Homework 5

answers

Problem 1 Efficiency wages[1] are often suggested as one of the causes of long-term structural unemployment.

a. Explain how efficiency wages arise as a consequence of worker moral hazard.

The in-class lecture of Tuesday, October 18 addresses this. The basic story is that to prevent workers from shirking, employers can (broadly) choose between more monitoring of their activities at work or harsher punishments for workers caught shirking. The latter is generally cheaper to implement, but the worst punishment possible is termination of the worker. One way of making this more severe is to pay an above-market wage so that your job is better than the next best job the worker can get if fired.

b. Larry works construction; he works alongside his supervisor, and checks in with him constantly. Creed works for Dunder Mifflin, doing an assortment of poorly-defined general office tasks; he sees his supervisor at coffee breaks, but rarely directly discusses work with him. Which of these workers is more likely to be paid an efficiency wage, and why?

Larry is constantly monitored by his supervisor by virtue of working next to him; Creed is rarely monitored. Larry's employer may see little need to pay Larry an efficiency wage, as Larry's job isn't really subject to moral hazard. Creed's job is, and one solution to worker moral hazard is to pay an efficiency wage.

c. Efficiency wage theory suggests that paying a worker more will make him more productive. Suppose you had data on the wages and productivity of all US workers. What difficulties would you face in testing whether or not the proposed relationship between wage and productivity actually shows up in the data?

The main difficulty is establishing causality: more productive people are paid higher wages because they are more productive (i.e. people who go to college make higher wages than people who don't), but efficiency wage theory claims that higher wages lead to higher productivity across the same group of workers.

Problem 2 Suppose that workers value their time anywhere between \$0/hour and \$50/hour, with every value between 0 and 50 being equally likely. A worker will take a job only if the wage is above the value of his time. Suppose that if a worker takes a job, he will generate revenue equal to 1.5 times the amount he values his time (that is, a worker who values his time at \$20/hour will generate $\$20 * 1.5 = \$30$ revenue for a firm each hour). Firms cannot how productive workers are before hiring them; all workers look identical.

a. Is there an equilibrium in which all workers are hired? If so, describe it (what wages are paid, which workers work). If not, is there an equilibrium in which any workers are hired?

No; if all workers were to be hired, the max wage a firm would be willing to pay is \$37.50, but the best workers will not work at this wage. Similar to the used car example from the lecture of Tuesday, October 11, this market will completely unravel, and no workers will work for firms.

b. What is the name for this economic phenomenon studied in this question?

Adverse selection or market collapse.

c. Suppose workers become more productive, so that now when a worker is hired, he increases a firm's revenue by X times the amount he values his time (that is, a worker who values his time at \$20/hour will generate $\$20 * X$ dollars for a firm each hour). Would you get a different answer to part a if X were much larger? Explain why.

[1] Efficiency wage = any wage above the market clearing wage.

Yes, you would get a different answer. Suppose all workers work. Then, a firm is willing to pay a wage no higher than average productivity, which is $25X$. So, as long as $X > 2$, there is an equilibrium in which all workers work, and adverse selection is not a problem.

Problem 3 Suppose that normal workers increase a firm's revenue by \$6, while smart workers increase revenue by \$$A$, where $A > 6$. Firms cannot tell smart workers from normal workers *ex ante*, but can observe a worker's educational level.

Any worker can acquire as much education as she wishes, but getting e years costs a normal worker $B * e$, where $B > 1$, while e years cost a smart worker only e.

a. Solve for e^*, the minimum years of education that smart workers must get to differentiate themselves from normal workers. Your answer will be a function of the variables A and B.

Following the lecture of Thursday, October 13, the normal workers must be indifferent between 0 education (and utility 6) and e^* education (and utility $A - Be^*$). This gives

$$e^* = \frac{A-6}{B}$$

b. As A increases, does e^* increase or decrease? Explain intuitively why this is the case.

e^* is increasing in A. As smart workers become more productive, they are paid more in a competitive labor marker, and so there is more of an incentive for normal workers to try to pool witht he smart workers by getting education. Therefore, education must be made costlier, by increasing the number of years required to be identified as a smart worker.

c. As B increases, does e^* increase or decrease? Explain intuitively why this is the case.

As B increases, e^* decreases. This is because as education becomes costlier to normal workers, less education is required for smart workers to differentiate themselves from normal workers.

Problem 4 A 2009 study by the White Group found that new cars lose, on average, 30% of their resale value in the first year after purchase, but only an additional 5% in their second year after purchase. Explain why this is, using concepts discussed in class.

Used cars are subject to adverse selection; there are (potentially large) differences in quality across a given make/model of used cars, so buyers will only pay for average quality, which causes people with used cars in good shape to be unwilling to sell them, which lowers average quality, etc. Adverse selection is not a problem with new cars. So the 30% decrease is because of the shift from new to used cars, while the problem of adverse selection isn't really any worse for 1-year old cars versus 2-year old cars, so the 5% decrease in the second year may just be normal depreciation from age.

Problem 5 ABC explosives has purchased fire insurance for its factory. It can institute a fire prevention program, which would cost \$90, but which would lower the probability of a fire from .01 to .001. The insurance company cannot determine whether ABC has instituted the program. However, it charges a deductible in the event of a fire (i.e. ABC has to pay a certain amount to the insurance company if a fire occurs).

a. What problem discussed in class is the insurance company worried about in charging a deductible?

Moral hazard.

b. What is the smallest deductible that will incentivize ABC to institute the fire prevention program? (Hint: ABC's expected loss from a fire with no fire prevention program is $.01 * deductible$. Compare this to the expected loss from a fire with the fire prevention program.)

If ABC purchases the fire prevention plan, it's expected loss is $90 + .001 * D$, where D is the deductible they must pay in the event of a fire. If they do not purchase the fire prevention plan, their expected loss is $.01 * D$. They will purchase the plan if and only if

$$\begin{aligned} 90 + .001D &\leq .01D \\ D &\geq \$10,000 \end{aligned} \tag{1}$$

Problem 6 A principal hires an agent to run a business for one year. The agent can exert high effort or low effort. High effort lowers the agent's utility by 10,000. Low effort is costless. If the agent exerts high effort, the business makes a profit of \$150,000 with probability .5 and breaks even with probability .5. If the agent exerts low effort, the business makes a \$150,000 profit with probability .25, and breaks even with probability .75. The principal cannot tell what effort level is exerted, although he is of course aware of the business's profit. The agent's utility function is his annual salary minus the cost of effort, and he can be guaranteed a utility of \$50,000 if he quits and works for his brother's landscaping business (his outside option).

a. If the principal pays the agent a fixed salary S, what effort level does the agent choose?

With a fixed salary, the agent gets paid the same regardless of his effort, and so he will exert low effort.

b. Now suppose that the principal pays the agent a fixed salary S and a bonus B, to incentivize the agent to exert high effort. Write down the participation constraint and the incentive constraint, and clearly label each.

The participation constraint says that the agent must earn at least as much in expectation by working for the principal as he can working for the landscaping business. The incentive constraint says that the agent must prefer high effort to low effort. Both are given below.

$$\text{incentive constraint: } .5(S+B) + .5S - 10,000 \geq .25(S+B) + .75S \tag{2}$$

$$\text{participation constraint: } .5(S+B) + .5(S) - 10,000 \geq 50,000 \tag{3}$$

c. Solve for the choices of S and B that maximize the owner's profit. Be sure to show that offering a contract with a bonus is more profitable to the owner than offering a contract with no bonus, and only a fixed salary.

The owner wishes to pay the lowest salary and bonus for which (2) and (3) hold. If both equations hold with equality, then:

$$S = \$40,000$$
$$B = \$40,000$$

Thus, $S = B = \$40,000$ is the optimal contract to induce high effort. Finally, we must make sure that the principal is better off with the agent exerting high effort than low effort. Under high effort, the principal makes an expected profit of \$15,000 — he makes a profit of \$70,000 in years in which the business is profitable, and -\$40,000 in years in which it is not; as these outcomes are equally likely, his expected profit is the average of \$70,000 and -\$40,000.

Now, the optimal contract to induce low effort is $S = \$50,000$, $B = \$0$. In this case, the principal earns a profit of \$100,000 in years in which the business is profitable, and -\$50,000 in years in which it is not. Under low effort, the business is profitable only 25% of the time, so the principal's expected profit is $.25 * \$100,000 + .75 * -\$50,000 = -\$12,500$. So, the principal makes a higher profit by inducing high effort from the agent.