SHUFE, Fall 2013
Intermediate Macroeconomics
Professor Hui He

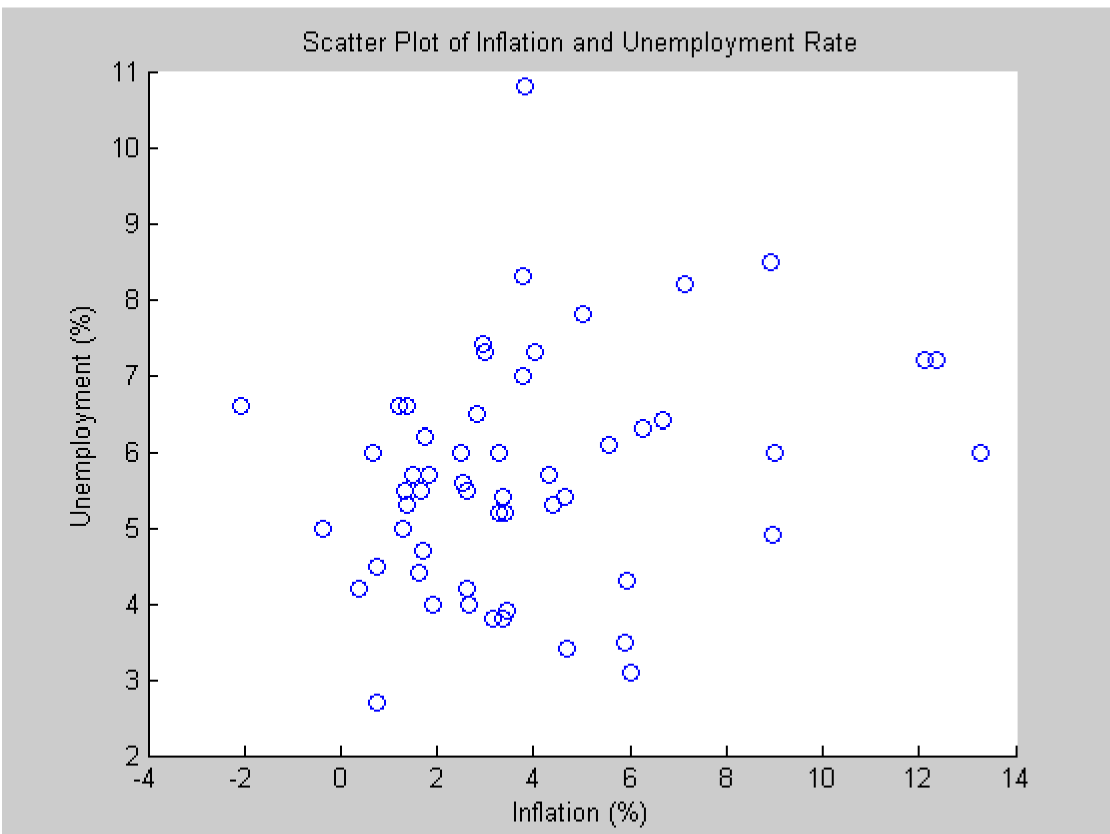
Homework 2 Suggested Answer

Due on October 17， Thursday

In this homework, we will intensively work with data to understand the concepts about business cycle.
"Working with the data" page 93-94(4th edition page 98-99), problem no.1, 3

No. 1 **(10 points)**

The graph is below.

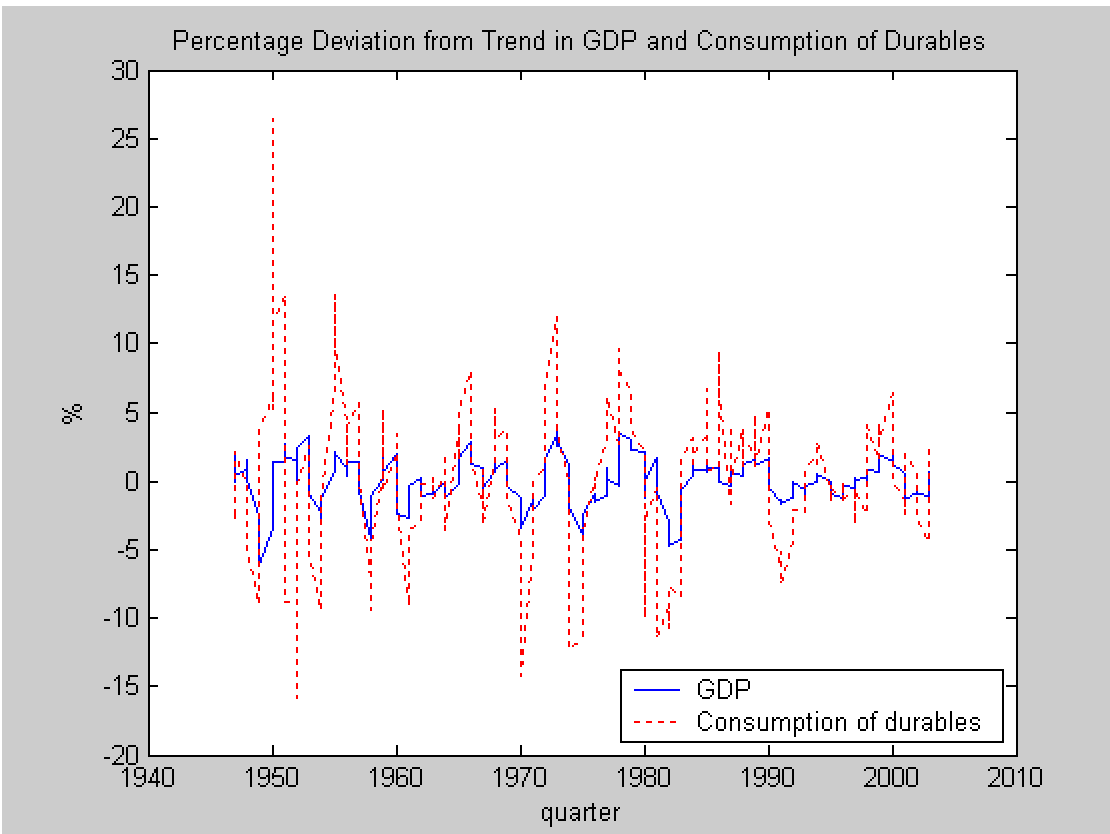


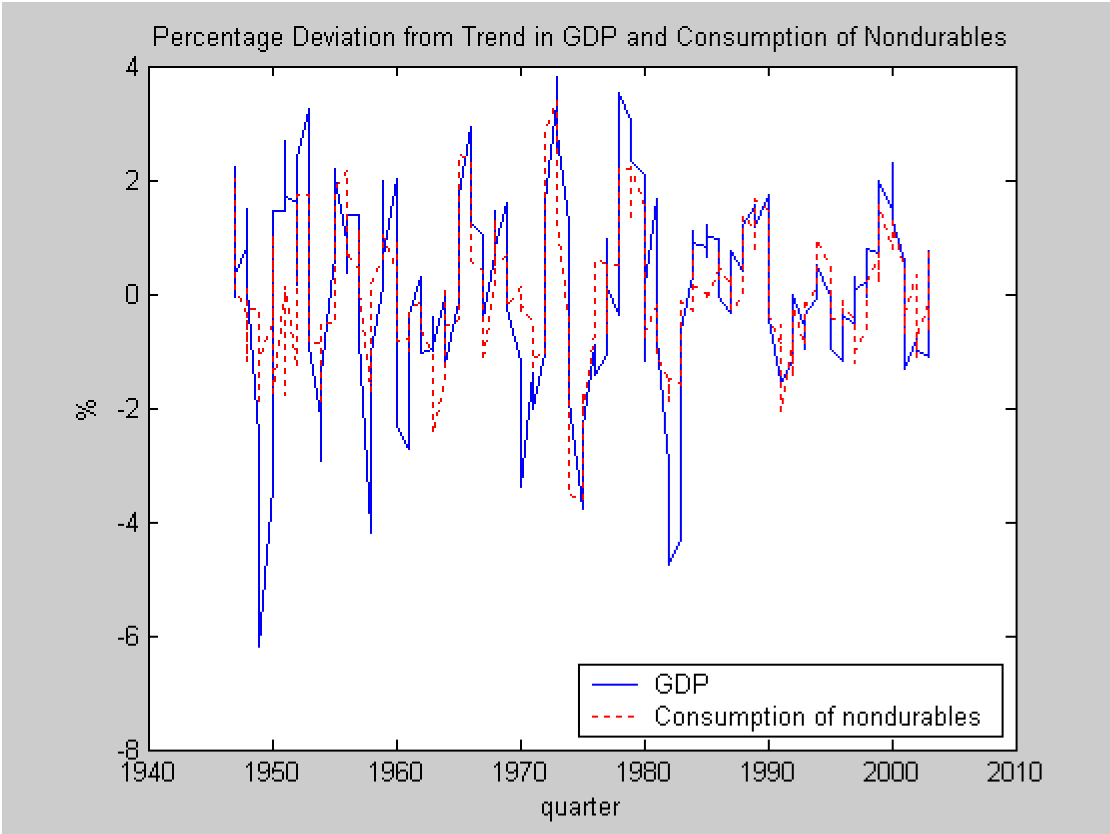
From this graph, I would like to say the correlation b/w inflation rate and unemployment rate is slightly positive. Check the correlation coefficient, it is 0.2490, means they are slightly positive. Phillips curve implies we should have negative relationship between these two, obviously this is not true here.

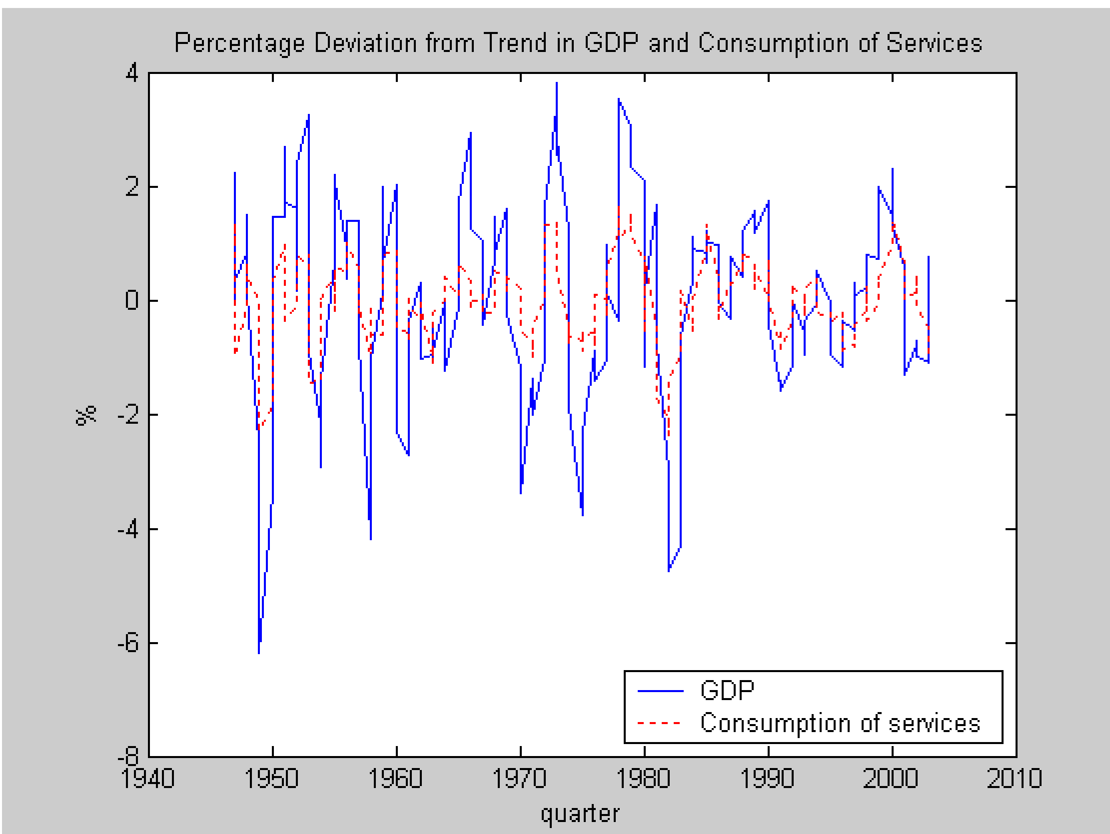
No.3 **(10 points)**

We get the data from the "detrended" spreadsheet. The graphs are as following. From the graphs, we can see durable consumption (Cd) is much more volatile than the GDP, while nondurable (Cnd) and services (Cs) are less volatile. Compare with the Figure 3.9 on the textbook, since consumption C=Cd+Cnd+Cs, higher volatility in Cd makes the percentage deviation of total consumption looks almost like that of GDP. Notice the spike in 1950 comes from the spike in Cd.

On the other hand, the fluctuation of Cd is much alike that of real investment as shown in Figure 3.10 on the textbook. The conclusion we can draw from this observation is Cd acts as more like an investment. Think about you buy a car, you spend a bulk of money in advance to enjoy the services this car will provide you for the subsequent years. In this sense, it is an investment.

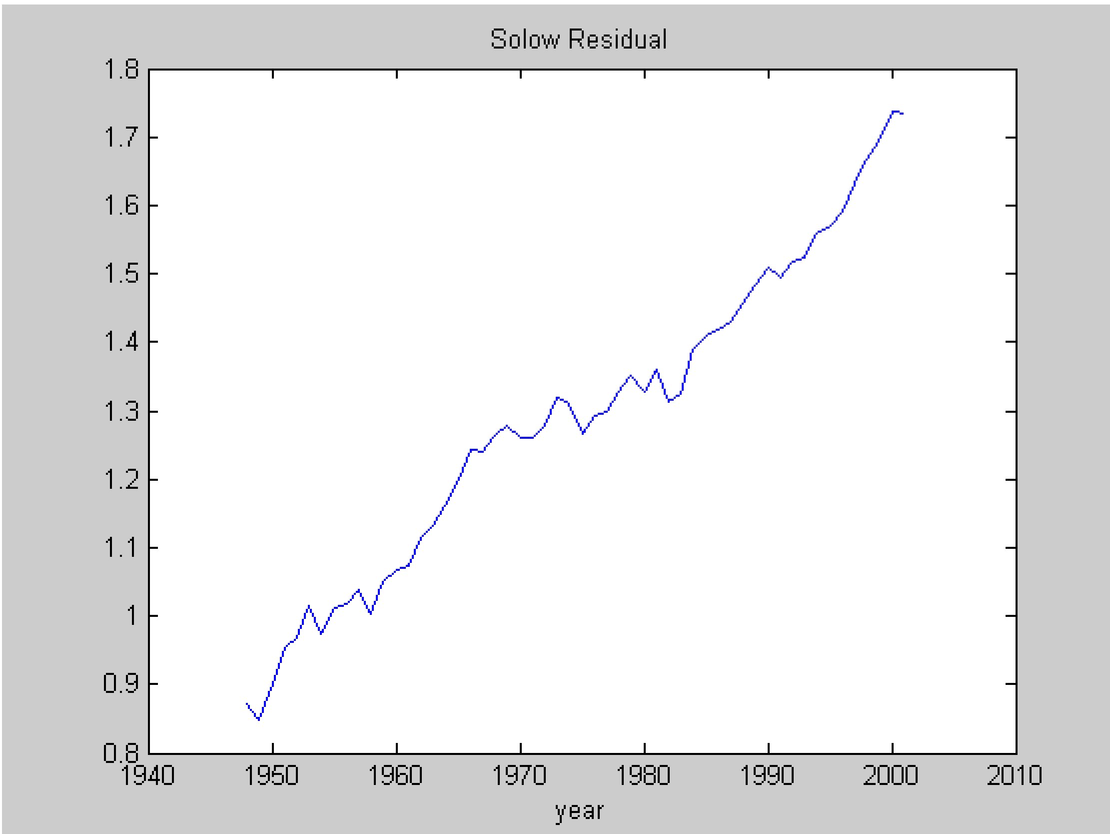



Percentage Deviation from Trend in GDP and Consumption of Nondurables
4
2
0
-2
-4
-6
-8
%
1940
1950
1960
1970
1980
1990
2000
2010
quarter
GDP
Consumption of nondurables


Percentage Deviation from Trend in GDP and Consumption of Services
4
2
0
-2
-4
-6
-8
%
1940
1950
1960
1970
1980
1990
2000
2010
quarter
GDP
Consumption of services

"Working with the data" page 138 (4th edition page 145), problem no. 2 **(10 points)**

Since we know the Cobb-Douglas production function takes the form as following: $Y = zK^{0.3}N^{0.7}$. Here Y is the GDP, K is the capital stock, N is the employment. We can have the expression for the Solow Residual *z* as following: $z = Y/(K^{0.3}N^{0.7})$. Substituting into the data of *Y*, *K*, *N*, we can calculate *z*.
We calculate the growth rate of Solow Residual *z* and the real GDP *Y*, plot them in the same graph. From it we can see clearly growth rate of *z* and *Y* follow the same pattern. This indicates that Solow Residual might be the source of the business cycles.



Static model of work-leisure decision and profit-maximization
Problem no. 2, 5, 7, 8, 9, 13 on page 136-138 (4th edition: no. 2, 7, 9, 10, 11, 15 on page 143-145)

No. 2 **(15 points)**

$u = al + bC$

(a) To specify an indifference curve, we hold utility constant at $\bar{u}$. Next rearrange in the form:

$$C = \frac{\bar{u}}{b} - \frac{a}{b} l$$

Indifference curves are therefore linear with slope, -a/b, which represents the marginal rate of substitution. There are two main cases, according to whether $\frac{a}{b} > w$ or $\frac{a}{b} < w$. The top panel of Figure 4.2 shows the case of $\frac{a}{b} < w$. In this case the indifference curves are flatter than the budget line and the consumer picks point A, at which $l = 0$ and $C = wh + \pi - T$. The bottom panel of Figure 4.2 shows the case of $\frac{a}{b} > w$. In this case the indifference curves are steeper than the budget line, and the consumer picks point B, at which $l = h$ and $C = \pi - T$. In the coincidental case in which $\frac{a}{b} = w$, the highest attainable indifference curve coincides with the indifference curve, and the consumer is indifferent among all possible amounts of leisure and hours worked.

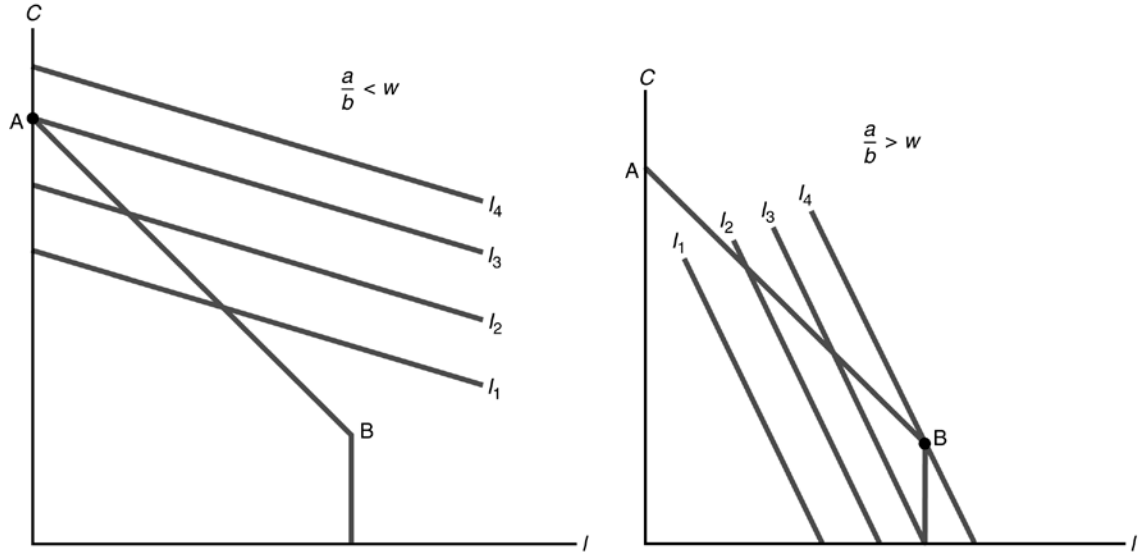


Figure 4.2

(b) The utility function in this problem does not obey the property that the consumer prefers diversity, and is therefore not a likely possibility.
(c) This utility function does have the property that more is preferred to less. However, the marginal rate of substitution is constant, and therefore this utility function does not satisfy the property of diminishing marginal rate of substitution.

N0. 5 **(15 points)**

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 EJG in Figure 4.5. The budget constraint is steeper for levels of leisure less than h – q, because of the higher overtime wage. Figure 4.5 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.

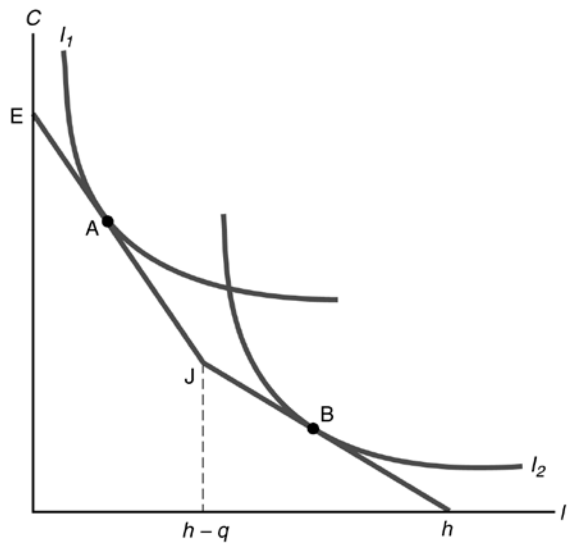


Figure 4.5

(b) The geometry of Figure 4.5 makes it clear that it would be very difficult to have an indifference curve tangent to EJH close be to point J. In order for this to happen, indifference curve would need to 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 the segment JG. For an individual like Consumer #2, the increase in the overtime wage has no effect up until 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 out of a higher wage rate 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.

No. 7 **(10 points)**

Leisure represents all time used for nonmarket activities. If the government is now providing for some of those, like providing free child care, households will take advantage of such a program, thereby allowing more time for other activities, including market work. Concretely, this translates in a change of preferences for households. For the same amount of consumption, they are now willing to work more, or in other words, they are willing to forego some additional leisure. On the figure below, the new indifference curve is labeled I_2. It can cross indifference curve I_1 because preferences, as we measure them here, have changed. The equilibrium basket of goods for the household now shifts from A to B. This leads to reduced leisure (from l^*_1 to l^*_2), and thus increased hours worked, and increased consumption (from C^*_1 to C^*_2) thanks to higher labor income at the fixed wage.

Note: If the students answer that it is a parallel shift up of the budget constraint so that both consumption and leisure increase, it is fine too.

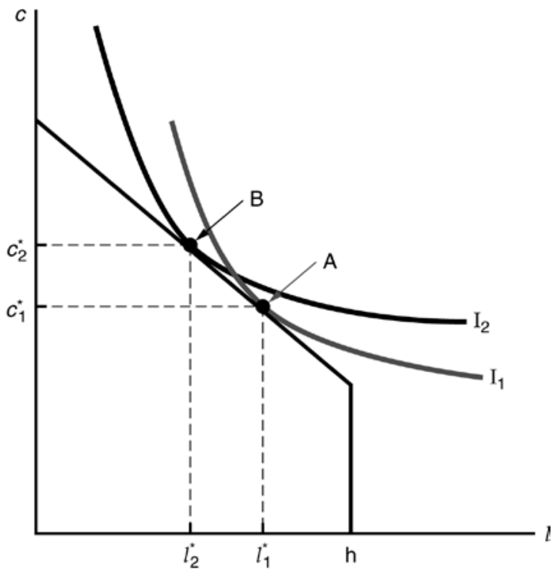


Figure 4.7

No. 8 **(10 points)**

The firm chooses its labor input, N^d, so as to maximize profits. When there is no tax, 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 panel in Figure 4.7 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 bottom panel of Figure 4.7.

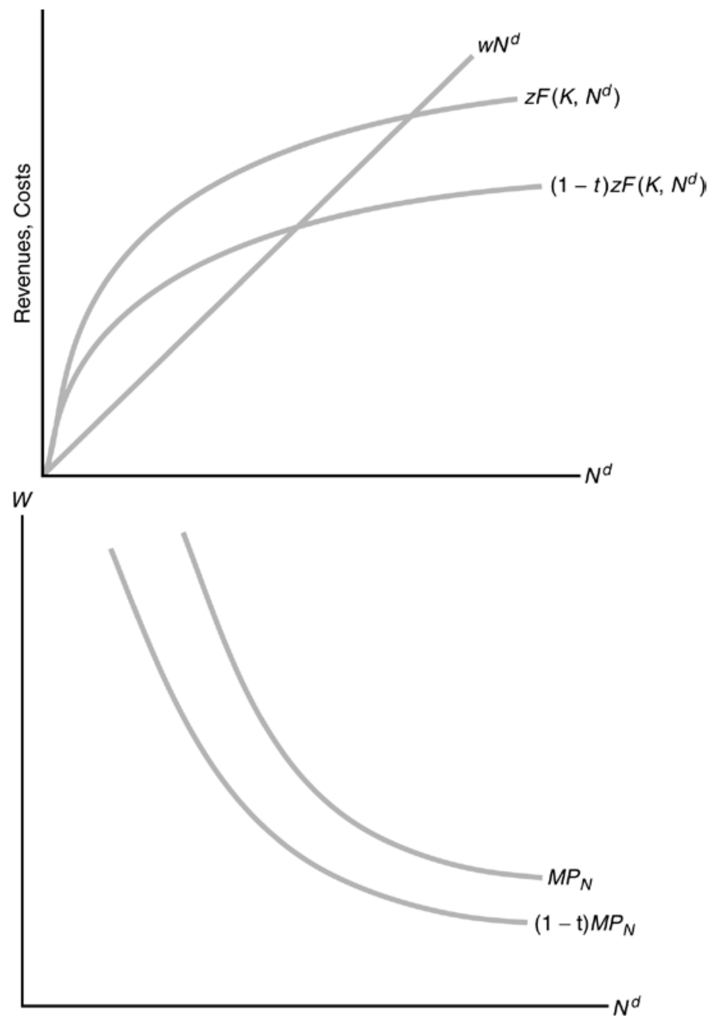


Figure 4.8

With a tax that is proportional to the firm's output, the firm's profits are given by:

$$\pi = zF(K, N^d) - wN^d - tzF(K, N^d)$$
$$= (1-t)zF(K, N^d),$$

where the term $(1-t)zF(K, N^d)$ is the after-tax revenue function, and as before, wN^d is the cost function. In the top panel of Figure 4.7, the tax acts to shift down the revenue function for the firm and reduces the slope of the revenue function. 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, but the slope of the revenue function is $(1-t)MP_N$, so the firm chooses the quantity of labor where $(1-t)MP_N = w$. In the bottom panel of Figure 4.7, the labor demand curve is now $(1-t)MP_N$, and the labor demand curve has shifted down. The tax acts to reduce the after-tax marginal product of labor, and the firm will hire less labor at any given real wage.

No. 9 **(10 points)**

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 panel in Figure 4.8 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 bottom panel of Figure 4.8.

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 top panel of Figure 4.8, 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, $(t - s)$, so the firm chooses the quantity of labor where

$MP_N = w - s$.

In the bottom panel of Figure 4.8, 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.

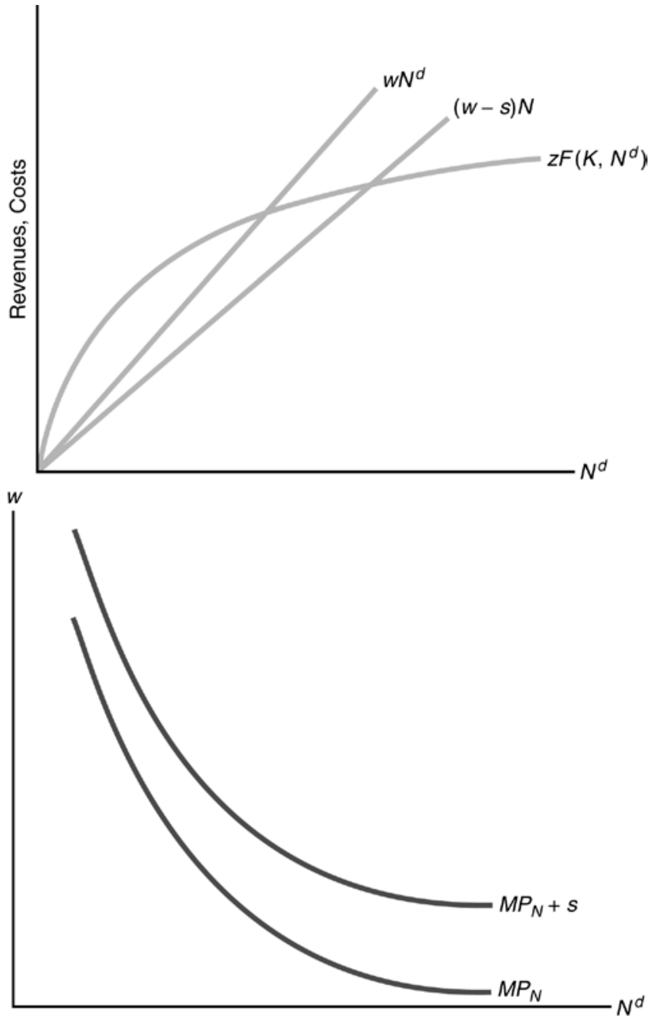


Figure 4.9

No. 13 **(10 points)**

$Y = zK^{0.3}n^{0.7}$

(a) $Y = n^{0.7}$. See the top panel in Figure 4.13. The marginal product of labor is positive and diminishing.

(b) $Y = 2n^{0.7}$. See Figure 4.13.

(c) $Y = 2^{0.3}n^{0.7} \approx 1.23n^{0.7}$. See Figure 4.13.

(d) See the bottom panel of Figure 4.13.

$z = 1, K = 1 \Rightarrow MP_N = 0.7n^{-0.3}$

$z = 2, K = 1 \Rightarrow MP_N = 1.4n^{-0.3}$

$z = 1, K = 2 \Rightarrow MP_N = 2^{0.3} \times 0.7n^{-0.3} \approx 0.86n^{-0.3}$

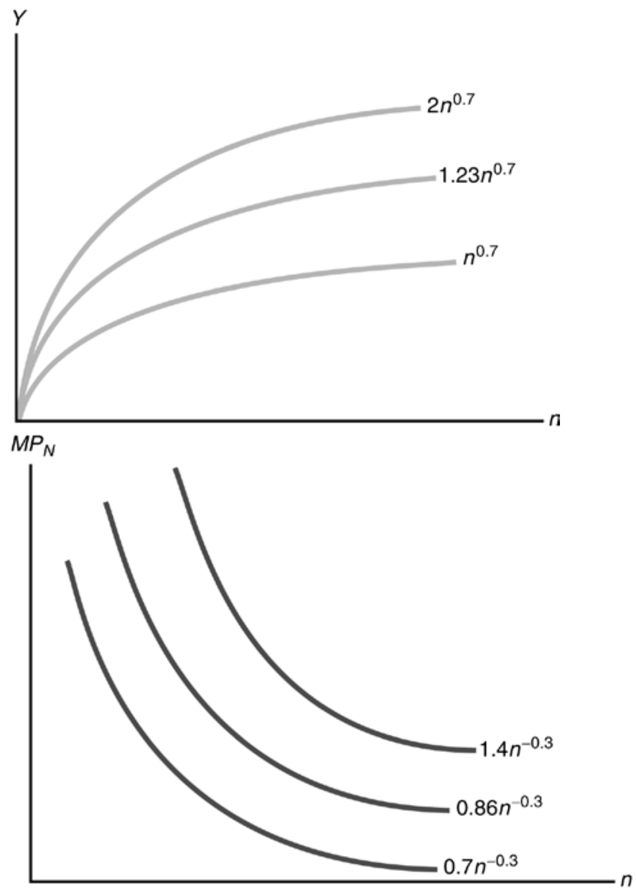


Figure 4.13