

LABOR ECONOMICS (EE 471)

☺☺ Optional practice questions ☺☺

Chapter 6

1. Debbie is about to choose a career path. She has narrowed her options to two alternatives. She can either become a marine biologist or a concert pianist. Debbie lives two periods. In the first, she gets an education. In the second, she works in the labor market. If Debbie becomes a marine biologist, she will spend \$15,000 on education in the first period and earn \$472,000 in the second period. If she becomes a concert pianist, she will spend \$40,000 on education in the first period and then earn \$500,000 in the second period.

(a) Suppose Debbie can lend and borrow money at a 5 percent rate of interest between the two periods. Which career will she pursue? What if she can lend and borrow money at a 15 percent rate of interest? Will she choose a different option? Why?

(b) Suppose musical conservatories raise their tuition so that it now costs Debbie \$60,000 to become a concert pianist. What career will Debbie pursue if the interest rate is 5 percent?

2. Peter lives for three periods. He is currently considering three alternative education-work options. He can start working immediately, earning \$100,000 in period 1, \$110,000 in period 2 (as his work experience leads to higher productivity), and \$90,000 in period 3 (as his skills become obsolete and physical abilities deteriorate). Alternatively, he can spend \$50,000 to attend college in period 1 and then earn \$180,000 in periods 2 and 3. Finally, he can receive a doctorate degree in period 2 after completing his college education in period 1. This last option will cost him nothing when he is attending graduate school in the second period as his expenses on tuition and books will be covered by a research assistantship. After receiving his doctorate, he will become a professor in a business school and earn \$400,000 in period 3. Peter's discount rate is 20 percent per period. What education path maximizes Peter's net present value of his lifetime earnings?

3. Jane has three years of college, Pam has two, and Mary has one. Jane earns \$21 per hour, Pam earns \$19, and Mary earns \$16. The difference in educational attainment is due completely to different discount rates. How much can the available information reveal about each woman's discount rate?

4. Suppose Carl's wage-schooling locus is given by

<u>Years of Schooling</u>	<u>Earnings</u>
9	\$18,500
10	\$20,350
11	\$22,000
12	\$23,100
13	\$23,900
14	\$24,000

Derive the marginal rate of return schedule. When will Carl quit school if his discount rate is 4 percent? What if the discount rate is 12 percent?

5. Suppose there are two types of persons: high-ability and low-ability. A particular diploma costs a high-ability person \$8,000 and costs a low-ability person \$20,000. Firms wish to use education as a screening device where they intend to pay \$25,000 to workers without a diploma and \$ K to those with a diploma. In what range must K be to make this an effective screening device?

6. Some economists maintain that the returns to additional years of education are actually quite small but that there is a substantial "sheepskin" effect whereby one receives a higher salary with the successful completion of degrees or the earning of diplomas (i.e., sheepskins).

(a) Explain how the sheepskin effect is analogous to a signaling model.

(b) Typically in the United States, a high school diploma is earned after 12 years of schooling while a college degree is earned after 16 years of school. Graduate degrees are earned with between 2 and 6 years of post-college schooling. Redraw Figure 6-2 under the assumption that there are no returns to years of schooling but there are significant returns to receiving diplomas.

(c) Devise a difference-in-differences estimator (i.e., what data would you need and what would you do with the data) that would allow one to get at whether completing each year of school or completing degrees matters more when determining wages.

7. Jill is planning the timing of her on-the-job training investments over the life cycle. What happens to Jill's OJT investments at every age if

(a) the market-determined rental rate to an efficiency unit falls?

(b) Jill's discount rate increases?

(c) the government passes legislation delaying the retirement age until age 70.

(d) technological progress is such that much of the OJT acquired at any given age becomes obsolete within the next 10 years.

ANSWERS

1. Debbie is about to choose a career path. She has narrowed her options to two alternatives. She can either become a marine biologist or a concert pianist. Debbie lives two periods. In the first, she gets an education. In the second, she works in the labor market. If Debbie becomes a marine biologist, she will spend \$15,000 on education in the first period and earn \$472,000 in the second period. If she becomes a concert pianist, she will spend \$40,000 on education in the first period and then earn \$500,000 in the second period.

(a) Suppose Debbie can lend and borrow money at a 5 percent rate of interest between the two periods. Which career will she pursue? What if she can lend and borrow money at a 15 percent rate of interest? Will she choose a different option? Why?

Debbie will compare the present value of income for each career choice and choose the career with the greater present value. If the interest rate is 5 percent,

$$PV_{Biologist} = -\$15,000 + \$472,000/(1.05) = \$434,523.81$$

and

$$PV_{Pianist} = -\$40,000 + \$500,000/(1.05) = \$436,190.48.$$

Therefore, she will become a concert pianist. If the rate of interest is 15 percent, however, the present value calculations become

$$PV_{Biologist} = -\$15,000 + \$472,000/(1.15) = \$395,434.78$$

and

$$PV_{Pianist} = -\$40,000 + \$500,000/(1.15) = \$394,782.61.$$

In this case, Debbie becomes a biologist. As the interest rate increases, the worker discounts future earnings more, lowering the returns from investing in education.

(b) Suppose musical conservatories raise their tuition so that it now costs Debbie \$60,000 to become a concert pianist. What career will Debbie pursue if the interest rate is 5 percent?

Debbie will compare the present value of being a biologist from part (a) with the present value of becoming a pianist. The relevant present values are:

$$PV_{Biologist} = -\$15,000 + \$472,000/(1.05) = \$434,523.81$$

and

$$PV_{Pianist} = -\$60,000 + \$500,000/(1.05) = \$416,190.48.$$

Debbie will, therefore, become a biologist, showing that as the cost of an invest increases, the chance of pursuing that investment falls.

2. Peter lives for three periods. He is currently considering three alternative education-work options. He can start working immediately, earning \$100,000 in period 1, \$110,000 in period 2 (as his work experience leads to higher productivity), and \$90,000 in period 3 (as his skills become obsolete and physical abilities deteriorate). Alternatively, he can spend \$50,000 to attend college in period 1 and then earn \$180,000 in periods 2 and 3. Finally, he can receive a doctorate degree in period 2 after completing his college education in period 1. This last option will cost him nothing when he is attending graduate school in the second period as his expenses on tuition and books will be covered by a research assistantship. After receiving his doctorate, he will become a professor in a business school and earn \$400,000 in period 3. Peter's discount rate is 20 percent per period. What education path maximizes Peter's net present value of his lifetime earnings?

The present discounted values of Peter's earnings associated with each of the alternatives are

$$PV_{HS} = 100,000 + \frac{110,000}{1.2} + \frac{90,000}{1.2^2} = \$254,167,$$

$$PV_{COL} = -50,000 + \frac{180,000}{1.2} + \frac{180,000}{1.2^2} = \$225,000,$$

and

$$PV_{PhD} = -50,000 + \frac{0}{1.2} + \frac{400,000}{1.2^2} = \$227,778.$$

Thus, the best option for Peter is to start working upon completely high school.

3. Jane has three years of college, Pam has two, and Mary has one. Jane earns \$21 per hour, Pam earns \$19, and Mary earns \$16. The difference in educational attainment is due completely to different discount rates. How much can the available information reveal about each woman's discount rate?

The returns to increasing one's education from one to two years of college and then from two to three years of college are

$$r_{1to2} = \frac{\$19 - \$16}{\$16} = 18.75\% \quad \text{and} \quad r_{2to3} = \frac{\$21 - \$19}{\$19} = 10.53\%.$$

Having observed their educational choices, we know that Mary's discount rate is greater than 18.75 percent (otherwise she would have invested in a second year of education and earned 18.75% on the investment), Pam's is between 10.53 percent and 18.75 percent, and Jane's is less than 10.53 percent.

4. Suppose Carl's wage-schooling locus is given by

<u>Years of Schooling</u>	<u>Earnings</u>
9	\$18,500
10	\$20,350
11	\$22,000
12	\$23,100
13	\$23,900
14	\$24,000

Derive the marginal rate of return schedule. When will Carl quit school if his discount rate is 4 percent? What if the discount rate is 12 percent?

The marginal rate of return is given by the percentage increase in earnings if the worker goes to school one additional year.

<u>Schooling</u>	<u>Earnings</u>	<u>MRR</u>
9	\$18,500	
10	\$20,350	10.0
11	\$22,000	8.1
12	\$23,100	5.0
13	\$23,900	3.5
14	\$24,000	0.4

Carl will quit school when the marginal rate of return to schooling falls below his discount rate. If his discount rate is 4 percent, therefore, he will quit after 12 years of schooling; if his discount rate is 12 percent, he will quit after 9 years of schooling.

5. Suppose there are two types of persons: high-ability and low-ability. A particular diploma costs a high-ability person \$8,000 and costs a low-ability person \$20,000. Firms wish to use education as a screening device where they intend to pay \$25,000 to workers without a diploma and \$K to those with a diploma. In what range must K be to make this an effective screening device?

In order for a low-ability worker to not pursue education, it must be that

$$\$25,000 \geq K - \$20,000,$$

otherwise pursuing the diploma would be better than not pursuing the diploma. Thus, it must be that $K \leq \$45,000$ to make sure low-ability people don't pursue the diploma.

Similarly, in order for a high-ability worker to pursue education, it must be that

$$K - \$8,000 \geq \$25,000,$$

otherwise not pursuing the diploma would be better than pursuing the diploma. Thus, it must be that $K \geq \$33,000$ to make sure high-ability people pursue the diploma.

Thus, in order to use education as a signaling device in this example, it must be that educated workers are paid between \$33,000 and \$45,000.

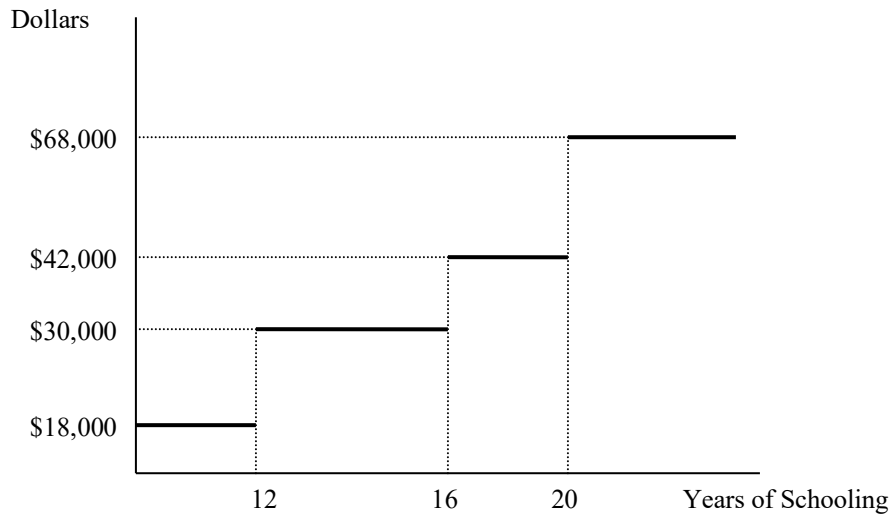
6. Some economists maintain that the returns to additional years of education are actually quite small but that there is a substantial “sheepskin” effect whereby one receives a higher salary with the successful completion of degrees or the earning of diplomas (i.e., sheepskins).

(a) Explain how the sheepskin effect is analogous to a signaling model.

The sheepskin effect is analogous (in fact it is identical) to the signaling model in that purchasing the signal doesn't actually change the person's skills or productivity. Rather, purchasing the signal in effect documents or reveals that the person is a high ability person. This is exactly the same as the sheepskin effect. That is, paying the money and sitting through classes and doing the work doesn't change the person. Rather, no one without high skills would choose to do this, so acquiring a sheepskin is a tool by which to “signal” one's productivity even though achieving the sheepskin had not direct effect on the individual.

(b) Typically in the United States, a high school diploma is earned after 12 years of schooling while a college degree is earned after 16 years of school. Graduate degrees are earned with between 2 and 6 years of post-college schooling. Redraw Figure 6-2 under the assumption that there are no returns to years of schooling but there are significant returns to receiving diplomas.

The Wage-Schooling Locus with Sheepskin Effects



The bold line in the above graph gives the wage-schooling locus with sheepskin effects. In particular, anyone without a high school diploma earns \$18,000; anyone with a high school diploma (and no college diploma) earns \$30,000; someone with a college diploma (but not a graduate school diploma) earns \$42,000; and people with a graduate degree earn \$68,000.

(c) Devise a difference-in-differences estimator (i.e., what data would you need and what would you do with the data) that would allow one to get at whether completing each year of school or completing degrees matters more when determining wages.

One way to do this without a difference-in-differences estimator (in fact, it is just a differences estimator) would be to collect data on yearly salary, years of education, and diplomas on a randomly chosen group of individuals. From these data, a wage-schooling locus can be produced. One could then see if it looks like the graph above (suggesting a sheepskin effect) or like the graph in Figure 6-2 (suggesting continuous returns to each year of education). The problem here is that self-selection remains a problem.

In order to use a difference-in-differences estimator, one would want to grab a random group of a cohort of individuals (say born in 1980) and observe each person's years of schooling, diplomas, and salary in two separate years. Differences in income can then be computed for all, as well as differences in years of education and differences in diplomas if any exist. The difference-in-differences estimator is then straightforward. The difficult part is making sure some people don't change years of education or diplomas across the two time periods while others change just years of education (and return to work) without ever receiving an additional diploma, while others change their years of education and receive an additional diploma (and have returned to work). This estimator still suffers from selection bias, but it is less than a simple differences estimator.

7. Jill is planning the timing of her on-the-job training investments over the life cycle. What happens to Jill's OJT investments at every age if

(a) the market-determined rental rate to an efficiency unit falls?

The marginal revenue of investing in OJT declines, so Jill will invest less at each age as the return to making the investment has fallen.

(b) Jill's discount rate increases?

If Jill's discount rate increases she becomes more "present oriented", reducing the future benefits associated with OJT. Thus her OJT investments fall as she no longer values the benefits from making the investment as much as she had before her discount rate fell.

(c) the government passes legislation delaying the retirement age until age 70.

The marginal revenue of investing in OJT increases because the payoff period to the investment is longer. Thus, she undertakes more OJT in this case.

(d) technological progress is such that much of the OJT acquired at any given age becomes obsolete within the next 10 years.

The marginal revenue to investing in OJT declines and the amount of OJT acquired falls.