

PROBLEM SET II SOLUTIONS

Section I: Chapter 4

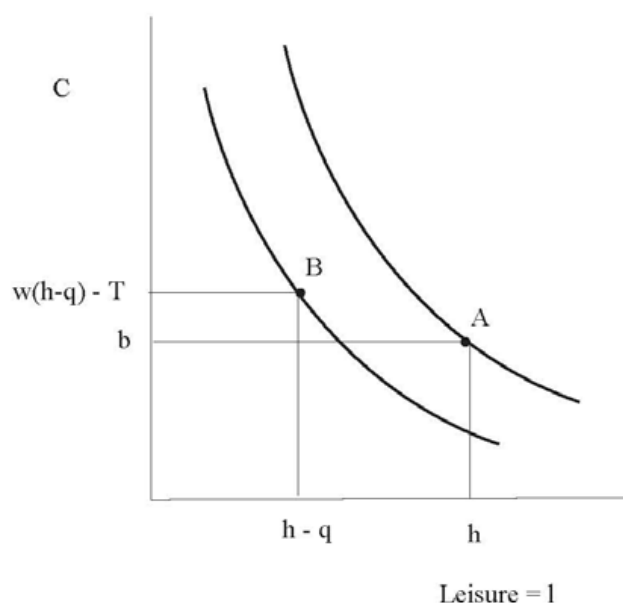
Question 3

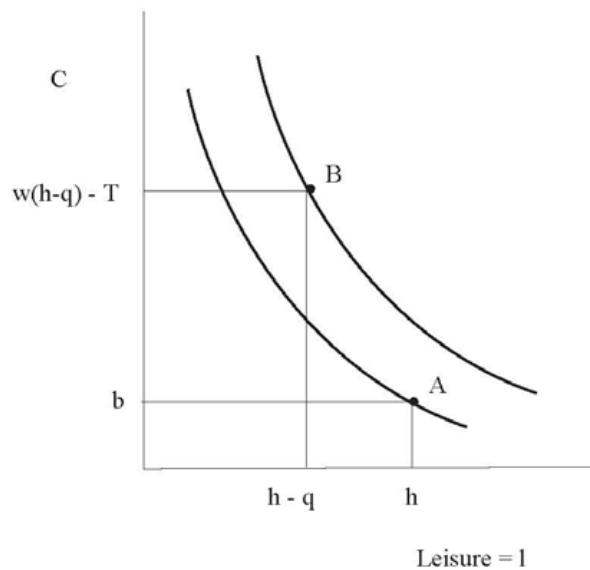
Suppose that a consumer cannot vary hours of work as he or she chooses. There is a standard working hour as $h-l$ hours per day (for example 8 hours). In particular, he or she must choose between working q hours and not working at all, where $q > 0$. Suppose that dividend income is zero, and that the consumer pays a tax T if he or she works, and receives a benefit b when not working, interpreted as an unemployment insurance payment.

- If the wage rate increases, how does this affect the consumer's hours of work? What does this have to say about what we would observe about the behavior of actual consumers when wages change?
- Suppose that the unemployment insurance benefit increases. How will this affect hours of work? Explain the implications of this for unemployment insurance programs.

Solution:

- Think of the economy as consisting of many consumers, some of whom are in a situation as in the figures. Some consumers do not work, and some choose to work. If the wage goes up, then that will make working preferable for some consumers who formerly did not choose to work. An increase in wages will not discourage anyone from working, but those who are working already will not choose to vary hours of work (they cannot). But total employment in the economy will increase, as now more people are working. With the constraint on hours of work, there are no issues related to income and substitution effects. A higher wage always increases the total quantity of labor supplied.





- b) Similar to part (a), if the unemployment insurance benefit increases, this will make not working preferable to some consumers who were formerly working, and employment will fall. An increase in unemployment insurance benefit unequivocally reduces the quantity of labor supplied.

Question 4

Suppose that a consumer can earn a higher wage rate for working overtime. That is, for the first q hours the consumer works, he or she receives a real wage rate of w_1 , and for hours worked more than q he or she receives w_2 , where $w_2 > w_1$. Suppose that the consumer pays no taxes and receives no non-wage income, and he or she is free to choose hours of work.

- Draw the consumer's budget constraint and show his or her optimal choice of consumption and leisure.
- Show that the consumer would never work q hours, or anything very close to q hours. Explain the intuition behind this.
- Determine what happens if the overtime wage rate w_2 increases. Explain your results in terms of income and substitution effects. You must consider the case of a worker who initially works overtime, and a worker who initially does not work overtime.

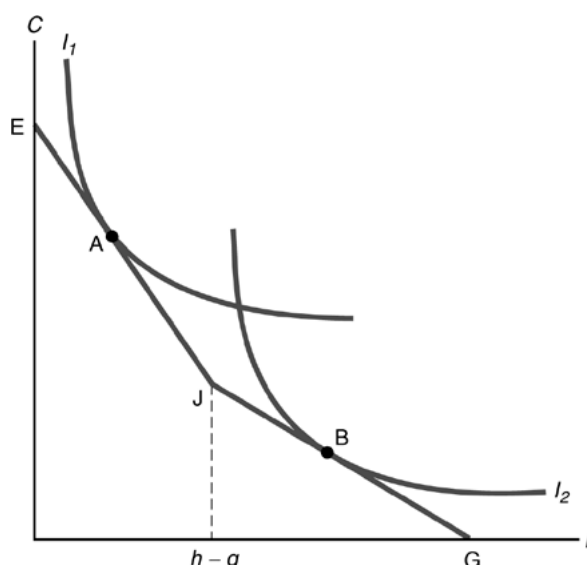
Solution:

This problem introduces a higher, overtime wage for hours worked above a threshold, q . This problem also abstracts from any dividend income and taxes.

a) The budget constraint is now EFG in the figure below. The budget constraint is steeper for levels of leisure less than $h - q$, because of the higher overtime wage. The figure depicts possible choices for two different consumers. Consumer #1 picks point A on her indifference curve, I_1 . Consumer #2 picks point B on his indifference curve, I_2 . Consumer #1 chooses to work overtime; consumer #2 does not.

b) The geometry of the figure above makes it clear that it would be very difficult to have an indifference curve tangent to EFG close to point J. For this to happen, an indifference curve

would need to be close to right angled as in the case of pure complement. It is unlikely that consumers wish to consume goods and leisure in fixed proportions and so points like A and B are more typical. For any other allowable shape for the indifference curve, it is impossible for point J to be chosen.



c) An increase in the overtime wage steepens segment EJ of the budget constraint, but has no effect on segment JG. For an individual like consumer #2, the increase in the overtime wage has no effect up to the point at which the increase is large enough to shift the individual to a point like point A. Consumer #2 receives no income effect because the income effect arises from higher wage rates on inframarginal units of work. An individual like consumer #1 has the traditional income and substitution effects of a wage increase. Consumer #1 increases her consumption but may either increase or reduce hours of work according to whether the income effect outweighs the substitution effect.

Question 5

Suppose that the government subsidizes employment. That is, the government pays the firm s units of consumption goods for each unit of labor that the firm hires. Determine the effect of the subsidy on the firm's demand for labor.

Solution:

The firm chooses its labor input N^d so as to maximize profits. When there is no subsidy, profits for the firm are given by

$$\pi = zF(K, N^d) - wN^d$$

That is, profits are the difference between revenue and costs. In the top figure on the following page the revenue function is $zF(K, N^d)$ and the cost function is the straight line, wN^d . The firm maximizes profits by choosing the quantity of labor where the slope of the revenue function equals the slope of the cost function:

$$MP_N = w.$$

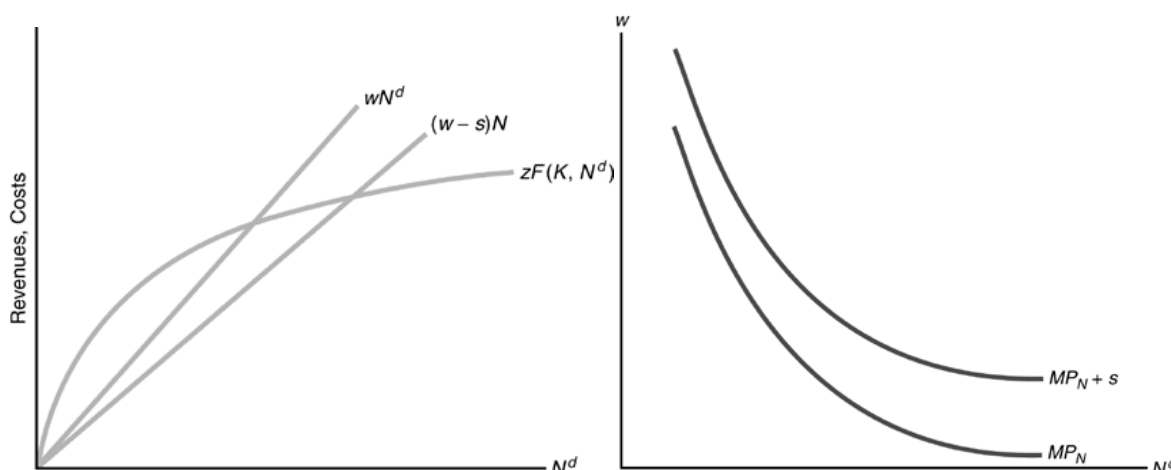
The firm's demand for labor curve is the marginal product of labor schedule in the figure below. With an employment subsidy, the firm's profits are given by:

$$\pi = zF(K, N^d) - (w - s)N^d$$

where the term $zF(K, N^d)$ is the unchanged revenue function, and $(w - s)N^d$ is the cost function. The subsidy acts to reduce the cost of each unit of labor by the amount of the subsidy, s . In the first figure below, the subsidy acts to shift down the cost function for the firm by reducing its slope. As before, the firm will maximize profits by choosing the quantity of labor input where the slope of the revenue function is equal to the slope of the cost function, $(w - s)$, so the firm chooses the quantity of labor where

$$MP_N = w - s.$$

In the bottom figure below, the labor demand curve is now, $MP_N + s$ and the labor demand curve has shifted up. The subsidy acts to reduce the marginal cost of labor, and the firm will hire more labor at any given real wage.

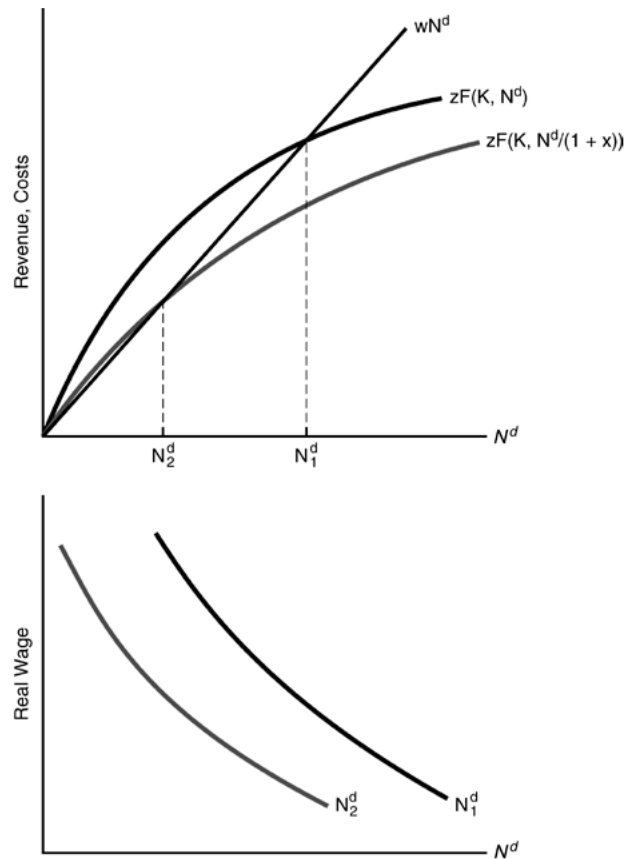


Question 6

In the course of producing its output, a firm causes pollution. The government passed a law that requires the firm to stop polluting, and the firm discovers that it can prevent the pollution by hiring x workers for every worker that is producing output. That is, if the firm hires N workers, then xN workers are required to clean up the pollution caused by the N workers who are actually producing output. Determine the effect of the pollution regulation on the firm's profit-maximizing choice of labor input, and on the firm's labor demand curve.

Solution:

As the firm has to internalize the pollution, it realizes that labor is less effective than it previously thought. It now needs to hire $N(1 + x)$ workers where N were previously sufficient. This is qualitatively equivalent to a reduction of z , total factor productivity. The figure below highlights the resulting outcome: the firm now hires fewer people for a given wage and thus its labor demand is reduced.



Section II: Chapter 5

Question 9

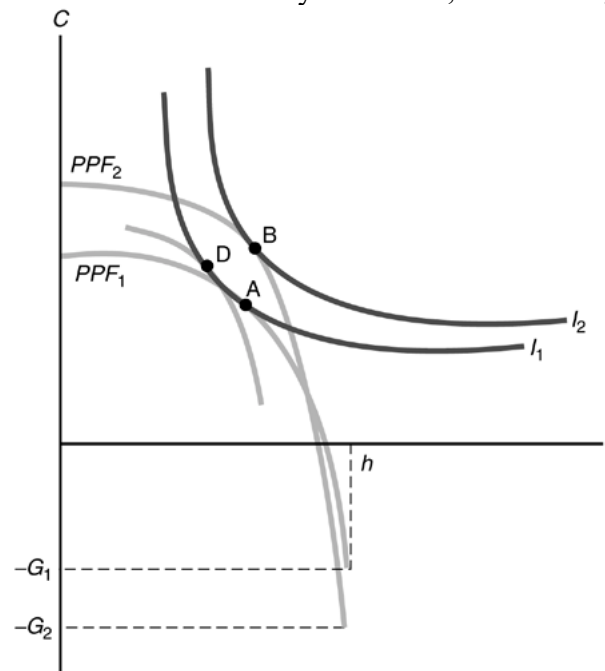
Suppose that government spending makes private firms more productive; for example, government spending on roads and bridges lowers the cost of transportation. This means that there are now two effects of government spending: the first being the standard effects of an increase in G , and the second being similar to the effects of an increase in the nation's capital stock K .

- Show that an increase in government spending that is productive in this fashion could increase welfare for the representative consumer.
- Show that the equilibrium effects on consumption and hours worked for an increase in government spending of this type are ambiguous, but that output increases. You must consider income and substitution effects to show this.

Solution:

- The increase in government spending in this example has two separate effects on the production possibilities frontier. First, the increase in government spending from G_1 to G_2 implies a parallel downward shift in the production possibilities frontier. Second, the productive nature of government spending is equivalent to an increase in total factor productivity that shifts the production possibilities frontier upward and increases its slope. The figure below draws the original production possibilities frontier as PPF_1 and the new production possibilities frontier as PPF_2 . If the

production-enhancing aspects of the increase in government spending are large enough, representative consumer utility could rise, as in this figure.



b) There are three effects at work in this example. First, there is a negative income effect from the increase in taxes needed to pay for the increased government spending. This effect tends to lower both consumption and leisure. Second, there is a substitution effect due to the productive effect of the increase in G , which is drawn as the movement from point A to point D. This effect tends to increase consumption and decrease leisure. Third, there is a positive income effect from the increase in G on productivity. This effect tends to increase both consumption and leisure. In the figure above, the movement from point D to point B is the net effect of the two income effects. In general, consumption may rise or fall, and leisure may rise or fall. The overall effect on output is the same as in any increase in total factor productivity. Output surely rises.

Question 12

Suppose that the representative consumer's preferences change, in that his or her marginal rate of substitution of leisure for consumption increases for any quantity of consumption and leisure.

- Explain what this change in preferences means in more intuitive language.
- What effects does this have on the equilibrium real wage, hours worked, output, and consumption?
- Do you think that preference shifts like this might explain why economies experience recessions (periods when output is low)? Explain why or why not, with reference to the key business cycle facts in Chapter 3.

Solution:

a) At the margin, the consumer decides that leisure is more preferred to consumption. That is, the consumer now requires a bigger increase in consumption to willingly work more (consume less leisure). In more intuitive language, the consumer is lazier.

b) To work out the effects of this change in tastes, we refer to the figure below. The production possibility frontier in this example is unchanged. The consumer now picks a new point at which one of the flatter indifference curves is tangent to the production possibilities frontier. That is, the equilibrium will shift from point A to point B. Consumption falls and leisure rises. Therefore, the consumer works less and produces less. Because employment has fallen, it also must be the case that the real wage increases.

