

I. Quasi-fixed costs #2: Training Investments and the Demand for Labor

A. Human Capital: an Introduction

"Human capital" is the embodied skills of a worker, their potential stock of productive activity. This human capital provides a flow of services that, utilized with time, can be used in employment to earn an income. Alternatively, human capital can be used in leisure to enhance human enjoyment and the quality of life. In this lecture, we focus on investments made after school, on-the-job (OJT) that potentially enhance workplace productivity.

As with physical capital (factories, houses, roads, etc.), the quantity and quality of the human-capital stock can be increased through such investments. When a firm makes such an investment, it generally becomes a quasi-fixed cost. Almost every job in our modern economy involves such investments: secretaries learning multi-tasking computer skills, Econ 463 graduates working in executive positions for multi-national companies, Utah Valley residents creating multi-level marketing firms, and multi-personality winter Olympics committee members creating new names for "tax." Since skilled employment is very important in today's labor market, these investments have a large impact on labor demand.

In terms of the stock of productivity potential and the flow of labor services, human capital may be likened to an irrigation dam, as indicated in Table 1.

Table 1: Human Capital as an Irrigation Dam

Type of investment:	An Irrigation Dam as a Farming Investment	Human Capital as a Work Investment
investor	farmers	firms (specific HK), workers (general HK)
capital asset	irrigation capacity	stock of human capital
asset service flow	water flowing for irrigation purposes	labor services flowing into productive work
investment in capacity	building up greater capacity by enlarging the dam	formal education in school, on the job training
maintenance	good repair and maintenance of dam	health investments: medical care, exercise, diet
alternative use of the capital asset	alternative uses of dam: recreational boating, fishing, water skiing, etc.	alternative uses of human capital: enhance home production, leisure, consumption activities

Irrigation is used in many places to capture water during the wet season by means of an irrigation dam, in order to distribute water over the whole year¹. The size of the irrigation dam determines its potential for watering large tracts of farm land, just as formal schooling (to be discussed later) and informal on-the-job training determine the capacity

of a worker to do various tasks. The stock of a worker's potential is known as her human capital.

While the accumulated water in the dam (the "stock") measures its potential irrigation capacity, it is the flow of water that is the direct benefit. It is similar for firms and workers: all the training in the world is of no use to the firm until that training is applied to actual productive activities. That is, the productive use of human capital is the skilled labor services that workers provide to their firms.

The owners of the dam maintain its value both by augmenting its capacity and by keeping it in good repair. Workers augment their human capital by educational and on-the-job training investments, and help maintain their capacity for working by investments in health. However, not all investments are automatically profitable to the owners. Farmers, for instance, may subsidize dam maintenance only to find that it increases recreational uses more than agricultural uses. Likewise firms may invest in education and health, and find that the returns from those investments are less than their costs.

Because returns from human capital investment are realized as a flow of labor services (just as the returns to building a dam is realized as the flow of irrigation and other services it generates over time), larger OJT investments will be made in younger workers since they have a potentially longer working life over which they can recover those investments. The profitability or "cost effectiveness" of an investment is measured by weighing future benefits against current costs. To illustrate, consider a college graduate who is evaluating some post-college alternative investments, with costs and benefits given in Table 2. In these hypothetical examples, we assume that there is no price inflation and that the costs and benefits to each investment activity are independent in the sense that costs/benefits for one project are not affected by other investments that may be undertaken.

Table 2: Hypothetical Investments (in thousands of dollars)

Investment Project	Net Benefit in Period					
	"t"	1 st	2 nd	3 rd	4 th	5 th
I. Executive Development Program		-100	0	30	60	60
II. Exercising		-3	-2	1	4	10
III. Retirement		-3	-3	-3	-3	20

Executive Development Program as an Investment

The three investments considered are 1) continuing education and getting a masters degree, 2) exercising on a regular basis, or 3) participating in a defined contribution retirement program. The one thing that is common with these hypothetical investments (typical also of investments in physical capital) is that the costs are incurred in the

beginning periods and the benefits are realized later. If benefits exceed costs, positive amounts are entered as in the last column.

If our graduate continues her participation in the company's executive development program, for example, it will cost her \$100 in terms of foregone wages (that she could have earned had she not attended the company's program), but brings her the extra earnings indicated in the 3rd, 4th and 5th periods. For example, in the 5th period a person who graduated from the program will earn \$60,000 more than a person that did not participate in the program. This is the net benefit in the fifth period of having been through the executive development program. If the value of these future benefits outweigh the current costs (when costs and benefits are appropriately discounted to the current period), then the investment will be undertaken.

Health as an Investment

Preventive and therapeutic health care services may improve workers' productivity as well as increase their quality of life. If so, these services increase the stock of human capital, and consequently, the productivity of labor services. Workers who have better health provide immediate benefits to themselves and the employers by having greater mental acuity, strength, and stamina while on the job. Also, the life expectancy of the human capital stock will affect the number of future years available for productive work, affecting incentives for other types of human-capital investments. The productivity of human capital, therefore, depends both on its embodied training and educational investment and on its physical, psychological, and emotional state of health. Investment in preventing and curing disease and disability that increases physical energy and psychological zest for living and working, is productivity-enhancing and makes labor more valuable to the firm. For the firm and its employees, therefore, incentives to invest in health capital can be just as powerful as incentives to invest in education and job training.

Because workers usually work for a given employer for more than one year, often it is in the firm's self-interest to invest, even when the current costs exceed the current benefits, since future benefits may also accrue to the worker and to the firm. Consider the "exercising" investments in Table 2 as an example of these points. We assume that exercise involves only "psychic" costs and benefits. That is, we assume that exercise involves no change in total expenditures relative to the no exercise regime. Nonetheless there are "inconveniences" and "life style" changes (adjusting to "sweat" and in the author's case, very, very hard breathing, for example) when participating in this exercise program. These nonmonetary, psychic costs, are translated into dollar values by asking the potential exerciser what she would be willing to pay to avoid the boredom of exercise.

Consider the net benefits of exercising in the first year, for example. Suppose that our exerciser reports that she would be willing to pay \$5,000 to avoid the sweat and hard breathingⁱⁱ. She also reports some benefits from exercise, including a sense of wellness and an improvement in the quality of leisure, worth about \$2,000 in the first year. That is, our exerciser would be willing to pay at most \$2,000 to purchase these benefits if she could buy them in the market place. The "-3" figure in the first year of the program indicates the initial net benefit of exercise was negative (-\$3,000) since the psychic costs

outweighed the psychic gains. Partly this is because the exerciser is young and the marginal impact of the exercise is small. However, as the good consequences of exercise manifest themselves over the life cycle (as they age, the gap in health between exercisers and non-exercisers continues to widen), we assume that the benefits increase relative to the costs. This is why our self-interested college graduate may choose to exercise, even though initially the net benefits are negative. In our example, as in life, frequently we engage in activities whose initial costs exceed their benefits, because eventually they will pay off. This underscores the importance of putting these investments into their long run, life cycle context.

Financial Investments, By Way of Contrast

The last investment in Table 2 is the decision whether or not to participate in a "defined contribution" retirement program offered by the employer. Here, the employer offers a 1 for 3 match: if the employees contributes \$3,000 each period toward retirement, then the employer will add an additional \$1,000. The plan has a 5 percent growth rate, yielding about \$20,000 at the end of the working career (when the retirement benefits are collected). Note that this is quite different from the previous two examples since the investment is in a financial asset rather than in human capital. It differs from "human capital" investments in three ways: 1) the benefits of the financial investment can be transferred to another person while human capital investments like health and education cannot be transferred, 2) the benefits of the financial asset are strictly monetary in nature (unlike education and good health, which may also include nonmonetary advantages), and 3) there is a market for financial assets, but no market for human capital assets (so it may be easier to "insure" financial assets because of the greater difficulty with accessing damage to human capital assets).

B. PRESENT VALUE (PV): EVALUATING THE ALTERNATIVES

For all of the investments above, we need a way of weighing future benefits against current costs, in order to decide which investments are good. In order to evaluate costs and benefits received at different periods in the life cycle, the concept of *present value* is very important. The issue is how to value a dollar today against a dollar received some time in the future, such as a year from today. The answer to this question, as well as the answer to virtually all economic questions, will depend on what the alternatives are. Suppose, for example, that we deposit \$100 today and get back \$105 next year. The rate of return, or interest rate, on our deposit is 5 percent: $\$100 * (1 + .05) = \105 . Such payments are determined by the following formula:

$$\text{deposits this year} * (1 + \text{rate of interest}) = \text{deposits next year}$$

If saving and accruing the interest is our alternative, we would not loan out \$100 today in order to be repaid with \$100 next period. Rather, we would require \$105 next period, before offering to loan someone \$100 today.

This is the essence of the present value calculation: \$100 this period will be worth \$105 next year, so \$105 received next year is equivalent to receiving a \$100 today.

That is, the present value of \$105 received next year is \$100, when the interest rate is 5 percent. What sum of money received in 2 years would be worth \$100 today, if the rate of interest on savings were 5 percent for the next 2 years? It would be \$110.25, since after one year we would have \$100*(1.05), and waiting an additional year--that is, after two years--we would have (\$100*(1.05))*(1.05). In order to find the present value, we must divide the future payments by “(1 plus the rate of interest)*(1 plus the rate of interest),” “(1 + .05)²” in our example with a five percent rate of interest:

$$\$100_{\text{this year}} = \frac{\$110.25_{\text{two years from now}}}{(1 + .05)^2}$$

This devaluing future income to current values by dividing through by the growth factor “(1+r)²”, where r is the rate of interest, is simply calculating the present value of future payments. The general pattern of calculating the present value of a payment Z, received in t years from now is

$$\text{Present Value of } Z = \frac{Z}{(1+r)^t}$$

assuming an interest rateⁱⁱⁱ of r. For an income stream of payments received for 5 years, starting this period (call it time “t”) and extending over the next 4 years, the present value is:

$$\begin{aligned} PV_t &= I_t + \frac{I_{t+1}}{(1+r)} + \frac{I_{t+2}}{(1+r)^2} + \frac{I_{t+3}}{(1+r)^3} + \frac{I_{t+4}}{(1+r)^4} \\ &= \sum_{i=0}^4 \frac{I_{t+i}}{(1+r)^i} \end{aligned}$$

Using the present value formula, we can evaluate the stream of payments associated with each of the investments considered above. When we receive benefits, it is recorded as a positive flow of income and when we incur costs, it is recorded as a negative flow of income. The income stream associated with the second investment alternative would be:

$$PV \text{ of the exercise “investment”} = -3 + \frac{-2}{(1+r)} + \frac{1}{(1+r)^2} + \frac{4}{(1+r)^3} + \frac{10}{(1+r)^4} = 7.6846,$$

if the interest rate were 5 percent (r=.05). (Since we calculate benefits/costs as of the first period, we do not begin discounting until next period when net benefits are -2.) At a 5 percent rate of interest, the future benefits are discounted relatively little so that the discounted benefits outweigh the current costs. Projects with positive net present value are those whose discounted benefits exceed their discounted costs, so they are worth undertaking. The *net present value rule* is to invest in all projects with a positive net present value. At a 5 percent rate of interest, it is easy to show that all of these projects are good investments.

A higher rate of interest means that the return to financial investments (like a savings account) is increasing relative to other types of investments. Unless the implicit return on those other investments (like the three discussed above) is equally high, then we will put our money in savings rather than invest it. For example, if the rate of interest

is 25 percent, then the net present value for the exercise investment would fall to 2.184 as follows:

$$\text{Net Benefit} = -3 + -2/(1+.25) + 1/(1+.25)^2 + 4/(1+.25)^3 + 10/(1+.25)^4 = 2.184$$

Since the net present value is still positive, it is still worth undertaking. But at an interest rate of 25 percent, neither one of the other investments are worth undertaking. The net present value for the executive development investment is as follows:

$$\text{Net Benefit} = -100 + 0/(1+.25) + 30/(1+.25)^2 + 60/(1+.25)^3 + 60/(1+.25)^4 = -.7284$$

When the rate of interest reaches 25 percent, then you are better off financially to leave your money in a bank (and earn the 25 percent interest) than to invest it in executive development. (You should prove to yourself, that the you are also better off financially to leave your money in a bank than make the defined contribution "investment" when the interest rate is 25 percent.)

C. Net Present Value and Training

Because of the nature of investments (in workers training), the firm has to weigh present costs against the future benefits, while considering the constraints placed on it by competition in the labor market. We model set-up, considering a two period employment model. Training may take place in the first period, the costs of that training would have to be offset by the benefits in the second period. Here is the setup:

MP_0 =value of worker's marginal product during training (period 0) = \$30,000

MP^* =value of worker's marginal product if worker is not trained (both periods) = \$40,000

MP_1 =value of worker's marginal product after being trained (period 1) = \$70,000

Z =costs of training to the firm (period 0)=\$10,000

W_0 =wage offered to the worker in period 0=?

W_1 =wage offered to the worker in period 1=?

The profit maximizing condition here is to train employees (add new "skilled" workers) until the present value of benefits from training,

$$MP_0 + \frac{MP_1}{(1+r)}$$

equals the present value of the marginal expense of labor:

$$W_0 + Z + \frac{W_1}{(1+r)},$$

or that

$$MP_0 + \frac{MP_1}{(1+r)} = W_0 + Z + \frac{W_1}{(1+r)} .$$

What wages (W_0, W_1) can be offered to the worker, that will satisfy this maximization condition while being at least as good as the alternative market wage (\$40,000 in our model)? The answer will depend partly on the rate of interest, r . Suppose we assume that it is five percent. Then let's try out an offer of paying the worker \$40,000 during the training phase (because that is the going rate for non-trained employees) and \$70,000 in the next (post-trained) period.

Paying \$40,000 during the first period results in a net loss during that period:

$$MP_0 - W_0 - Z = \$30,000 - \$40,000 - \$10,000 = -\$20,000$$

The net gain in the second period would be:

$$\frac{MP_1}{(1+r)} - \frac{W_1}{(1+r)} = \frac{\$70,000}{(1+.05)} - \frac{\$70,000}{(1+.05)} = 0.$$

With a “ $W_0=\$40,000; W_1=\$70,000$ ” offer, the firm loses $-\$20,000$ on its training investments. While the worker wouldn't mind this offer, it is unprofitable investment for the firm. What are some of the alternatives to the firm?

The firm could pay the worker her value of marginal product in the second period, only if the worker paid for all of their own costs in the first period. That is, one wage offer that would work would be “ $W_0=\$20,000; W_1=\$70,000$ ”. In this case, the worker pays for her own training. This turns out to be the right offer if the human capital training is *perfectly general* in the sense that the workers productivity is raised not only in the firm offering the training, but also in all other firms as well. Perfectly general training might be such things as time-management skills or general Internet browser skills. These increase the worker's productivity in many firms, not just the firm providing the training. In the case of general human capital training, if the firm were to pay for the training in the first period by say offering a wage contract of \$30,000 in the training period and \$59,500 in the post training period ($W_0=\$30,000; W_1=\$59,500$)—which satisfies the firms profit maximizing condition—

$$W_0 + Z - MP_0 = \frac{MP_1}{(1+r)} - \frac{W_1}{(1+r)} \quad \text{or} \quad \$30,000 + \$10,000 - \$30,000 = \frac{\$70,000}{(1+.05)} - \frac{\$59,500}{(1+.05)}$$

the contract would tend to break down because the worker with general HK has an incentive to quit. Since the general HK training increased her productivity to \$70,000, she will look for another job (her productivity is now \$70,000) rather than remain with the firm offering her only \$59,500 in the post training period. Unless the firm can write an enforce a contract that keeps the worker employed for both periods with the training

firm (almost all labor contracts restrict firms behavior, but not the workers ability to quit), the firm will not find it profitable to pay for general HK training. Generally, workers will have to pay for general HK investments themselves.

The ($W_0=\$30,000;W_1=\$59,500$) contract will work if the training is specific to the firm. Firm-specific training, or firm-specific HK investments, increase the productivity of the worker at the training firm but do not affect the worker's productivity at other firms. Examples of firm specific training would be a computer system that is unique to the firm, or developing relationships (learning names, likes/dislikes, hobbies, product preferences, etc.) with customers specific only to the firm. In other words, if the training is firm-specific, then the value of the worker to the training firm is \$70,000 in the post training period but the value of the worker to other firms is still only \$40,000 as the firm-specific training did not increase the worker's productivity elsewhere. With firm-specific HK investments, the ($W_0=\$30,000;W_1=\$59,500$) contract works because:

1. the net present value of the contract with the training is greater than the net present value without the training: \$86,667 with the training vs. \$78,095 ($\$40,000 + [\$40,000/1.05]$) without the training.

2. the firm maximizes its profits (so the costs of the investment are covered, and the marginal cost of adding one more worker to the contract just equals the marginal benefit from doing so:

$$W_0 + Z - MP_0 = \frac{MP_1}{(1+r)} - \frac{W_1}{(1+r)}$$

3. the worker has no incentive to quit in the second period. With firm-specific training, her wage in the second period at the training firm is \$59,500, which is less than her marginal product at the training firm in the post training period (\$70,000) but more than she can make at other firms in the post training period (\$40,000).

In general, these three conditions must be met for a OJT contract to be sustainable.

II. Implications of Firm-Specific Investments for Production Risk

Firms also have lifetimes, and making allowances for future skilled workers is important. Human resource and risk managers have to insure that the human capital needs of the firm are meet in an uncertain, future work environment. The term "risk management" means making decisions to alter the risk/return of future cash flows to the firm, and these cash flows can be profoundly affected by the firm's human capital stock. In particular, if management efforts are directed at reducing risk, then the managers are said to be *hedging*. If managers are increasing risk, then they are *speculating*. We will only be interested in hedging activities.

Why worry about "human capital hedging"? Human capital hedging is managing the firm's human resources to reduce volatility of future output, in order to maximize the firm's long-run profitability. Because loss of firm-specific capital cannot be replaced in

the short run, worker absences can be very costly to the firm. Hence, it may be beneficial to allow for some redundancy (or flexibility) in firm-specific skills available to the firm when the future is uncertain.

We illustrate the potential usefulness of such hedging with a small, specialized car maker that--given the limitation of their building and equipment, can only make 10 cars each year. The technology for this car maker is a simple Leontiff technology, where the production of a single car requires a tenth of an executive's (E) time, one fifth of a manager's (M) time, and all of a production worker's (P) time each year. If the input of any one of these occupational groups is missing, then the car cannot be produced. That is, the number of cars produced is the smaller of the following quantities: 10 E, 5 M, or P. This fixed car making process can be described mathematically as follows:

$$Y = \min(10E, 5M, P) \text{ where } Y = \text{car output,}$$

and $\min(a, b, c)$ means take the smaller of a, b or c.

Table 3 clarifies the meaning of this type of technology, with some numerical examples. Going across the row, the minimum from the first three columns will be the output in the fourth column:

Table 3 Output For Worker Combinations, where $Y = \min(10E, 5M, P)$

E=number of executives (10 x E)	M=number of managers (5 x M)	P=number of production workers (1 x P)	Y=Output, given the skill mix of workers
1	2	10	10
3	2	10	10
1	20	10	10
1	1	16	5
1	2	6	6

In the last four rows of Table 3, one or more of those in the car company are redundant in the production process. In the second row, for example, the two additional executives are redundant because going from 3 executives in row two to 1 executive in row one does not lower output. Since executives are expensive, row one would be the preferred proportions of workers to employ as long as there is no uncertainty, since costs are lower for the mix of workers used in row one, but the output is the same as for row two. Similarly, in row three managers are redundant. (In rows four and five, who are the redundant workers and why?)

While it never pays to hire redundant workers when the future is certain, it may make sense to do so when it is uncertain, workers have firm specific capital and cannot be replaced in the short run, and workers are subject to leaving the firm because of injuries, layoffs, or employment elsewhere. Consider possible outcomes in Table 4, for the car maker described above, in which injuries occur randomly with the probabilities specified in the top row. For this example, we assume that the executives is paid \$100k per year, that the managers are each paid \$50k per year, and that executives and

managers are salaried in the sense that the firm pays them full compensation even when they are out on injuries. Production workers are paid on an hourly wage, and will make \$40k unless they are injured. If they are injured, we assume that they are paid nothing (there is no workers' compensation or disability pay in this system). However, we assume that production workers have a collective bargaining agreement that guarantees them full salary when they are at work, even in periods when the absence of upper management may make some of the production workers redundant. In other words, even if they are redundant, they remain employed at full salary as long as they are at work. If they miss work due to an injury, there are paid nothing. All workers are assumed to have firm-specific capital that cannot be readily replaced in the short run.

Each of the middle columns in Tables 4 and 5 represent a different outcome, associated with the injury of one or more workers from each of the skill groups. For example, there is a 45 percent chance that no one is injured, so that output will be 10 cars, each sold for \$100,000 for a total revenue of \$1 million. The costs are the sum of wages and salaries paid to the skill groups, which totals \$600k as long as none of the production workers are injured. Hence profits, the difference between revenues and costs, when there is no injury is \$400k. Each column to the right can be evaluated similarly: in the second column, there is a thirty percent chance that two production workers will be injured. This lowers car output to 8 cars, total revenues to \$800k and total costs to \$280k. Hence, profits with two injured production workers is \$280k.

Table 4 Uncertainty and Car Production: The No Redundancy Case

Inputs, Outputs, Revenue s, Costs and Profits	Possible Outcomes Next Period: People with Temporary Total Injuries				
	no injury, P=.45	2 Production Employees injured, P=.3	1 Manager injured, P=.2	1 Executive injured, P=.05	
E	1	1	1	0	Expected Output = 7.9
M	2	2	1	2	
P	10	8	10	10	
Y	10	8	5	0	
Revenue	\$1,000k	\$800k	\$500k	\$0	Expected Profit= \$214k
Costs	\$600k	\$520k	\$600k	\$600k	
Profits	\$400k	\$280k	-\$100k	-\$600k	

Note: P=probability of the indicated event in the second row

With one manager injured, car output is restricted to 5 cars, and there is a loss of \$100,000 since cost is greater than revenue. With the executive injured, car output falls off to zero and no output is produced.

The expected output is the average outcome for the four “injury state outcomes” given by the four middle columns of Table 4. Each output is weighted (i.e., multiplied) by the likelihood of its occurrence. Hence the expected output (denoted “E(Y)”) is:

$$E(Y) = 10 * .45 + 8 * .30 + 5 * .20 + 0 * .05 = 7.9.$$

The expected, or average profit (denoted as “E(π)”) is calculated in the same way:

$$E(\pi) = \$400k * .45 + \$280k * .30 + -\$100k * .20 + -\$600k * .05 = \$214k.$$

Since work absences are uncertain, and firm-specific capital important, the firm decides to hedge its human capital assets by hiring a “redundant” worker. This worker, paid as a manager, is provided with some firm-specific training. However, since she does not specialize in anyone area, we assume that she is only half as productive as a replacement as the regular worker in that position would be. So when 2 production workers are absence and she fills in, she is only half as productive as a regular production worker (hence, there are effectively “8.5” full-time equivalent production workers). When she covers for an absent manager in column 3, she is only half as productive as a full time manager; in column 4, only half as productive as the executive would be.

With this redundancy, profits are lowered when there is no injury but losses are lessened when there is an injury: profits have fallen from \$400k to \$350k when there is no injury, and losses have fallen from -\$100k to profits of \$100k, when a manager is injured, and from -\$600k to -\$150k, when the executive is injured. The variance in firm’s profitability has been reduced, and average profits increased, by hedging against the loss of firm specific capital. Management has hedged human capital risk by hiring a redundant worker.

Table 5 Uncertainty and Car Production: Adding Worker Redundancy

Inputs, Outputs, Revenue s, Costs and Profits	Possible Outcomes Next Period: People with Temporary Total Injuries				
	no injury, with P=.45	2 production employees injured, P=.3	1 Manager injured, P=.2	1 Executive injured, P=.05	
E	1	1	1	.5	Expected Output= 8.8
M	3	2	1.5	2	
P	10	8.5	10	10	
Y	10	8.5	7.5	5	
Revenue	\$1,000k	\$850k	\$750k	\$500k	Expected Profit= \$254k
Costs	\$650k	\$570k	\$650k	\$650k	
Profits	\$350k	\$280k	\$100k	-\$150k	

Note: P=probability of the indicated event in the second row

In this case, the reduction of risk has been accompanied by increase in expected output and profits as well. The expected output (denoted “E(Y)”) is now:

$$E(Y) = 10 * .45 + 8.5 * .30 + 7.5 * .20 + 5 * .05 = 8.8.$$

The expected, or average profit (denoted as “E(π)”) is calculated in the same way:

$$E(\pi) = \$350k * .45 + \$280k * .30 + \$100k * .20 + -\$150k * .05 = \$254k.$$

Profits are \$50k higher on average, because about one more car on average is built which brings in an additional \$100k of revenue, at a \$50k cost for the redundant worker.

While we have discussed losses due to workplace injuries, work absences for other reasons--such as quits or poor labor relations (either collectively with all workers, or with specific individuals in the organization)--will have the same deleterious impact on the firm. Besides redundant staffing, other ways to hedge against the loss of firm specific skills include cross training individuals in several areas, and outsourcing work that involves little or no firm-specific training (such as food or janitorial services). Employee benefit plans (profit sharing and pension plans) may be structured to encourage longer term commitment to the firm (possibly associated with an implicit, firm-specific investment contract).

ⁱ The dam is another example of how people deal with diminishing utility. In areas requiring irrigation dams (because of periodic moisture), it is much more valuable to distribute water more or less evenly over the whole growing season than it is to use only during the rainy season. That is, the economic value of a liter of water diminishes as the total volume of water in use at one point in time increases. Hence, it is better to spread the water over the whole of the growing season, than it is to bunch its use during the much shorter rainy season.

⁷ There will probably be real costs and benefits as well to dieting/exercising. Other, non-psychoic, exercise costs might include gym fees, possibly foregone wages during the time spent exercising, buying exercise equipment, etc. Non-psychoic benefits would include any wage increase due to greater productivity on the job. But we focus just on psychoic costs in the text to underscore the fact that workers are maximizing their perceived self interest, including both monetary and nonmonetary benefits.

ⁱⁱⁱ. Illustrate what would happen if the interest rate were not a constant, but varied from year to year.