs lesss labor to increase MPN to maximize profit. In other words, as w increases, labor demand decreases.

   The answer to question 13(c) : Labor demand is decreasing in the wage because the production function is concave in labor input. Marginal product of labor is decreasing as more labor is used.