Economics 500: Microeconomic Theory

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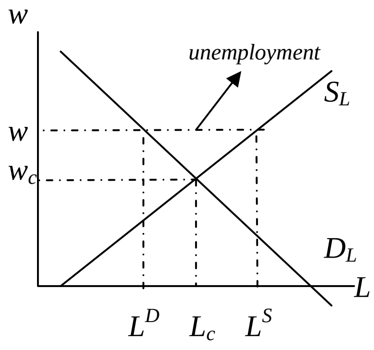
Problem Set #9 – Answers

1. Offer an example of both adverse selection and moral hazard in production. Discuss the related impact on market outcomes of each of these examples.
   See the lecture notes.

2. When there is asymmetric information regarding how hard workers work, equilibrium in the labor market may contain efficiency wages and involuntary unemployment. Explain. Why don't firms reduce wage they pay workers in response to the excess supply of labor?
   Under asymmetric information, firms do not know how hard the workers are working.
   For an employee,
   $U=U(I, e) \quad e=e(w-w_c,s)$
   For an employer,
   $\pi = \pi(I, e, s)$
   Necessary condition for firms to maximize π, $w-w_c>0$, $s>0$
   Because under asymmetric information, the firms can not know how hard every worker is working, so the firms pay the workers at the same wage rate.
   If the wage rate is at w_c*, the good-performance workers who should be paid at higher wage than* w_c *if the firm know how hard they are working, will feel unfair and work less hard. To avoid this happens, the firms have to pay wages higher than* w_c ➔ $w-w_c>0$.
   To encourage those whose performances are not worth w, the firms need to employ some supervisors to encourage workers working hard. This increases the cost of the firms.
   In addition the firm pay higher wage than w_c*, because that will cause involuntary unemployment, the employees know that if they do not work hard, someone else is ready to replace them, therefore they will work hard*➔*firms increase* π.



3. A machine that costs 100 will yield returns of 30 at the end of each of the next 3 years, at which time it will be sold as scrap for 30. If the interest rate facing this firm is 10 percent (note that it does not change over time), should it purchase this machine? Now suppose the interest rate decreases by ten percent each year, should it purchase this machine?

   C=100, R=30, t=3, S=30

   r=10%, PV= $\frac{R}{1.1}+\frac{R}{1.1^2}+\frac{R+S}{1.1^3}=\frac{30}{1.1}+\frac{30}{1.1^2}+\frac{30+30}{1.1^3}=97.15<100$ ➔*PV<cost*

   ➔*It should not purchase this machine.*

   $r_1=10\%, r_2=9\%, r_3=8.1\%$

   PV= $\frac{R}{1.1}+\frac{R}{1.1*1.09}+\frac{R+S}{1.1*1.09*1.081}=\frac{30}{1.1}+\frac{30}{1.1*1.09}+\frac{30+30}{1.1*1.09*1.081}=27.27+25.02+46.29=98.58<100$

   ➔*PV<cost*➔*It should not purchase this machine.*

4. Assume an individual expects to work for 40 years and then retire with a life expectancy of an additional 20 years. Suppose also that the individual's earning rise at a rate of 3 percent per year and that the interest rate is also 3 percent (the overall price level is constant in this problem). What (constant) fraction of income must the individual save in each working year to be able to finance a level of retirement income equal to 60 percent of earnings in the year just prior to retirement?

   Working years:40; Retire years:20

   Wage increasing rate 3%; interest rate 3%

   Suppose pay at the beginning, n^{th} *working year income is* I_n*:*

   The present value of retire year's income,

   $PV_R=\frac{60\%*I_{40}}{(1+r)^{40}}+\frac{60*I_{40}}{(1+r)^{41}}+...+\frac{60*I_{40}}{(1+r)^{59}}$, $I_{40}=I_1*(1+3\%)^{39}$

   ➔$PV_R=\frac{60\%*I_1*(1+3\%)^{39}}{(1+3\%)^{40}}+\frac{60*I_1*(1+3\%)^{39}}{(1+3\%)^{41}}+...+\frac{60*I_1*(1+3\%)^{39}}{(1+3\%)^{59}}$

   $=60\%*I_1*\frac{1}{(1+3\%)}+\frac{1}{(1+3\%)^2}+...+\frac{1}{(1+3\%)^{20}}$

   Suppose the individual saves C% of his income every working year.

   $PV_S=C*I_1+\frac{60\%*I_1*(1+3\%)}{(1+3\%)}+\frac{60*I_1*(1+3\%)^2}{(1+3\%)^2}+...+\frac{60*I_1*(1+3\%)^{39}}{(1+3\%)^{39}}=40CI_1$

   ➔$PV_R=PV_S$➔$40CI_1=60\%*I_1*\frac{1}{(1+3\%)}+\frac{1}{(1+3\%)^2}+...+\frac{1}{(1+3\%)^{20}}$

   ➔*C=22.32%*

   So the individual should save 22.32% of his income in each working year.

5. Suppose that a monopoly farmer of Wonder Grain must pay all of its costs of production in this year but that it must wait until next year to sell its output. Why would the farm's profit-maximizing output level be the level for which MR = MC (1 +r)?

Profit function of the farmer at current year: $\pi = TR(q)/(1+r) - TC(q)$

Max profit: FOC $\frac{\partial \pi}{\partial q} = \frac{1}{1+r} \cdot \frac{\partial TR(q)}{\partial q} - \frac{\partial TC(q)}{\partial q} = 0$

$\frac{1}{1+r} \cdot \frac{\partial TR(q)}{\partial q} = \frac{\partial TC(q)}{\partial q}$ ➔ $MR(q)=(1+r)MC_0(q)$ ➔ $MC_0=MR/(1+r)$

Explain why this profit-maximizing condition takes all costs into account.

Here, the farmer's all cost is not only including the total cost of production, but also the time value. Because if he can get revenue in the same year of costs, he can deposit his revenue in bank and get more revenue, so we need to take the time value into account.

Would this farmer produce more or less output if he or she could defer paying costs until next period?

Suppose he could defer paying costs until next year.

His profit function: $\pi = TR(q)/(1+r) - TC(q)/(1+r)$

Max profit: FOC $\frac{\partial \pi}{\partial q} = \frac{1}{1+r} \cdot \frac{\partial TR(q)}{\partial q} - \frac{1}{1+r} \cdot \frac{\partial TC(q)}{\partial q} = 0$ ➔ $MR=MC_1$

➔ MC_1 *of optimal point increases.*

➔ *The farmer produces more, if he/she can defer paying costs.*

Explain why the firm should also hire any input, such as labor, up to the point at which $MRP_L = w*(1 + r)$.

Suppose $q=q(L)$ $MP_L = \frac{\partial q}{\partial L}$ *and* $P=P(q)$*, since he is a monopoly farmer.*

$TR=P(q(L))*q(L)$ ➔ $MR = \frac{\partial TR(q)}{\partial q} = \frac{\partial P}{\partial q} + P$

Suppose L is the only input.

$TC=wL(1+r)$

Max $\pi = TR-TC = P(q(L))*q(L) - wL(1+r)$

FOC: $\frac{\partial \pi}{\partial L} = \frac{\partial P}{\partial q} \cdot \frac{\partial q}{\partial L} \cdot q + P \cdot \frac{\partial q}{\partial L} - w(1+r) = 0$ ➔ $(\frac{\partial P}{\partial q} \cdot q + P) \cdot \frac{\partial q}{\partial L} = w(1+r)$

➔ $MP_L*MR=w(1+r)$ ➔ $MRP_L=w(1+r)$

Which means to maximize profit, the marginal revenue of any input should be equal to the marginal cost of this input.