Chapter 4

Labor Quality: Investing in Human Capital

After reading this chapter, you should be able to:

1. **Explain the meaning of investment in human capital.**
2. **Use the human capital model to analyze decisions to invest in human capital.**
3. **Use a supply and demand of human capital to explain the unequal distribution of earnings.**
4. **Explain general and specific training and their effects on the human capital investment decision, wages, and worker retention.**
5. **Critically evaluate the human capital model.**

Education and training are much in the current news. Today's challenge is being able to compete effectively in the rapidly emerging global marketplace. Experts agree that to maintain our relative standard of living, we must upgrade the education and skill levels of our workforce. They also agree that the dynamic aspects of global technological innovation and product competition have rendered many of our jobs less secure. Continuous education, training, and retraining will be crucial to keeping our workforce fully employed.

In Chapters 2 and 3, we looked primarily at the decisions of whether and to what degree to participate in the labor market. Our emphasis there was on the work–leisure decision and the various participation rates. In this chapter, we turn from the quantitative to the qualitative aspects of labor supply. Workers bring differing levels of formal educational attainment and skills to the labor market. They also acquire substantially different amounts of on-the-job training. A more educated, better-trained person is capable of supplying a larger amount of useful productive effort than one with less education and training.

Any activity that increases the quality (productivity) of labor may be considered an investment in human capital. Human capital investments include expenditures not only on formal education and on-the-job training but also on health, migration, job search, and the preschool nurturing of children. Workers can become more productive by improving their physical or mental health and also by moving from locations and jobs where their productivity is relatively low to other locations and jobs where their productivity is relatively high. In fact, in Chapter 9, human capital theory will be the core concept used to analyze labor migration.

INVESTMENT IN HUMAN CAPITAL: CONCEPT AND DATA

When a firm invests in physical capital, it is acquiring some asset that is expected to enhance the firm's flow of net profits over a period of time. For example, a company might purchase new machinery designed to increase output and therefore sales revenues over, say, the 10-year projected useful life of the machinery. The unique characteristic of investment is that *current* expenditures or costs are incurred with the intent that these costs will be more than compensated for by enhanced *future* revenues or returns. Analogously, investments are made in human capital. When a person (or a person's parents or society at large) makes a current expenditure on education or training, it is anticipated that the individual's knowledge and skills and therefore future earnings will be enhanced.[1] The important point is that expenditures on education and training can be fruitfully treated as ***investment in human capital*** just as expenditures on capital equipment can be understood as investment in physical capital.

Relevant data reveal three things. First, expenditures on education and training are substantial. In the school year 2013–2014, Americans spent some $1,194 billion on elementary, secondary, and higher education. In addition, an estimated 2 percent of payroll is spent each year by employers for on-the-job training.

Second, the educational attainment of the labor force has increased dramatically over the past two decades. For example, in 1992, 13 percent of the civilian labor force aged 25 and older had achieved less than a high school education, while 26 percent had completed four or more years of college. Similar figures for 2014 were 8 and 37 percent, respectively.

Third, investments in education result in an enlarged flow of earnings. This tendency is reflected in the ***age–earnings profiles*** of Figure 4.1, which show the lifetime earning patterns of male workers who have attained various educational levels. Observe that the average earnings of more educated workers exceed those of less educated workers. Also, the earnings profiles of more educated workers rise more rapidly than those of less educated workers. Differences in the earnings of more and less educated workers tend to widen during workers' prime earning years.

[1] As will be noted later, the payoff from an investment in education may also take nonmonetary forms, such as obtaining a more pleasant job or a greater appreciation of literature and art.

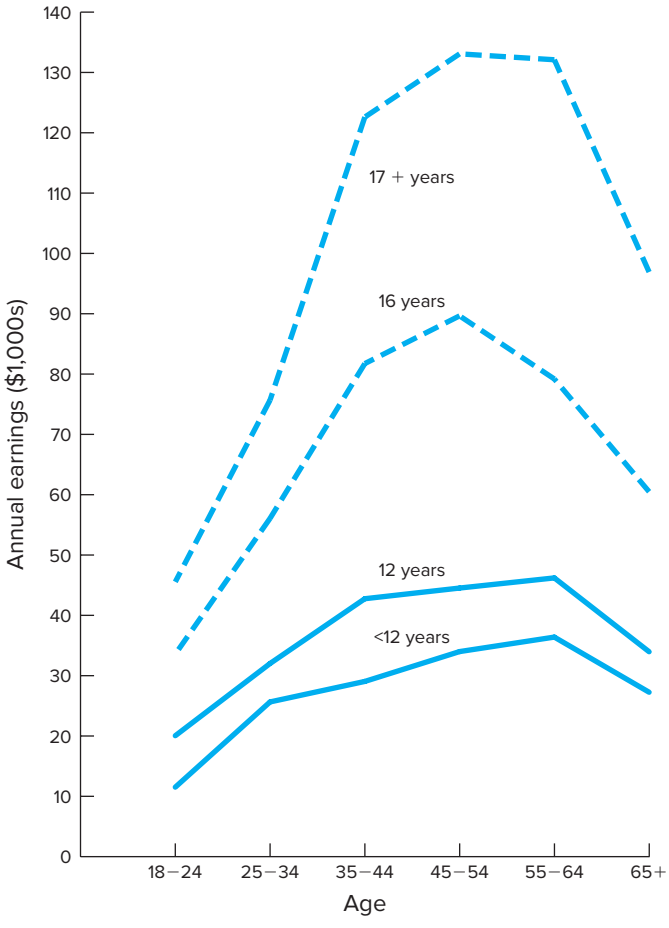

FIGURE 4.1
Age–Earnings Profiles by Years of Education
Age–earnings profiles (in this case for males in 2013) indicate that education "pays" in that more educated workers obtain higher average annual earnings than less educated workers of the same age group.

Source: Derived From U.S. Census Bureau, Personal Income Tables, Table P28_2013

Not shown, the age–earnings profiles of females display similar overall characteristics to those in Figure 4.1 but lie significantly below those of men. Also, the profiles for women are much flatter than those for men. We discuss these gender differences in earnings in detail in Chapter 14.[2]

[2] The fact that the age–earnings profiles ultimately decline must be interpreted with some care. Although it is tempting to attribute the declining incomes of older workers to diminished physical vigor and mental alertness, the obsolescence of education and skills, or the decision to work shorter hours, the decline may be largely due to the character of the data. In particular, these data do *not* track the earnings of specific individuals through their lifetimes. Rather, these cross-sectional data show the earnings of different individuals of different ages in some particular year. Longitudinal data that trace the earnings of specific people over time indicate that earnings continue to increase until retirement. The declining segments of the age–earnings profiles in Figure 4.1 may occur because the U.S. economy has been growing, and therefore each succeeding generation has earned more than the preceding one. Thus, the average 45-year-old college-educated worker has higher earnings as shown in the age–earnings profiles simply because he or she is a member of a more recent generation than a 65-year-old college-educated worker.

THE HUMAN CAPITAL MODEL

Let's introduce a simple model to analyze the decision to invest in, say, a college education. Assume you have just graduated from high school and are deciding whether to go to college. From a purely economic standpoint, a rational decision will involve a comparison of the associated costs and benefits. The monetary costs incurred in the purchase of a college education are of two general types. On the one hand, there are *direct* or *out-of-pocket costs* in the form of expenditures for tuition, special fees, and books and supplies. Expenditures for room and board are *not* included as a part of direct costs because you would need food and shelter regardless of whether you attended college or entered the labor market. On the other hand, the *indirect* or *opportunity cost* of going to college is the earnings you give up by not entering the labor market after completing high school. For example, estimates suggest that indirect costs may account for as much as 60–70 percent of the total cost of a college education, at least at public universities. The economic *benefit* of investing in a college education, as we know from Figure 4.1, is an enlarged future flow of earnings.

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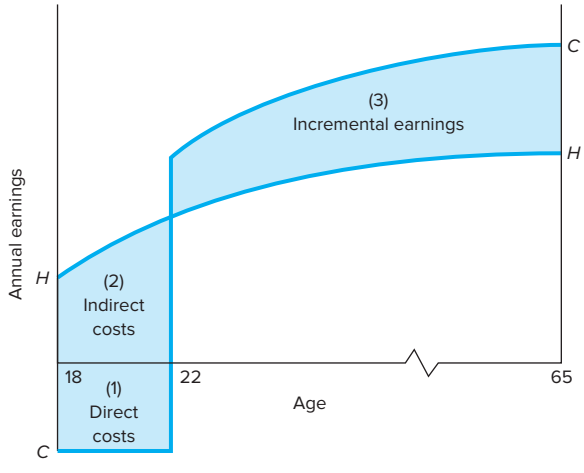
This conception of a human capital investment decision is portrayed graphically in Figure 4.2. Curve *HH* represents your earnings profile if you decide not to attend college, but rather enter the labor market immediately on the completion of

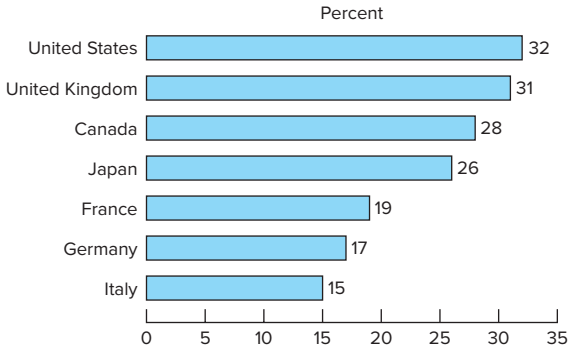
FIGURE 4.2 Age–Earnings Profiles with and without a College Education
If an individual decides to enter the labor market after graduation from high school at age 18, the age–earnings profile will be *HH* in comparison with the *CC* profile if she or he had gone to college. Attending college entails both direct costs (tuition, fees, books) and indirect costs (forgone earnings). But on entering the labor market at age 22, the college graduate will enjoy a higher level of annual earnings over her or his working life. To determine whether it is economically rational to invest in a college education, we must find its net present value by discounting costs and benefits back to the present (age 18).



4.1 Global Perspective

College Graduates Worldwide

The percentage of adults aged 25–64 who have a college degree in major industrial countries ranges from 15 percent in Italy to 32 percent in the United States.



Source: Organization for Economic Cooperation and Development, *Education at a Glance, 2014,* Table A1.1a (Paris: OECD, 2014). Data are from 2012.

high school at age 18. The *CC* curve is your cost–earnings profile if you decide to undertake a four-year college degree before entering the labor market. We note that area 1 below the horizontal axis represents the direct or out-of-pocket costs (the negative income) incurred in attending college. Area 2 reflects the indirect or opportunity costs; that is, the earnings you forgo while attending college. The sum of areas 1 and 2 shows the total cost (your total investment) in a college education. Area 3—the difference between the *CC* and *HH* curves over ages 22 to 65—shows the gross *incremental* earnings that you will realize by obtaining a college degree; it shows how much *additional* income you will obtain as a college graduate over your work life compared to what you would have earned with just a high school diploma. Your work life in this case is presumed to extend over the 43-year period from age 22 to age 65.

Discounting and Net Present Value

We know that to make a rational decision you will want to compare costs (areas 1 and 2) with benefits (area 3). But a complication arises at this point. The costs and benefits associated with investing in a college education accrue at different points in time. This is important because dollars expended and received at different points in time have different value. A meaningful comparison of the costs and benefits associated with a college education requires that these costs and benefits be compared in terms of a common point in time, such as the present. What we seek to determine from the vantage point of an 18-year-old youth is the net present discounted value,

or simply the ***net present value***, of the present and future costs *and* present and future benefits of a college education.

Time Preference

Why do dollars earned (or expended) have a different value a year, or two or three years, from now than they have today? The immediate answer is that a positive interest rate is paid for borrowing or "renting" money. But this raises an additional question: *Why* is interest paid for the use of money? The answer lies in the notion of ***time preference***: the idea that, given the choice, most people prefer the pleasure of indulgence today to the promise of indulgence tomorrow. Most individuals prefer present consumption to future consumption because, given the uncertainties and vagaries of life, the former seems more tangible and therefore more valuable. Time preference, in short, is the idea that people are impatient and subjectively prefer goods in the present over the same goods in the future. It follows that an individual must be compensated by an interest payment to defer present consumption or, alternatively stated, to save a portion of her or his income. If an individual equates $100 worth of goods today with $110 worth of goods a year from now, we can say that his or her time preference rate is 10 percent. The individual must be paid $10 or 10 percent as an inducement to forgo $100 worth of present consumption.

Present Value Formula

Because the preference for present consumption necessitates payment of a positive interest rate, a dollar received a year from now is worth less than a dollar obtained today. A dollar received today can be lent or invested at some positive interest rate and thereby can be worth more than a dollar a year from now. If the interest rate is 10 percent, one can lend $1 today and receive $1.10 at the end of the year; the $1.10 comprises the original $1 plus $.10 of interest. This can be shown algebraically as follows:

$$V_p(1 + i) = V_1 \qquad \textbf{(4.1)}$$

where V_p = present or current value—for example, $1.00 today
V_1 = value (of the $1.00) one year from now
i = interest rate

The $(1 + i)$ term indicates that one receives the original or present value ($1.00) *plus* the interest. Substituting our illustrative numbers, we have

$$\$1.00(1.10) = \$1.10$$

This formulation tells us that, given a 10 percent interest rate, $1.10 received next year is the equivalent of $1.00 in hand today.

Equation (4.1) focuses on determining the *future* value of the $1.00 one has today. As indicated earlier, our goal is to determine the *present* (today's) value of expenditures and revenues incurred and received in the future. We can get at this by restating our original question. Instead of asking how much $1.00 obtained today will be worth a year from now, let's inquire how much $1.10 received a year from

now would be worth today. In general terms, the answer is found by solving Equation (4.1) for Vp. Thus,

$$V_p = \frac{V_1}{(1+i)} \tag{4.2}$$

Equation (4.2) is a ***discount formula*** for a one-year period. Inserting our illustrative numbers,

$$\$1.00 = \frac{\$1.10}{1.10}$$

That is, $1.10 received a year from now is worth only $1.00 today if the interest rate is 10 percent.

Observing in Figure 4.2 that both costs and benefits are incurred over a number of years, we can extend the discounting formula of Equation (4.2) as follows:

$$V_p = E_0 + \frac{E_1}{(1+i)^1} + \frac{E_2}{(1+i)^2} + \frac{E_3}{(1+i)^3} + \cdots + \frac{E_n}{(1+i)^n} \tag{4.3}$$

where the E values represent a stream of incremental earnings (E_0 being any additional income received immediately, E_1 the additional income received next year, E_2 the incremental earnings received two years from now, and so forth); n is the duration of the earnings stream or, in other words, the individual's expected working life; and i is the interest rate.[3] Observe that incremental earnings (or costs), E_0, incurred immediately need not be discounted. But the incremental earnings received next year, or one year hence, E_1, must be discounted one year. Note further that the denominator of the third term is squared, the fourth is cubed, and so forth. This is so because the values of E_2 and E_3 must be discounted two and three years, respectively, to determine their present value. Dividing E_2—the incremental earnings to be received two years hence—by $(1 + i)$ discounts the value of those earnings for the time elapsed in the first year; but *that* value must be again divided by $(1 + i)$ to find its present value because the time between the first and second year further diminishes the value.

Restating the formula for our high school graduate who enters the labor force at age 18, we have

$$V_p = E_{18} + \frac{E_{19}}{(1+i)} + \frac{E_{20}}{(1+i)^2} + \frac{E_{21}}{(1+i)^3} + \cdots + \frac{E_{64}}{(i+)^{46}} \tag{4.4}$$

which can be more compactly stated as

$$V_p = \sum_{n-18}^{64} \frac{E_n}{(1+i)^{n-18}} \tag{4.5}$$

This formulation tells us that we are calculating the present value (V_p) of the sum (Σ) of the discounted incremental earnings (E_n) over the individual's working life,

[3] We are sidestepping the troublesome problem of deciding which interest rate is appropriate. A small difference in the rate used can have a substantial impact on the calculation of present value.

which runs from age 18 through age 64, after which time he or she retires when attaining age 65. Because n is 64 years of age, the $n = 18$ notation indicates that we are discounting future earnings over 46 (= 64 − 18) years of working life.

Figure 4.2 reminds us that the decision to invest in a college education entails both costs and benefits (enhanced earnings). How can both be accounted for in Equation (4.3) or (4.4)? The answer is to treat costs as negative earnings. Thus, the "earnings" for the four years the individual is in college (E_0, E_1, E_2, and E_3) will be the negative sum of the direct and indirect costs incurred in each of those years. For each succeeding year until retirement, incremental earnings will be positive. We therefore are actually calculating the *net* present value of a college education in these two equations.

Decision Rule: $V_p > 0$

The relevant investment criterion or decision rule based on this calculation is that *the individual should make the investment if its net present value is greater than zero*. A positive value tells us that the present discounted value of the benefits exceeds the present discounted value of the costs, and when this is so—when benefits exceed costs—the decision to invest is economically rational. If the net present value is negative, then costs exceed benefits and the investment is not economically justifiable.

Illustration

A truncated example may be helpful at this point. Assume that after graduating from high school, Carl Carlson contemplates enrolling in a one-year intensive course in data processing. The direct costs of the course are $1,000, and the opportunity cost is $5,000. Upon completion of the course, he has been promised employment with the Computex Corporation. Expecting to receive a large inheritance, he plans to work only three years and then retire permanently from the labor force. The incremental income he anticipates earning because of his data-processing training is $2,500, $3,000, and $3,500 for the three years he intends to work. The relevant interest rate at this time is 10 percent. Is the decision to enroll in the data-processing course rational? Substituting these figures in Equation (4.3), we have

$$V_p = E_0 + \frac{E_1}{(1+i)} + \frac{E_2}{(1+i)^2} + \frac{E_3}{(1+i)^3}$$

$$V_p = -\$6{,}000 + \frac{\$2{,}500}{(1.10)} + \frac{\$3{,}000}{(1.10)^2} + \frac{\$3{,}500}{(1.10)^3}$$

$$V_p = -\$6{,}000 + \$2{,}273 + \$2{,}479 + \$2{,}630$$

$$V_p = \$1{,}382$$

Our formula shows that the present value of the benefits (the incremental earnings) totals $7,382 (= $2,273 + $2,479 + $2,630) and exceeds the present value of the costs of $6,000 by $1,382. This positive net present value indicates that it *is* economically rational for Carlson to make this investment in human capital.

Internal Rate of Return

An alternative means of making an investment decision involves calculating the ***internal rate of return***, *r*, on a prospective investment and comparing it with the interest rate *i*. *By definition, the internal rate of return is the rate of discount at which the net present value of a human capital investment will be zero*.

Formula

Instead of using the interest rate *i* in Equation (4.3) to calculate whether the net present value is positive or negative, one determines what particular rate of discount *r* will equate the present values of future costs and benefits so that the net present value is zero. We must modify Equation (4.3) as follows:

$$V_p = E_0 + \frac{E_1}{(1+r)} + \frac{E_2}{(1+r)^2} + \cdots + \frac{E_n}{(1+r)^n} = 0 \qquad \textbf{(4.6)}$$

Instead of solving for *Vp* as in Equation (4.3), we solve for *r*, given the *E* values and assuming *Vp* is zero. A moment's reflection makes clear that *r* indicates the maximum rate of interest that one could pay on borrowed funds to finance a human capital investment and still break even.

Decision Rule: r = i

The investment criterion or decision rule appropriate to this approach involves a comparison of the internal rate of return *r* with the interest rate *i*. *If r exceeds the market i, the investment is profitable and should be undertaken*. For example, if one can borrow funds at a 10 percent interest rate and make an investment that yields 15 percent, it is profitable to do so. But *if r is less than i, the investment is unprofitable and should not be undertaken*. If one can borrow money at a 10 percent rate and the prospective investment yields only 5 percent, it is not profitable to invest. As we will discover momentarily, investing in human capital is subject to diminishing returns, so *r* generally declines as the number of years of schooling increases (look ahead to Figure 4.4). In this case, given *i, it will be profitable to invest in all human capital investment opportunities up to the point where r = i*.

Generalizations and Implications

The explanatory power of the human capital model is considerable. Let's pause at this point to consider several generalizations that stem from the basic model presented in Figure 4.2 and Equations (4.3) and (4.6).

1 Length of Income Stream

Other things being equal, the longer the stream of postinvestment incremental earnings, the more likely the net present value of an investment in human capital will be positive. Alternatively, the longer the earnings stream, the higher the internal rate of return. A human capital investment made later in life will have a lower net present value (and a lower *r*) simply because fewer years of work life and, hence, of positive incremental earnings will remain after completion of the investment.

This generalization helps explain why it is primarily young people who go to college[4] and why younger people are more likely to migrate (invest in geographic mobility) than older people. It also explains a portion of the earnings differential that has traditionally existed between women and men. In many cases, the participation of women in the labor force has been discontinuous; that is, many women work for a few years after the completion of formal schooling, then marry and stay out of the labor force for a time to bear and raise children. They then reenter the labor force sometime after the last child begins school. In Equations (4.3) and (4.6), this means an abbreviated stream of earnings. This dampens the economic incentive of these particular women to invest in their own human capital by lowering the net present value or the rate of return. Furthermore, their discontinuous labor force participation inhibits employers from investing in their on-the-job training.

2 Costs

Other things being equal, the lower the cost of a human capital investment, the larger the number of people who will find that investment to be profitable. If the direct or indirect costs of attending college were to fall, we would expect enrollment to rise. For example, the guaranteeing of student loans by the government eliminates the risk to the lender and lowers the interest rate charged for borrowing funds to attend college. By reducing the private direct cost[5] of a college education, such loan guarantees increase college enrollment.[6] Lower direct or indirect costs increase the net present value of a college education, making the investment in education profitable for some who previously found it to be unprofitable.[7]

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A more subtle point ties in with our previous generalization that older individuals are less likely to invest in human capital. Our age–earnings profiles (Figure 4.1) reveal that earnings rise with age. Thus, the opportunity cost of attending college will be greater for the older worker; and other things being equal, the net present value and the internal rate of return associated with human capital investments will be lower. In other words, there are two reasons older people are less likely to invest in a college education: (1) The length of their future earnings stream will be relatively short, and (2) their opportunity costs of attending college will be high.

[4] Although perhaps not rational on investment grounds, the decision of older people to return to college may be justified in terms of consumption (utility) criteria.

[5] Of course, there is no free lunch. Taxpayers (society as a whole) pay the costs associated with loan guarantees. But in calculating the cost of a college education from a *private* (as opposed to a *social*) perspective, loan guarantees reduce the costs to the individual enrollee and increase the private net present value associated with a college education.

[6] Public subsidies appear to have large enrollment effects, particularly for low-income students and those attending community colleges. See Thomas J. Kane and Cecilia Elena Rouse, "The Community College: Educating Students at the Margin between College and Work," *Journal of Economic Perspectives,* Winter 1999, pp. 63–84.

[7] For a series of papers examining the impact of college costs and other factors on college choices, see Caroline M. Hoxby (ed.), *College Choices: The Economics of Where to Go, When to Go, and How to Pay for It* (Chicago, IL: University of Chicago Press, 2004).

4.1 World of Work — Recessions and the College Enrollment Rate

Do recessions increase or decrease the number of college students? The answer, in theory, is uncertain because business downturns yield conflicting effects on college enrollment rates.

Three factors related to the ability to pay for a college education tend to reduce the number of college students during recessions. First, the availability of part-time jobs that may help finance college expenses usually decreases in downturns. Second, the ability of parents to borrow money for college educations (perhaps due to a reduction in income and asset values) may decline. Finally, state and private spending for financial aid may decrease during recessions.

In contrast, recessions tend to lower the cost of attending college because they reduce the earnings of high school graduates or lower the probability of obtaining a job. As a result, the opportunity cost of attending college will fall, and enrollment rates will, therefore, rise.

The empirical evidence indicates that the decreased opportunity cost of college in recessions dominates the reduced ability to pay because college enrollment rates tend to rise significantly during recessions. Dellas and Sakellaris find that a 1 percent increase in the unemployment rate increases the college enrollment rate of 18- to 22-year-olds by .8 percentage points. Their models indicate that some recessions may have added more than 400,000 college students. Men and women do not appear to respond differently to recessions. However, the college enrollment rate of nonwhites is less sensitive than that of whites to business downturns.

Source: Harris Dellas and Plutarchos Sakellaris, "On the Cyclicality of Schooling: Theory and Evidence," *Oxford Economic Papers*, January 2003, pp. 148–72. For an analysis of the effects of the 2007–2009 recession, see Bridget Terry Long, "The Financial Crisis and College Enrollment: How Have Students and Their Families Responded," in Jeffrey Brown and Caroline Hoxby (eds.), *How the Financial Crisis and Great Recession Affected Higher Education* (Chicago: University of Chicago Press, forthcoming).

3 Earnings Differentials

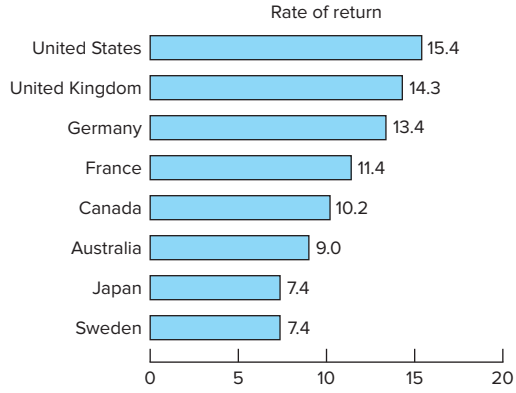
Not only is the *length* of the incremental earnings stream critical in making a human capital investment decision, but so is the *size* of that differential. The generalization is that *other things being equal, the larger the college–high school earnings differential, the larger the number of people who will invest in a college education*. Empirical evidence confirms this generalization. Freeman has argued that in 1970 the labor market for college graduates changed from one characterized by shortages to one of surpluses. One manifestation of this change was that the incremental earnings associated with a college education declined sharply.[8] As a result, the proportion of young people enrolling in colleges declined significantly in the early 1970s. In the 1980s, the earnings advantage for college graduates rebounded. Ge and Yang stated that part of the sharp rise in the rate of college attendance that occurred over the 1980–1996 period was due to the rise in the college premium.[9]

[8] Richard B. Freeman, *The Overeducated American* (New York: Academic Press, 1976).
[9] Suqin Ge and Fang Yang, "Accounting for the Gender Gap in College Attainment," *Economic Inquiry,* January 2013, pp. 478–499.

4.2 Global Perspective

Rate of Return per Year of College Education

The private rate of return per year of college education for males ranges from 7.4 percent in Sweden to 15.4 percent in the United States.



Source: Organization for Economic Cooperation and Development, *Education at a Glance, 2014,* Table A7.3a.

All data are for males in 2010, except Australia which is for 2009.

Empirical Data

Numerous empirical studies have estimated the returns of human capital investments at all educational levels. Here we concentrate on those showing private rates of return on investments in a college education.

Rate-of-Return Studies

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Speaking very generally, most rate-of-return studies have estimated such rates to be on the order of 10–15 percent.[10] For example, in his classic work Becker estimated the internal rate of return to be 14.5, 13.0, and 14.8 in 1939, 1949, and 1958, respectively.[11] Estimates by Freeman indicate that the private rate of return ranged from 8.5 to 11.0 percent over the 1959–1974 period.[12] The social rate of return for the corresponding period was estimated to range from 7.5 to 11.1 percent. Card finds a return of

[10] For surveys of recent studies, see George Psacharopoulos and Anthony Patrinos, "Returns to Investment in Education: A Further Update," *Education Economics,* August 2004, pp. 111–34; and Claudio E. Montenegro and Harry Anthony Patrinos, "Comparable Estimates of Returns to Schooling Around the World," World Bank Policy Research Working Paper 7020, September 2014.
[11] Gary Becker, *Human Capital,* 2nd ed. (New York: National Bureau of Economic Research, 1975).
[12] Richard B. Freeman, "Overinvestment in College Training?" *Journal of Human Resources,* Summer 1975, p. 296.

4.2 World of Work — What Is a GED Worth?

The popularity of obtaining high school certification through an equivalency exam has skyrocketed over the past four decades. In 1960, only 2 percent of high school certificates were given through equivalency exams. By 2013, 14 percent of all high school certificates were awarded through equivalency exams.

The General Education Development (GED) program is the main method for achieving high school equivalency through an exam. The program involves dropouts passing a 7½-hour exam covering the areas of writing, social studies, science, reading, and mathematics. The exam is meant to certify that a person has the knowledge and skills of a high school graduate.

Heckman and LaFontaine have examined the economic benefits from obtaining a GED. They found little or no direct benefit to obtaining a GED for those not obtaining postsecondary schooling. The earnings of GED recipients are greater than the earnings of high school dropouts, but this difference is entirely due to the higher ability of GED recipients. This pattern holds for men and women, older and more recent cohorts, and native-born and immigrant workers.

The main avenue for economic benefits from the GED is through greater access to postsecondary education. However, relatively few GED recipients pursue postsecondary education: Only 40 percent attend college at all. Furthermore, only 3 percent of GED recipients complete a four-year college degree, and 5 percent complete an associate degree at a two-year college.

Heckman and LaFontaine conclude that there is no easy shortcut to learning in a classroom.

Source: James J. Heckman and Paul A. LaFontaine, "Bias-Corrected Estimates of GED Returns," *Journal of Labor Economics*, July 2006, pp. 661–700; National Center for Education Statistics, *Digest of Educational Statistics, 2013* (http://www.nces.ed); and GED Testing Service, *2013 Annual Statistical Report on the GED Test* (http://www.gedtestingservice.com). For a summary of research on the GED, see James J. Heckman, John Eric Humphries, and Nicholas S. Mader, "The GED," in Eric. A. Hanushek, Stephen J. Machin, and Ludger Woessmann (eds.), *Handbook of the Economics of Education*, Volume 3 (Amsterdam: North-Holland, 2011), pp. 423–484.

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10 percent in 1976.[13] Kane and Rouse report a rate of return of 9 percent to higher education for 1986.[14] In a more recent study, Heckman, Lochner, and Todd find a private rate of return of 14 percent for 2000 for white men.[15]

The College Wage Premium

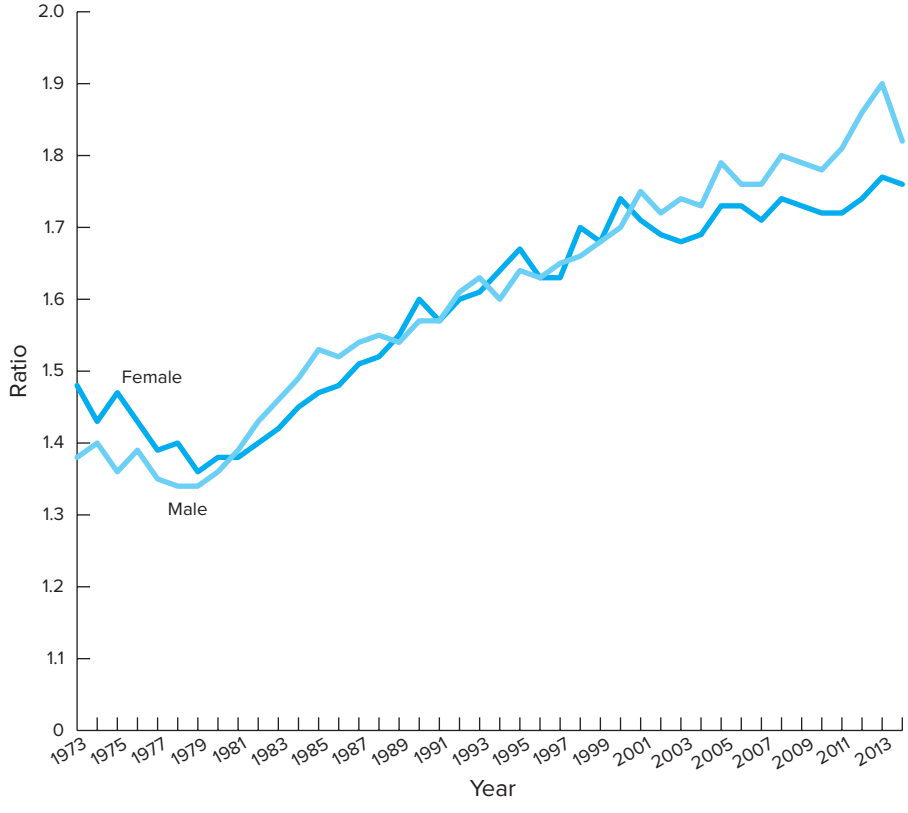
Readers might have a special interest in the trend of the college wage premium in recent decades. We define the ***college wage premium*** as *the ratio of the earnings of college graduates to the earnings of high school graduates*. Figure 4.3 presents this wage premium over the 1973–2014 period for women and men. Data are for workers with exactly a high school or college degree. We observe that in 1973 the ratio was

[13] David Card, "Using Geographic Variation in College Proximity to Estimate the Return to Schooling," in Louis N. Christofides, E. Kenneth Grant, and Robert Swindisky (eds.), *Labour Market Behavior: Essays in Honour of John Vanderkamp* (Toronto, University of Toronto Press: 1995).
[14] Thomas J. Kane and Cecilia Rouse, "Labor Market Returns to Two- and Four-Year Colleges," *American Economic Review,* June 1995, pp. 600–13.
[15] James J. Heckman, Lance J. Lochner, and Petra E. Todd, "Earnings Functions and Rates of Return," *Journal of Human Capital,* Spring 2008, pp. 1–31. Their internal rate of return estimates differ across demographic groups and estimation techniques.

FIGURE 4.3 Recent Trends in College Wage Premiums

The college wage premium—measured here as the ratio of earnings of college graduates to the earnings of high school graduates—has varied substantially over time. The premium for women fell moderately in the 1970s. The premium for men drifted downward from 1974 to 1979. Since 1979 the wage premiums for both groups have increased dramatically. Changes in the college premium are generally explained by changes in the supply of and the demand for college- and high school–educated workers.

Source: Author calculations from 1973–1978 *May Current Population Survey* and the monthly *Outgoing Rotation Group Current Population Survey* files from 1979 to 2014.



1.48 for women and 1.38 for men, meaning that college-educated women earned 48 percent and men 38 percent more than high school graduates of the same gender. During the 1970s, the premium dropped moderately for women and fell modestly for men. But since the late 1970s, the wage premiums for women and men have increased sharply, rising from 36 percent to 76 percent for women and from 34 percent to 82 percent for men. Studies have found that the most rapid rise in the wage premium has been for young college graduates with one to five years of experience.[16]

[16] Kevin Murphy and Finis Welch, "Wage Premiums for College Graduates: Recent Growth and Possible Explanations," *Educational Researcher,* May 1989, pp. 17–26.

Explanations of changes in the college wage premium center on labor supply and demand. It is generally agreed that the declining premium in the 1970s resulted from the large influx of baby boomers completing college, coupled with a relatively stagnant demand for college graduates. There is less consensus about why the college premium soared in the 1980s. Murphy and Welch[17] explain the rapid increase in the wage premium in terms of huge increases in the demand for college-trained workers. In particular, changes in the structure of domestic industry (for example, the shift of employment to high-technology industries) and changes in production techniques (for example, the greater use of computer-aided technologies) may have greatly increased the demand for college-trained workers.[18] Coupled with a relatively slower growth of the college-educated workforce, these demands caused the college premium to rise sharply.

Although the Murphy–Welch interpretation is generally accepted, some economists have pointed out that a growing number of college graduates are working in occupations where college degrees have not traditionally been required. This fact seems to contradict the idea of a growing demand for college graduates relative to their supply. Hecker[19] contends that the increasing college wage premium has resulted not from increased demand for college-educated workers but from declining demand for high school graduates, particularly males. In this view, a decline in the wages of high school graduates has pushed up the college wage premium.

Gottschalk and Hansen disagree that an increasing portion of college graduates are taking jobs requiring only a high school degree.[20] They report that Hecker's assertion does not hold when one uses a rigorous definition of noncollege jobs rather than the perceptions of survey respondents. In fact, they find that as the college wage premium increased between the mid-1980s and the mid-1990s, the proportion of college workers in noncollege jobs declined.

Caveats

But all such empirical data must be interpreted with some care. First, we have no way of accurately predicting the future. Economists cannot accurately estimate the future earnings of a new college graduate. Data used in research studies to calculate rates of return on human capital investments or the college wage premium are *historical* data. They represent the age–earnings profiles of *past* college graduates who obtained their

[17] Ibid., pp. 13–26.

[18] See Steven G. Allen, "Technology and the Wage Structure," *Journal of Labor Economics,* April 2001, pp. 440–83.

[19] Daniel E. Hecker, "Reconciling Conflicting Data on Jobs for College Graduates," *Monthly Labor Review,* July 1992, pp. 3–21.

[20] Peter Gottschalk and Michael Hansen, "Is the Proportion of College Workers in Noncollege Jobs Increasing?" *Journal of Labor Economics,* April 2003, pp. 449–71. For a recent review of the overeducation literature, see Edwin Leuven and Hessel Oosterbeek, "Overeducation and Mismatch in the Labor Market," in Eric A. Hanushek, Stephen Machin, and Ludger Woessmann (eds.), *Handbook of the Economics of Education,* Volume 4, (Amsterdam, Holland: Elsevier, 2011), pp. 283–326. Also see, Paul Beaudry, David A. Green, and Benjamin M. Sand, "The Great Reversal in the Demand for Skill and Cognitive Tasks," in Alexandre Mas and David Card (eds.), *The Labor Market in the Aftermath of the Great Recession* (Chicago: University of Chicago Press, forthcoming).

education as far back as, say, 1970 or even earlier. The observation that college graduates in the labor market in 2013 received on average $26,780 more per year than the typical high school graduate is no guarantee that this difference will persist. By 2020 the amount of incremental income might have widened or diminished.

Also, while incremental earnings affect the decision to invest in a college education, the decision to invest in a college education affects incremental earnings. If college graduates have enjoyed a high earnings differential compared with high school graduates in the recent *past,* an increasing proportion of new high school graduates will invest in a college education. But this investment will increase the supply of college as opposed to high school graduates and will reduce the *future* earnings differential or college premium. A high rate of return in the recent past could contribute to a decreasing rate of return in the future.

Second, the historical data used in human capital studies are in the form of *average* (median) earnings, and the distribution of earnings by educational level around the average is wide. Although a given study may calculate that the average rate of return on a college education is 10 percent, some individuals may earn 30 or 50 percent, whereas the return may be negative for others. A significant percentage of those with only high school educations earn more than the median income of college graduates. And some college graduates earn less than the median income of high school graduates.

WW4.3

Third, the discussion so far has focused on amount of schooling rather than quality of schooling. We have implicitly assumed that the only relevant factor was the number of years students spend in school. However, schooling quality will likely affect the rate of return to schooling. For example, higher-quality teachers, better classroom resources, and greater studying by students should increase the rate of return to schooling.

GP4.3

Some evidence exists on how schooling inputs affect the rate of return.[21] A study by Card and Krueger indicates that higher teacher salaries and lower student–teacher ratios raise the return to schooling.[22] They also find that relative improvements in schooling quality among African-Americans account for 20 percent of the decline in the male African-American to white wage gap between 1960 and 1980.[23] However, Heckman, Layne-Farrar, and Todd conclude that schooling inputs have a more modest impact on the return to schooling than estimated by Card and Krueger.[24]

[21] For a survey, see Eric A. Hanushek, "School Resources," in Eric A. Hanushek and Finis Welch (eds.), *Handbook of the Economics of Education,* Volume 2, (Amsterdam, Holland: Elsevier, 2006), pp. 866–907.
[22] David Card and Alan B. Krueger, "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States," *Journal of Political Economy,* February 1992, pp. 1–40.
[23] See David Card and Alan B. Krueger, "School Quality and Black/White Relative Earnings: A Direct Assessment," *Quarterly Journal of Economics,* February 1992, pp. 151–200.
[24] James J. Heckman, Anne Layne-Farrar, and Petra Todd, "Does Measured School Quality Really Matter? An Examination of the Earnings–Quality Relationship," in Gary Burtless (ed.), *Does Money Matter? The Effect of School Resources on Student Achievement and Adult Success* (Washington, DC: Brookings Institution, 1996). For a similar conclusion, see Iida Hakkinen, Tanja Kirjavainen, and Roope Uusitalo, "School Resources and Student Achievement Revisited: New Evidence from Panel Data," *Economics of Education Review,* June 2003, pp. 329–35.

4.3 World of Work

Higher Education: Making the Right Choices

The accompanying table shows the annual salaries of 2014 college graduates by major. Clearly which major one chooses affects one's earnings. These data raise the question of whether other decisions impact a college graduate's earnings. For example, does it matter which college or university one attends?

Dale and Krueger shed light on this and related questions by examining the career earnings of individuals who were accepted and rejected by 27 colleges or universities in 1976 and 1989.* An innovative feature of this study is that the researchers were able to compare the earnings of (1) those who were accepted by a more selective college but decided to attend a less selective college with (2) those who actually attended a more selective college. This technique enables them to control for the ability problem that plagued previous studies of the impact of college quality on earnings; that is, earlier studies did not sort out whether students who attended elite universities gained higher earnings because they went to a selective school or because the students were smart and ambitious.

The study's results indicate that it does *not* pay to attend a more selective college as measured by the average SAT score of entering freshmen. For example, a student who attended a highly selective school such as Princeton University did not earn more than one who attended a less selective school such as the Pennsylvania State University. An exception to this finding is that minorities and students with poorly educated parents do tend to benefit from attending a highly selective school. This may be the result of these students getting connections they would not be otherwise able to obtain.

However, earnings *are* positively related to the average SAT scores of the schools a student applied to but did not attend. An example is the acclaimed movie producer and director Steven Spielberg, who applied to the film schools at USC and UCLA and was rejected at both places. He instead attended Cal State Long Beach. This suggests that ambition and a willingness to work hard are more important determinants of earnings than the selectivity of the school one attends.

* Stacy Dale and Alan B. Krueger. "Estimating the Return to College Selectivity over the Career Using Administrative Earning Data," *Journal of Human Resources*, Spring 2014, pp. 323–358.

Estimated Starting Salaries For New College Graduates 2014

Academic Major	Estimated Starting Salary	Academic Major	Estimated Starting Salary
Computer Science	$67,500	Accounting	$55,600
Chemical Engineering	$67,300	Nursing	$55,300
Management Information Systems	$65,000	Communications	$52,300
Mechanical Engineering	$63,700	Mathematics (incl. Statistics)	$50,500
Electrical/Electronics Engineering	$63,700	Advertising	$47,100
Civil Engineering	$60,000	Chemistry	$46,300
Finance	$59,500	Foreign Languages	$46,100
Economics	$58,900	Political Science/Government	$43,500
Business Administration/Management	$58,200	Journalism	$42,400
Marketing/Marketing Management	$57,500	Secondary Education	$41,300

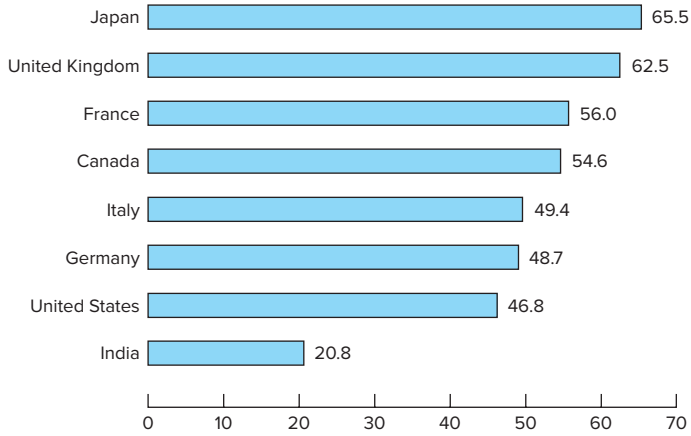
English	$40,100	Social Work	$37,100
Elementary Education	$39,700	Psychology	$36,900
History	$39,400	Sociology	$36,800
Criminal Justice	$38,800	Visual and Performing Arts	$35,600

Source: National Association of Colleges and Employers, September 2014 *Salary Survey* (Bethlehem, PA: National Association of Colleges and Employers, 2014).

4.3 Global Perspective

Schooling Quality

Schooling quality based on scores on standardized tests varies widely across the world.



Source: Eric A. Hanushek and Dennis D. Kimko, "Schooling, Labor Force Quality, and Economic Growth," *American Economic Review,* December 2000, pp. 1184–1208. The scores are normalized to make the world average across 39 countries equal to 50.

Strayer examines the ways in which school quality affects earnings. He reports that greater high school quality increases the likelihood that a student will attend either a four-year or a two-year college. This increased rate of college attendance in turn raises future earnings. He finds weaker evidence for direct effects of school quality on earnings.[25]

[25] Wayne Strayer, "The Returns to School Quality: College Choice and Earnings," *Journal of Labor Economics,* July 2002, pp. 475–503.

Private versus Social Perspective

To this point, we have viewed the human capital investment decision from a *personal* or ***private perspective***; that is, we have viewed benefits and costs strictly from the standpoint of an individual who is contemplating a human capital investment. The investment decision also can be viewed from a *public* or ***social perspective***. In changing perspectives, we can retain Equations (4.3) and (4.6); however, we must alter our conceptions of costs and benefits. The private approach includes only costs and benefits accruing to the individual. But from the social perspective, the scope of relevant costs and benefits must be broadened. In particular, the private perspective excludes any public subsidies to education in calculating costs simply because such subsidies are *not* paid by the individual. Similarly, benefits (incremental earnings) should be calculated on an *after-tax* basis from the personal point of view. From the standpoint of society, costs should include any public subsidies to education, and benefits should be in terms of *before-tax* incremental earnings. Presumably the part of incremental earnings taxed away by government will be used to finance public goods and services beneficial to society as a whole.

Furthermore, most economists believe that education entails substantial *external* or *social benefits;* that is, benefits accruing to parties other than the individual acquiring the education. From a social perspective, these benefits should clearly be included in estimating the rate of return on human capital investments. What are these social benefits? First, it is well known that more educated workers have lower unemployment rates than less educated workers. Having high unemployment rates, poorly educated workers receive unemployment compensation and welfare benefits with greater frequency and may also find crime a relatively attractive alternative source of income. This means that society might benefit from investing in education by having to pay less in taxes for social welfare programs, crime prevention, and law enforcement. Second, political participation and, presumably, the quality of political decisions might improve with increased literacy and education. More education might mean that society's political processes would function more effectively to the benefit of society at large. Third, there may be intergenerational benefits: The children of better-educated parents may grow up in a more desirable home environment and receive better care, guidance, and informal preschool education. Fourth, the research discoveries of highly educated people might yield large and widely dispersed benefits to society. Jonas Salk's discovery of an effective and economic polio vaccine is illustrative.[26]

Why is our distinction between private and social rates of return on human capital investments significant? First, the difference between the private and the social perspectives is of potential importance because efficiency demands that the economy's total investment outlay be allocated so that rates of return on human and physical capital should be equal at the margin. If a given amount of investment spending is

[26] For more detailed discussions of the social and nonmarket benefits from education, see Fabian Lange and Robert Topel, "The Social Value of Education and Human Capital," in Eric A. Hanushek and Finis Welch (eds.), *Handbook of the Economics of Education,* Volume 1, (Amsterdam, Holland: Elsevier, 2006), pp. 459–509; and Lochner Lance, "Nonproduction Benefits of Education: Crime, Health, and Good Citizenship," in Eric A. Hanushek, Stephen Machin and Ludger Woessmann (eds.), *Handbook of the Economics of Education,* Volume 4, (Amsterdam, Holland: Elsevier, 2011), pp. 183–282.

currently being allocated so that the rate of return on human capital investment is, say, 12 percent, while that on physical capital is only 8 percent, society would benefit by relocating investment from physical to human capital. In making this comparison, it is correct to use the social, rather than the private, rate of return. Thus if we were to find that the *private* rate of return on human capital was equal to the rate of return on physical capital, it would not necessarily be correct to conclude that investment resources were being efficiently divided between human and real capital. If the *social* rate of return was higher (lower) than the private rate, resources would have been underallocated (overallocated) to human capital investments. Incidentally, most studies of social rates of return yield rates that are quite comparable to those found in studies estimating private rates of return.

A second reason that the distinction between the private and social perspectives is important has to do with policy. The social or external benefits associated with education provide the rationale for subsidizing education with public funds. In the interest of allocative efficiency, the size of these public subsidies to education should be determined on the basis of the magnitude of the associated social benefits.

4.1 *Quick Review*

- Human capital consists of the accumulation of prior investments in education, on-the-job training, health, and other factors that increase productivity.
- The net present value method of computing the return on a human capital investment uses a market interest rate to discount the net earnings of the investment to its present value. If the net present value is positive, the investment should be undertaken.
- The internal rate of return method discovers the unique rate of discount that equates the present value of future earnings and the investment costs. If this internal rate of return exceeds the interest cost of borrowing, the investment should be undertaken.
- Private rates of return on investments in education are on the order of 10 to 15 percent and seem to be rising; social rates of return are thought to be similar.

Your Turn

Suppose the net present value of an educational investment is highly positive. What can you infer about the investment's internal rate of return relative to the interest cost of borrowing? (*Answer:* See page 598.)

HUMAN CAPITAL INVESTMENT AND THE DISTRIBUTION OF EARNINGS

Why do people vary significantly in the amounts of human capital they acquire? Why is Nguyen a high school dropout, Brooks a high school graduate, and Hassan a PhD? The reasons are many and complex; but by presenting a simple model of the demand for and the supply of human capital, we can gain valuable insights pertinent to this question. In so doing, we will also achieve some understanding of why earnings are quite unequally distributed.

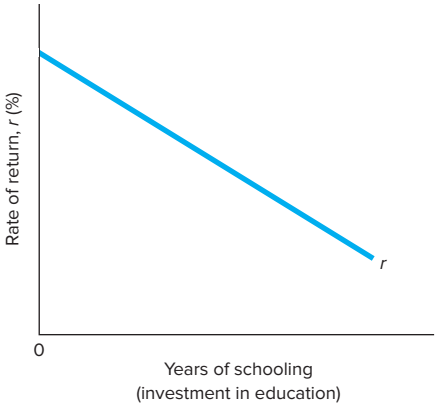
Diminishing Rates of Return

In Figure 4.4, we plot the marginal internal rate of return—the extra return from additional education—for a specific individual for successive years of education. For simplicity, we have assumed that the rate of return falls continuously. In reality, the rate of return on the fourth year of college—the year a student graduates—may yield a higher marginal return than the third year. But in general, it is reasonable to assume that rates of return fall as more investment takes place. Why do these rates of return diminish? The answer is essentially twofold. On the one hand, investment in human capital (education) is subject to the law of diminishing returns. On the other hand, as additional education is undertaken, the attendant benefits fall and the associated costs rise so as to reduce the internal rate of return.

1 Diminishing Returns

Investment in education is subject to the law of diminishing returns. The extra knowledge and skills produced by education or schooling become smaller and smaller as the amount of schooling increases. This means that the incremental earnings from each additional year of schooling will diminish, and therefore so will the rate of return. Think of the individual as analogous to a firm that combines fixed resources with variable inputs to generate a certain output. An individual combines certain physical and mental characteristics with inputs of education or schooling to generate outputs of labor market skills. The individual's physical and mental characteristics—IQ, motor coordination, and so forth—are essentially fixed resources determined by genes and the home environment. To these fixed resources, we add variable inputs in the form of years of schooling. As with any other situation where a variable input is added to some fixed input, the resulting increases in the amount of human capital produced—the new knowledge and skills acquired by the individual—will ultimately decline. And diminishing returns mean that the rate of return on successive human capital investments will also diminish.

FIGURE 4.4 Rates of Return from Successive Years of Schooling
The rate of return from investing in successive years of schooling diminishes because (1) such investment is subject to the law of diminishing returns and (2) costs rise and benefits fall as more education is obtained.



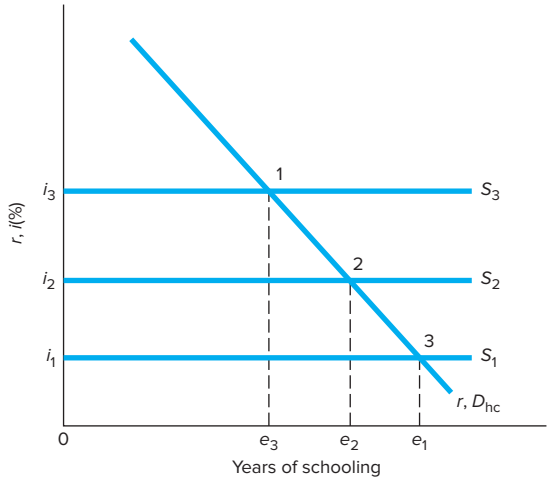
2 Falling Benefits, Rising Costs

We have already touched on the second reason the internal rate of return will decline as additional education is acquired. Costs tend to rise and benefits tend to fall for successive years of schooling. In addition to having essentially fixed mental and physical characteristics, the individual also possesses a fixed amount of time; that is, a finite work life. It follows that the more years one invests in education, the fewer one has during which to realize the benefits of incremental income from that investment, hence the lower rate of return. The rate of return also declines because the costs of successive years of schooling tend to rise. On the one hand, the opportunity cost of one's time increases as more education is acquired; that is, an additional year of school has a greater opportunity cost for the holder of a bachelor's degree than for someone who has only a high school diploma. Similarly, the private direct costs of schooling increase. Public subsidies make elementary and high school education essentially free, but a substantial portion of the cost of college and graduate school is borne by the individual student. Studies confirm that the rate of return on schooling diminishes as the amount of schooling increases.

Demand, Supply, and Equilibrium

Why have we identified the curve labeled r in Figure 4.5 as a ***demand for human capital curve*** (D_{hc})? This identification is the result of applying the previously discussed decision rule, which says that investment is profitable if $r > i$ and unprofitable if $r < i$. In the context of Figure 4.5, it is profitable to invest in human capital or schooling up to the point where the marginal rate of return equals the interest rate or, in short, where $r = i$. Thus, in Figure 4.5, we assume that the individual is a

FIGURE 4.5 Deriving the Demand for Human Capital Curve
Application of the $r = i$ rule reveals that the marginal internal rate of return curve is also the demand for human capital curve. Each of the equilibrium points (1, 2, 3) indicates the financial price of investing (i) on the vertical axis and the quantity of human capital demanded on the horizontal axis. This information about price and quantity demanded constitutes the demand curve for human capital.



"price taker" in borrowing funds for educational purposes and that needed amounts of money capital can be borrowed at a given interest rate. The horizontal line drawn at, say, i_2 indicates that the individual faces a perfectly elastic ***supply of investment funds*** S_2 at this interest rate. Our $r = i$ rule indicates that e_2 is the most profitable number of years of schooling in which to invest. Similarly, if the market rate of interest were higher at i_3, application of the $r = i$ rule would make only e_3 years of schooling profitable. If the interest rate were lower at i_1, it would be profitable to invest in e_1 years of schooling. By applying a selection of possible interest rates or money capital prices to the marginal rate of return curve, we locate a number of equilibrium points (1, 2, 3) that indicate the financial price of investing (various possible interest rates) on the vertical axis *and* the corresponding quantities of human capital demanded on the horizontal axis. Any curve containing such information about price and quantity demanded is, by definition, a demand curve—in this case, the demand curve for human capital or schooling.

Differences in Human Capital Investment

The demand and supply curves of Figure 4.5 can explain why different people invest in different amounts of human capital *and,* therefore, realize substantially different earnings. Our emphasis is on three considerations: (1) differences in ability, (2) differing degrees of uncertainty concerning the capacity to transform skills and knowledge into enhanced earnings due to discrimination, and (3) differing access to borrowed funds for human capital investment. The first two factors work through the demand side of the human capital market; the third works through the supply side.

1 Ability Differences

WW4.4

Figure 4.6 embodies two different demand curves for human capital—D_A and D_B for Adams and Bowen, respectively—and a common supply curve. The common supply curve shows that money capital for investment in schooling is available to Adams and Bowen on identical terms. The key question is why Bowen's demand curve for human capital (D_B) is to the right of Adams's (D_A). The answer may be that Bowen has greater abilities—better mental and physical talents and perhaps greater motivation and self-discipline—that cause any given input of schooling to be translated into a larger increase in labor market productivity and earning ability; that is, Bowen is more able than Adams to obtain enhanced earnings for each year of schooling; Bowen is capable of getting more than Adams out of education that is useful in the labor market. Thus, the rate of return on each year of schooling is higher, and Bowen's demand curve for human capital is therefore farther to the right. Given the interest rate and the perfectly elastic supply of financial capital, this means that Bowen will invest in e_B years of schooling, whereas Adams will choose to invest in only e_A years.[27]

Note that because it is rational for more able people to obtain more education than less able people, earnings differentials are compounded. Given the same

[27] Some evidence indicates that less educated people obtain less education mainly because they have a higher discount rate (perhaps they come from a poorer family or have a distaste for education) rather than because they lack ability. See David Card, "Earnings, Schooling, and Ability Revisited," *Research in Labor Economics* 16 (1995), pp. 23–48.

4.4 World of Work

What You Did in High School Matters*

High school students are often told by their teachers that their performance in high school will affect their future. Clearly high school grades affect whether a student is admitted to a college. The effects of high school grades, however, may well extend beyond the college admission decision.

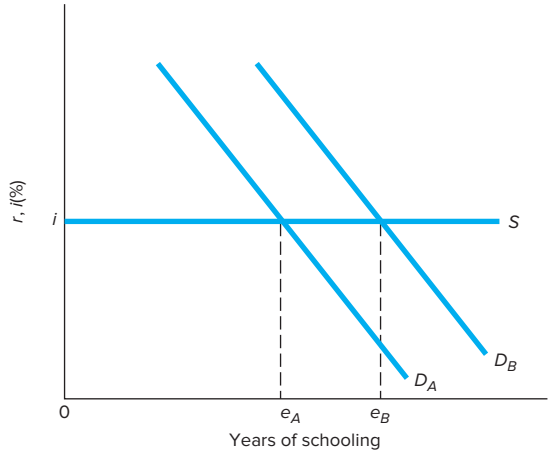
Michael French, Jenny Home, Ioana Popovivic, and Philip Robins examine how high school academic performance impacts future educational attainment and earning in adulthood. Their study uses data on over 10,000 24- to 34-year olds, and thus are on average about 10 years out of high school. An important advantage of their analysis is that it uses data from high school transcripts rather than less reliable self-reported grades.

High school grades strongly affect future educational attainment and earnings. A one-point increase in high school grade point average (GPA) doubles the probability of completing college, from 21 percent to 42 percent, for both men and women. These estimates control for other factors that may affect future educational attainment, such as family size, school characteristics, innate ability, motivation, and parents' education. Those with higher high school GPAs were also more likely to complete graduate degrees. Similarly, a one-point rise in high school GPA raises annual earnings by 12 percent for males and 14 percent for females.

African-American and Hispanic men obtain more education than whites with the same high school performance and background characteristics. One possible explanation is that minority men are more motivated than their white counterparts.

* Michael T. French, Jenny F. Homer, Ioana Popovicic, and Philip K. Robins, "What You Do in High School Matters: High School GPA, Educational Attainment, and Labor Market Earnings as a Young Adult," *Eastern Economic Journal*, forthcoming.

FIGURE 4.6 Ability, Discrimination, and Investment in Human Capital
If Bowen has greater ability to translate schooling into increased labor market productivity and higher earnings than Adams, then Bowen's demand curve for human capital (D_B) will lie farther to the right than Adams's (D_A). Given the interest rate, it will be rational for Bowen to invest in more education than Adams. Similarly, if Adams and Bowen have equal ability but discrimination reduces the amount of incremental income Adams can obtain from additional education, it will be rational for Adams to invest in less education than Bowen.



amount of schooling, we would expect Bowen to earn more than Adams because of the former's greater innate ability. Because it is rational for Bowen to obtain more education than Adams, we would anticipate a further widening of the earnings differential.

2 Discrimination: Uncertainty of Earnings

Let's now assume that Adams and Bowen are identical in terms of ability. But let's suppose that Adams is African-American or female and therefore is more likely to encounter discriminatory barriers to selling in the labor market the higher productivity acquired through education. In other words, Adams may encounter various forms of discrimination that reduce the likelihood of transforming the labor market skills acquired through education into incremental earnings. In Equations (4.3) and (4.6), discrimination creates the probability that the flow of earnings to African-American (female) Adams will be smaller than those accruing to white (male) Bowen from the same amount of education. This means rates of return on each level of education are lower to Adams than to Bowen. In Figure 4.6, Adams's demand for human capital is less than Bowen's. Given equal access to funds for financing education (the *iS* curve in Figure 4.6), Bowen will again find it rational to invest in more human capital than Adams. Discrimination, which reduces wages and earnings, also has the perverse impact of reducing the incentive for those discriminated against to invest in human capital.

WW4.5

3 Access to Funds

This brings us to a final consideration. Figure 4.7 portrays the situation where the demand for human capital curves for Adams and Bowen is identical, but Bowen can acquire money capital on more favorable terms than Adams. Why the difference? Bowen may be from a wealthier family that is in a position to pledge certain financial or real assets as collateral and therefore obtain a lower interest rate. Under these conditions, it is rational for Bowen to invest in more years of schooling than Adams.[28]

Interactions

The basic point is that differences in ability, the impact of discrimination, and varying access to financial resources are all reasons various individuals find it rational

[28] A more elusive factor, one's *time preference,* also affects human capital investment. For example, Curt may be highly present-oriented in that he is relatively reluctant to sacrifice current consumption for future benefits. In terms of Equation (4.3), Curt would in effect use a high interest rate in discounting the future flow of earnings. Other things being equal, this would reduce the present value of a human capital investment and decrease the likelihood that it would be undertaken. Conversely, Beth may be highly future-oriented in that she is quite willing to forgo current consumption for future benefits. She would use a low interest rate in discounting Equation (4.3)'s future flow of earnings, tending to increase the present value of a human capital investment and enhancing the likelihood that it will be undertaken. The notion of time preference is helpful in explaining why individuals who are quite homogeneous with respect to ability and access to funds acquire much different amounts of human capital. This matter will be considered further in Chapter 8. For an analysis showing that more educated individuals are more future-oriented, see John T. Warner and Saul Pleeter, "The Personal Discount Rate: Evidence from Military Downsizing Programs," *American Economic Review,* March 2001, pp. 33–53.

4.5 World of Work — Reversal of the College Gender Gap

In 1960 there were 0.63 female graduates for every male graduating from college. This ratio has steadily risen over time. More women than men now graduate from college. By 2013 there were 1.34 females for every male graduating from college.

From the late 1950s to the early 1970s, many female students attended college to pursue traditionally female occupations such as teaching and intended to be in the labor force for a limited extent. Starting in the late 1960s and early 1970s, the career expectations of young women started to change: They expected to have much more attachment to the labor market. Many factors played a role in this change, including the women's movement, birth control (see World of Work 3.5), reduced gender discrimination, and an increased labor force participation rate among female college graduates of the previous generation.

As a result of their increased future work expectations, high school girls started to prepare for college in a different manner. They started to take more math and science classes. In 1972 high school boys took 24 percent more math classes and 20 percent more science classes than high school girls. By 1992 virtual parity was achieved between high school boys and girls in math and science class enrollment. High school girls also increased their achievement scores compared with boys. In fact, by 1992 high school girls had an advantage in combined math and reading achievement scores. Goldin, Katz, and Kuziemko find that the increased proportion of high school girls taking math and science classes as well as the rise in the achievement scores of girls relative to boys can account for between 37 and 63 percent of the rise in the female to male ratio of college graduates between the 1970s and the 1990s.

Why have women gone past parity to become a majority of college students? Goldin, Katz, and Kuziemko argue that noncognitive factors may play an important role. In particular, boys have more behavioral problems than girls. Boys are two to three times more likely to suffer from attention deficit hyperactivity disorder (ADHD) than are girls. They are much more likely than girls to engage in criminal activity, get suspended from school, or be in a special education program.

Source: Claudia Goldin, Lawrence Katz, and Ilyana Kuziemko, "The Homecoming of American College Women: The Reversal of the College Gender Gap," *Journal of Economic Perspectives,* Fall 2006, pp. 133–56; and National Center for Education Statistics (http://nces.ed.gov).

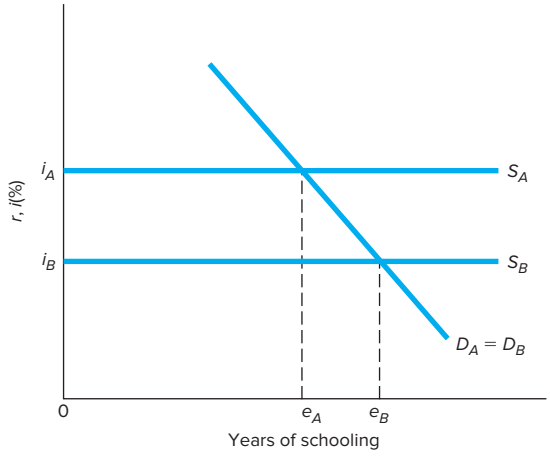


FIGURE 4.7
Access to Funds and Human Capital Investment If Bowen has access to financial resources on more favorable terms than Adams, it will be rational for Bowen to invest in a larger amount of education.

to obtain different amounts of education. As shown in the age–earnings profiles in Figure 4.1, we note that these differences in educational attainment are important in generating inequality in the distribution of earnings. In fact, the factors that explain educational inequality may interact to generate greater earnings inequality than our discussion would suggest. For example, discrimination not only may influence the demand side of the human capital market to reduce the demands of African-Americans and females for education but may also appear on the supply side. If a lender reasons that discrimination makes it less likely that an African-American or a female will be able to achieve employment in the occupation for which he or she is training, the lender will compensate for this greater risk by charging a higher rate of interest. This causes the supply of investment funds curve for African-Americans and women to shift upward as in Figure 4.7, and the amount of education acquired will be further diminished. Similarly, individuals with greater ability may also enjoy lower financial costs. Greater ability may stem not simply from one's genetic inheritance but also from the quality of one's home environment. The child fortunate to be born into a high-income family may enjoy more and better preschool education, have greater motivation and self-discipline, and place a higher value on education in general. These considerations mean that the child may have greater ability to absorb education and to increase his or her labor market productivity and earnings. Being born into a high-income family also means a greater ability to finance education on favorable terms.[29]

The comments here correctly imply that public policy may also play a significant role in determining the amounts of human capital various individuals acquire and the consequent distribution of earnings. For example, to the extent that antidiscrimination policies have been effective, variations in individual demand curves for education have been reduced, and so has earnings inequality. Scholarships based on student ability mean that students with the strongest demand curves for human capital would also have the greatest access to funds—a combination that would increase inequality in the distribution of human capital and earnings. Conversely, scholarships on the basis of need or targeted education programs for children from disadvantaged or minority families would reduce inequality in the dispersion of human capital and earnings.

Capital Market Imperfections

The capital market may include certain biases or imperfections causing it to favor investment in physical, rather than human, capital. Such biases are termed ***capital market imperfections***. Specifically, funds may be less readily available, or accessible only on less favorable terms, for investment in human capital as compared to real capital or the purchase of consumer durables. Perhaps the primary reason for this is that human capital is embodied in the borrower and therefore is not available as collateral on a loan. If one defaults on a house mortgage or an automobile loan,

[29] For an interesting discussion of how parents affect the earnings of their children, see Paul Taubman, *Income Distribution and Redistribution* (Reading, MA: Addison-Wesley Publishing Company, 1978), chap. 5.

there is a tangible asset the lender can repossess and sell to recover losses. But in a nation that rejects slavery and indentured servitude, there is no designated asset for the lender to seize if the borrower fails to repay an educational loan. This increases risk to the lender and prompts the inclusion of a risk premium in the interest rate charged. Furthermore, we have noted that other things being equal, it is more rational for young people to make human capital investments than for old people. But young people are less likely to have established credit ratings or collateral assets to allow them to borrow on reasonable terms. Finally, the variation in returns on human capital investments is large. Recall that although college graduates *on the average* earn substantially more than high school graduates, many college graduates earn less than the average high school graduate. This uncertainty of return may inflate the risk premium charged for human capital loans.[30]

The relative unsuitability of the capital market for educational loans has one or two important consequences. First, because of the problems and uncertainties just noted, financial institutions may choose *not* to make human capital loans. This means the amount of human capital investment individuals can undertake will depend on their, or their families', income and wealth. Thus well-to-do families can finance the college educations of their children by the relatively painless process of reducing their volume of saving. But poor families cannot save, and therefore financing a college education implies a possibly severe cut in living standards.[31] These circumstances may perpetuate a vicious cycle. Individuals and families with little human capital (education) may be poor; being poor, it is extremely difficult for them to finance the acquisition of additional human capital.

Capital market imperfections have a second important implication. If it is in the social interest to achieve a balance or equilibrium between investment in real capital and human capital, then the government may have to offset the imperfections by subsidizing or providing human capital loans. Ideally, an equilibrium between investment in real and human capital would occur when the last dollar spent on human capital contributes the same amount to the domestic output as the last dollar expended on real capital. But the higher interest rates charged for educational loans will restrict expenditures on human capital so that the relative contribution of the last unit to the national output will exceed that of the last unit of real capital. This indicates that investment resources are being underallocated to human capital. This rationale in part lies behind the loan guarantees and financial resources that government has provided to stimulate educational loans.

[30] For a further discussion of capital market imperfections, see Lester Thurow, *Investment in Human Capital* (Belmont, CA: Wadsworth Publishing Company, 1970), pp. 77–83.

[31] Even publicly supported colleges and universities that feature relatively low tuition and fees may attract fewer students from low-income families simply because their families may not be able to afford the opportunity costs (see Figure 4.2). A very poor family may not be able to forgo the income that a son or daughter can earn by entering the labor market immediately upon graduating from high school. Federal education loan programs have mitigated this problem in recent years. For an analysis of the impact of family finances on college enrollment, see Bhashkar Mazumder, "Family Resources and College Enrollment," *Economic Perspectives* (Federal Reserve Bank of Chicago), 4th Quarter 2003, pp. 30–41.

4.2 *Quick Review*

- The rate of return from investing in successive units of human capital declines; that is, the investment demand curve is downward-sloping—because opportunity costs rise and marginal benefits fall as more investment occurs.
- The optimal level of investment in human capital occurs when the marginal rate of return, *r*, equals the interest rate, *i* (the price of investing).
- It is rational for people having greater ability to obtain more education than others; conversely, those who are discriminated against in the labor market have less incentive to invest in human capital.
- People who have greater access to financial funding for investment on more favorable interest terms will rationally invest more in education than others.
- Imperfections in the capital market may bias investment toward physical capital rather than human capital.

Your Turn

In equilibrium, the marginal rates of return, *r*, for those with more ability to extract earnings from formal education and those with less ability are equal (see Figure 4.6). So why do people with greater ability get more formal education? (*Answer:* See pages 598, 599.)

ON-THE-JOB TRAINING

Many of the usable labor market skills that workers possess are acquired not through formal schooling but rather through ***on-the-job training***. Such training may be somewhat formal; that is, workers may undertake a structured trainee program or an apprenticeship program. On the other hand, on-the-job training is often highly informal and therefore difficult to measure or even detect. Less experienced workers often engage in "learning by doing"; they acquire new skills by simply observing more skilled workers, filling in for them when they are ill or on vacation, or engaging in informal conversation during coffee breaks.

Costs and Benefits

Like formal education, on-the-job training entails present sacrifices and future benefits. It, thus, is an investment in human capital and can be analyzed through the net present value and internal rate of return frameworks [Equations (4.3) and (4.6)]. In deciding whether to provide on-the-job training, a firm will weigh the expected added revenues generated by the training against the costs of providing it. If the net present value of the training investment is positive, the firm will invest; if it is negative, it won't. Alternatively, the firm will invest if the internal rate of return of the investment exceeds the interest cost of borrowing.

For employers, providing training may involve such direct costs as classroom instruction or increased worker supervision, along with such indirect costs as reduced worker output during the training period. Workers may have to accept the cost of lower wages during the training period. The potential benefit to firms is that

a trained workforce will be more productive and will therefore make greater contributions to the firm's total revenue. Similarly, trained workers can expect higher wages because of their enhanced productivity.

General and Specific Training

To understand how the associated costs and benefits are distributed among workers and employers, we must distinguish between two polar types of on-the-job training. At one extreme, ***general training*** *refers to the creation of skills or characteristics that are equally usable in all firms and industries*. Stated differently, general training enhances the productivity of workers to all firms. At the other end of the continuum, ***specific training*** *is training that can be used* only *in the particular firm that provides that training*. Specific training increases the worker's productivity only in the firm providing that training. In practice, most on-the-job training contains elements of both general and specific training, and it is therefore difficult to offer unequivocal examples. Nevertheless, we might venture that the abilities to concentrate on a task for a reasonable period, to show up for work regularly and be punctual, to read, to perform simple mathematical manipulations, and to follow instructions all constitute general training. Similarly, gaining word processing, carpentry, or accounting skills would be considered general training. Alternatively, the ability to perform an assembly procedure unique to a firm's product exemplifies specific training. Teaching personnel to answer toll-free telephone questions about a firm's products is another example of specific training.

The distinction between general and specific training is important for at least two reasons. First, it is helpful in explaining whether the worker or the employer is more likely to pay for on-the-job training. Second, it is useful in understanding why employers might be particularly anxious to retain certain of their trained workers.

Distributing Training Costs

Analyzing whether workers or firms pay the costs of on-the-job training gets a bit complex. Let's start by looking at pure cases and then modify our analysis to account for real-world observations. We begin with two broad generalizations, each based on the assumptions that markets are competitive and that workers are perfectly mobile. First, *the worker will pay for general training through lower wages during the training period*. Second, *the firm must bear the cost of specific training*.

General training gives a worker skills and understanding that are transferable; they can be sold to other firms at a higher wage rate. If the employer were to bear the cost, the worker might leave the firm's employment after the training and thus deprive the employer of any return (benefit) on the training investment. Alternatively, in the post-training period the employer would have to pay a wage rate commensurate with the worker's higher productivity, eliminating any possible return on the training investment to the employer. Therefore, if general on-the-job training is undertaken, it is paid for by the worker in the form of a reduced wage rate during the training period.

On the other hand, a specific skill is not transferable or salable by a worker. Thus, the worker will not pay for such training. If a worker is fired or laid off at the end of a period of specific training, the worker has gained nothing of value to sell in the

labor market. The cost is borne by the employer. This typically means that the employer will pay a wage rate in excess of the worker's contribution to the firm's revenue during the training period. Figure 4.8 is useful in elaborating these generalizations.

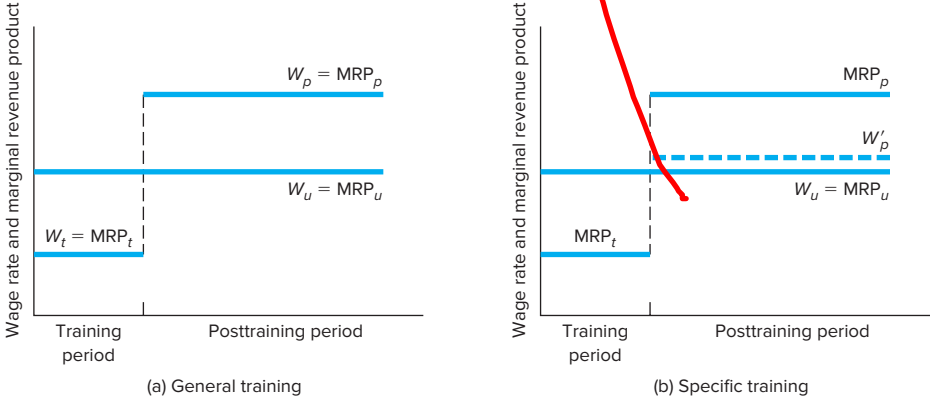
General Training

Figure 4.8(a) shows the case of general training. Here W_u and MRP_u indicate what the wage rate and marginal revenue product would be for an untrained worker. ***Marginal revenue product*** *is the increase in a firm's total revenue associated with the employment of a given worker*.[32] The employment of an additional worker will

FIGURE 4.8 Wage Rates and Marginal Revenue Products for General and Specific Training

(a) *General training*. Because general training is salable to other firms and industries ($W_p = \text{MRP}_p$), workers normally must pay for such training that a firm provides. This payment is in the form of a reduced wage ($W_t < W_u$) during the training period. A possible exception is where the firm faces a legal minimum wage and needs to provide remedial basic education to have a qualified workforce. The firm may conclude that it can pay a wage rate above W_t in the training period and recoup its investment by paying a wage rate slightly below W_p in the posttraining period. Workers facing high costs of job search and relocation may not leave for jobs paying W_p. (b) *Specific training*. Specific training is not transferable to other firms; therefore, the employer must pay for such training. During the training period, the employer pays a wage rate in excess of the worker's marginal revenue product ($W_u > \text{MRP}_t$). In the posttraining period, the employer receives a return on specific training because the worker's marginal revenue product will exceed his or her wage rate ($\text{MRP}_p > W_u$). Because the employer's return on specific training varies directly with the length of the posttraining period, the employer might voluntarily pay an above-competitive wage (W'_p as compared to W_u) to reduce worker turnover.

Source: Adapted from John T. Addison and W. Stanley Siebert, *The Market for Labor: An Analytical Treatment* (Santa Monica, CA: Goodyear Publishing Company, 1979), p. 114.



[32] This concept will be explored in more detail in Chapter 5.

add to a firm's total output and therefore to its revenue. This addition to its revenue is the MRP.

In Figure 4.8(a) the wage rate and marginal revenue product *during* training are represented by W_t and MRP_t while W_p and MRP_p are the posttraining wage rate and marginal revenue product. MRP_t is below that for an untrained worker because during the training period the worker is diverting time from production to learning. It is important to stress that the higher posttraining marginal revenue product (MRP_p) is relevant *to all firms* because the training is general. Competing firms will therefore bid up the wage rate of this trained worker until it is equal to MRP_p. It is precisely for this reason—that competition will force the posttraining wage rate upward into equality with the posttraining marginal revenue product—that the employer will normally *not* be willing to pay for general training. The employer has no opportunity to obtain a return on its training investment by paying a wage rate less than the worker's marginal revenue product. Why should the employer bear general training costs when the benefits accrue solely to the trained employee in the form of higher wages? To repeat: The worker pays for general training costs by accepting a wage below that of the untrained worker (W_t as compared to W_u) during the training period. Incidentally, the fact that competition will bid a worker's wage rate up into equality with his or her higher posttraining marginal revenue product (MRP_p), and thereby preclude a return to the employer, explains why general education typically occurs in schools and not on the job.

Specific Training

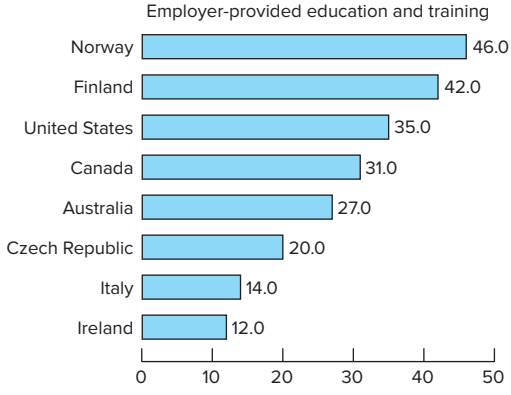
Figure 4.8(b) pertains to specific training. Again, W_u and MRP_u are the wage rate and marginal revenue product of an untrained worker, and MRP_t and MRP_p, respectively, show marginal revenue productivity during and after specific training. In contrast to Figure 4.8(a), the posttraining marginal revenue product applies *only to this firm*. The worker has acquired specific training that will increase productivity in *this* firm; but by definition, specific training is *not* transferable or useful to other firms. Because specific training is not transferable—that is, it will not allow the worker to obtain a higher wage rate as the consequence of labor market competition for his or her services—the worker will refuse to pay for such training and will not accept a lower wage during the training period. Note that during the training period the wage rate will remain at W_u, which means the employer must bear the cost of the training by paying a wage rate that is in excess of the worker's marginal revenue product (MRP_t). However, because specific training is not transferable—that is, it does not increase the worker's marginal revenue product to other firms—the employer need not increase the wage rate above W_u in the posttraining period. Thus, from the employer's standpoint, training imposes a flow of costs (W_u exceeds MRP_t) in the training period that is followed by a flow of benefits or incremental revenues (MRP_p exceeds W_u) in the posttraining period. As shown in Equation (4.3), if the net present value of these flows is positive, the firm will find it profitable to undertake specific training for its workers. Indeed, you have undoubtedly noticed that Figure 4.8(b) resembles Figure 4.2.

GP4.4

4.4 Global Perspective

Percentage of Workers Receiving Employer-Provided Education and Training

The percentage of workers who receive employer-provided job-related education and training ranges from 12 percent in Ireland to 46 percent in Norway.



Source: Organization for Economic Cooperation and Development, *Employment Outlook,* July 2003, Table 5.1.

The statistics are based on samples of workers aged 25–64 from the middle to late 1990s.

Modifications

Our discussion of general and specific training merits modifications in some important ways. First, let's look again at general training [Figure 4.8(a)]. Recently some firms have begun providing new employees with general training—remedial reading, writing, and mathematics—to compensate for a decline in the quality of primary and secondary education. These firms have been forced to provide this general training to ensure themselves a sufficient number of qualified workers. Usually these firms reduce the wage during the training period, as suggested in Figure 4.8. But in other instances, the legal minimum wage precludes this strategy. Thus, some firms may have to pay part of the training costs themselves.

In Figure 4.8(a), we are suggesting that the minimum wage may force some firms offering general training to pay more than W_t during the training period. How is it possible for these firms to recoup these general training expenses? Won't employees take their services elsewhere if they are paid less than W_p after completion of the training? The answer is that, in the real world, workers are not perfectly mobile; it is costly to change jobs and to relocate geographically. Thus, these firms may be able to recoup their investments in general training through paying less than the workers' marginal productivity during part or all of the posttraining period. The extra pay the worker could get by changing jobs may not be sufficient to cover the worker's job search and relocation costs.

We also need to modify our discussion of Figure 4.8(b). We have observed that in the posttraining period the employer realizes a return from specific training by paying a wage (W_u) that is less than each worker's contribution to the firm's total revenue (MRP_p). The total amount of revenue or profit derived from this discrepancy will vary directly with the length of time the worker remains employed by the firm. In short, the employer has a financial interest in lowering the turnover or quit rates of workers with specific training. The employer might accomplish this by voluntarily paying a wage rate somewhat higher than the worker could obtain elsewhere—for example, W'_p rather than W_u. Stated differently, the wage in the posttraining period is likely to be set so as to divide the gains from specific training between employer and employee. Specific training is one of a number of considerations that change labor from a variable input to a *quasi-fixed* factor of production.[33]

A final comment: On the average, individuals who receive the largest amount of formal education also receive more on-the-job specific training. This is not surprising. A person who has demonstrated his or her trainability by completing, say, a college degree is more likely to be selected by an employer for specific on-the-job training than someone with only a high school diploma. Why? Because that individual will be trainable at a lower cost. Indeed, Figure 4.8(b) implies that on-the-job training will have a higher rate of return to employers when workers can absorb training in a short time. A college degree is evidence of the capacity to absorb training quickly. The fact that people with more formal education on the average receive more on-the-job training helps explain why age–earnings profiles of more highly educated workers rise faster than those of less educated workers (see Figure 4.1).

4.3 *Quick Review*

- Because general training is salable to other firms, workers must normally pay for it indirectly through reduced pay during the training period.
- Specific training is not transferable to other firms; therefore, the employer normally must pay for it, recouping the investment cost later by paying these workers less than their MRPs.
- Faced with a legal minimum wage, some firms needing qualified workers may pay for general training, recouping their expenses by paying workers less than their MRPs during the posttraining period. Because of high job search and relocation costs, many workers will stay at their jobs even though they might be able to earn more elsewhere.
- The employer's return on specific training varies directly with the length of the posttraining period; thus, the employer may pay a higher-than-competitive wage to reduce worker turnover and increase its return on its investment.

Your Turn

Suppose that after graduation you take a job with an employer that offers to pay full tuition for employees wishing to return to school to get an MBA degree during nonwork hours. You are not required to continue working for the firm after getting your MBA. What type of training is this? Who do you think actually pays for it? (*Answer:* See page 599.)

[33] The classic study is Walter Oi, "Labor as a Quasi-Fixed Factor," *Journal of Political Economy,* December 1962, pp. 538–55.

Empirical Evidence

In 1995, 70 percent of employees in establishments with 50 or more workers reported participating in formal training to improve their job skills in the last year. Nearly 90 percent of college-educated workers received training, while 60 percent of those with a high school degree or less obtained training. An equal percentage of white and African-American workers received training at work. In 1995, two-thirds of men received training, while 73 percent of women participated in training.[34]

There has been a kaleidoscope of new research on training.[35] Here are a few recent findings:

- Union workers are more likely to receive training than nonunion workers.[36]
- Positive productivity effects have been found for general but not specific training.[37]
- The likelihood of participating in employer-provided training is greater in larger firms than in smaller ones.[38]
- Most training appears to be general in nature rather than firm-specific.[39]
- The accumulation of on-the-job training raises a worker's real wages. Each year of training with the current employer, among younger workers, raises earnings by 13 percent.[40]
- An analysis of 71 studies reveals that each on-the-job training course raises earnings by 2.6 percent. [41]
- A 1 percent increase in training is associated with an increase in productivity of about 0.6 percent and an increase in hourly wages of about 0.3 percent.[42]

[34] Harley Frazis, Maury Gittleman, Michael Horrigan, and Mary Joyce, "Results from the 1995 Survey of Employer-Provided Training," *Monthly Labor Review,* June 1998, pp. 3–13.
[35] For a survey of recent studies on the effects of training, see Harley J. Frazis and James R. Spletzer, "Worker Training: What We've Learned from the NLSY79," *Monthly Labor Review,* February 2005, pp. 48–58.
[36] Christian Dustmann and Uta Schönberg, "Training and Union Wages," *Review of Economics and Statistics,* May 2009, pp. 363–76.
[37] Alan Barrett and Philip J. O'Connell, "Does Training Generally Work? The Returns to In-Company Training," *Industrial and Labor Relations Review,* April 2001, pp. 647–62.
[38] Dan A. Black, Brett J. Noel, and Zheng Wang, "On-the-Job Training, Establishment Size, and Firm Size: Evidence for Economies of Scale in the Production of Human Capital," *Southern Economic Journal,* July 1999, pp. 82–100.
[39] Mark A. Loewenstein and James R. Spletzer, "General and Specific Training: Evidence and Implications," *Journal of Human Resources,* Fall 1999, pp. 710–33.
[40] Daniel Parent, "Wages and Mobility: The Impact of Employer-Provided Training," *Journal of Labor Economics,* April 1999, pp. 298–317.
[41] Carla Haelermans and Lex Borghans, "Wage Effects of On-the-Job Training: A Meta-Analysis," *British Journal of Industrial Relations,* September 2012, pp. 502–528.
[42] Lorraine Dearden, Howard Reed, and John Van Reenen, "The Impact of Training on Productivity and Wages: Evidence from British Panel Data," *Oxford Bulletin of Economics and Statistics* 4 (2006), pp. 397–421.

- Formal training lengthens employment durations.[43]
- Gender differences in the amount of on-the-job training play only a small role in the gender wage gap.[44]

CRITICISMS OF HUMAN CAPITAL THEORY

A number of criticisms have been made of the human capital model and its applications. The first two criticisms discussed here are concerned with measurement problems and suggest that estimates of the rates of return for investments in education are likely to be biased. Two other criticisms also have implications for measuring the rate of return on human capital investments but are more profound in that they challenge the very concept or theory of investing in human capital.

Investment or Consumption?

One criticism of measuring the rate of return on human capital investment is that it is *not* correct to treat all expenditures for education as investment because, in fact, a portion of such outlays are consumption expenditures. The decision to attend college, for example, is based on broader and more complex considerations than expected increases in labor productivity and enhanced earnings. Some substantial portion of one's expenditures on a college education yields consumption benefits either immediately or in the long run.[45] Expenditures for courses on Shakespeare, ceramics, music appreciation, and so forth yield both immediate and long-run consumption benefits by enlarging an individual's range of interests, tastes, and activities. It is true, of course, that a course in 19th-century English literature not only yields consumption benefits but also enhances the capacity of oral and written expression. And this ability has value in the labor market; it increases productivity and earnings. The problem, however, is that there is no reasonable way to determine what portion of the expense for a literature course is investment and what part is consumption. The main point is that by ignoring the consumption component of educational expenditures and considering *all* such outlays as investment, empirical researchers *understate* the rate of return on educational investments. In other words, by overstating the investment costs we understate the return on that investment.

[43] Adam Grossberg, "The Effect of Formal Training on Employment Duration," *Industrial Relations,* October 2000, pp. 578–99. See also Federico Garcia, Jeremy Arkes, and Robert Trost, "Does Employer–Financed General Training Pay? Evidence from the U. S. Navy," *Economics of Education Review,* February 2002, pp. 19–27.

[44] Paul Sicilian and Adam J. Grossberg, "Investment in Human Capital and Gender Wage Differences: Evidence from the NLSY," *Applied Economics* 33, no. 4 (March 2001), pp. 463–71.

[45] For an estimate of the consumption value of a college education, see Pedro Carniero, Karsten T. Hansen, and James J. Heckman, "Estimating Distributions of Treatment Effects with an Application to the Returns to Schooling and Measurement of the Effect of Uncertainty on College Choice," *International Economic Review,* May 2003, pp. 361–422.

Nonwage Benefits

In calculating the internal rate of return, most researchers simply compare the differences in the earnings of high school and college graduates. But the jobs of high school and college graduates differ in other respects. First, the fringe benefits associated with the jobs obtained by college graduates are more generous—both absolutely and as a percentage of earnings—than those received by high school graduates. By ignoring fringe benefits, empirical studies *understate* the rate of return on a college education. Second, the jobs acquired by college graduates are generally more pleasant and interesting than those of high school graduates. This means that a calculated rate of return based on incremental earnings *understates* the total benefits accruing from a college education.

The Ability Problem

Two other related criticisms, labeled the *ability problem* and the *screening hypothesis,* question the very concept of human capital investment. We first consider the ***ability problem***.

It is widely recognized that average incomes vary directly with the level of education. But it is less well accepted that a strong, clear-cut cause–effect relationship exists between the two. Critics of human capital theory doubt that the observed income differential is solely—or even primarily—the result of the additional education. To state the problem somewhat differently, the "other things being equal" assumption underlies the simple model of Figure 4.2 and the conclusions derived from it. Critics of human capital theory contend that other things in fact are not likely to be equal. It is widely acknowledged that those who have more intelligence, more self-discipline, and greater motivation—not to mention more family wealth and better job market connections—are more likely to go to college. If we could somehow blot out all of the knowledge and understanding that college graduates acquired in college, we would still expect this group to earn larger incomes than those who decided *not* to attend college. Thus, one can argue that although college graduates earn higher incomes than high school graduates, a substantial portion of that incremental income is *not* traceable to the investment in a college education. In other words, people with high abilities tend to do well in the labor market; the fact that they also attend college may be somewhat incidental to this success. "The only reason that education is correlated with income is that the combination of ability, motivation, and personal habits that it takes to succeed in education happens to be the same combination that it takes to be a productive worker."[46] This criticism implies that if a substantial portion of the incremental earnings enjoyed by college graduates is attributable to their *ability* and not to their *schooling,* then estimated rates of return on investing in a college education will be *overstated*.

Accepting the validity of this criticism, a number of researchers have tried to determine what portion of incremental earnings derives from human capital investment as opposed to differences in ability and other personal characteristics. For

[46] Alice M. Rivlin, "Income Distribution—Can Economics Help?" *American Economic Review,* May 1975, p. 10.

example, a study of identical twins concludes that ability bias plays a small role in the measurement of the rate of return to schooling.[47] A recent study, however, finds that the effect of ability bias has been growing over time and accounts for a substantial part of the rise in the college wage premium.[48]

It is also worth observing that the causal relationship between education and earnings has important implications for public policy. *If* human capital theorists are correct in arguing that education is the sole or primary cause of higher earnings, then it makes sense to provide more education and training to low-income workers if society chooses to reduce poverty and the degree of income inequality. On the other hand, *if* high incomes are caused primarily by ability, independent of education and training, then a policy of increased spending on the education and training of low-income groups may be of limited success in increasing their incomes and alleviating income inequality.

The Screening Hypothesis

The ***screening hypothesis*** (or *signaling hypothesis*) is closely related to the ability problem. This hypothesis suggests that education affects earnings not primarily by altering the labor market productivity of students but by grading and labeling students in such a way as to determine their job placement and thereby their earnings.[49] It is argued that employers use educational attainment—for example, the possession of a college degree—as an inexpensive means of identifying workers who are likely to be of high quality. A college degree or other credential thus signals trainability and competence and becomes a ticket of admission to higher-level, higher-paying jobs where opportunities for further training and promotion are good. Less educated workers are screened from these positions, not necessarily because of their inability to perform the jobs but simply because they do not have the college degrees to give them access to the positions. The incremental income enjoyed by college graduates might be a payment for being credentialed rather than a reward for being more productive.

Viewed from a private perspective, screening should have no effect on the internal rate of return. Whether one is admitted to a higher-paying position because of the knowledge and skills acquired in college or because one possesses the necessary credential (a college degree), the fact remains that having attended college typically results in higher earnings. But from a social perspective, the screening hypothesis, if valid, is very important. One might well question the expenditure of $745 billion (in 2002) on elementary, secondary, and higher education if the payoff is merely to signal employers that certain workers are above average in terms of intelligence, motivation, and self-discipline. To the extent that a college graduate's incremental

[47] Orley Ashenfelter and Alan Krueger, "Estimates of the Economic Returns to Schooling from a New Sample of Twins," *American Economic Review,* December 1994, pp. 1157–73. For similar results using a direct measure of ability, see McKinley Blackburn and David Neumark, "Omitted-Ability Bias and the Increase in the Return to Schooling," *Journal of Labor Economics,* July 1993, pp. 521–44.

[48] Baris Kaymak, "Ability Bias and the Rising Education Premium in the United States: A Cohort-Based Analysis," *Journal of Human Capital,* Fall 2009, pp. 224–67.

[49] Michael Spence, "Job Market Signaling," *Quarterly Journal of Economics,* August 1973, pp. 355–74. For a survey of the screening literature, see Andrew Weiss, "Human Capital vs. Signaling Explanations of Wages," *Journal of Economic Perspectives,* Fall 1996, pp. 133–54.

earnings stem from screening, the social rate of return of investing in a college education will be *overstated*.

To what extent are the higher earnings of more educated workers due to education augmenting the productivity of workers, as the human capital view suggests? Similarly, to what degree are the higher earnings of such individuals attributable to the screening hypothesis, which indicates that schooling merely flags more productive workers? Does schooling produce skills or merely identify preexistent skills? Empirical evidence is mixed. For example, research by Chatterji and colleagues suggests that as much as 30 percent of the effect of education on earnings might result from screening.[50]

On the other hand, studies by Altonji and Pierret, Wolpin, and Wise question the importance of screening. Altonji and Pierret argue that signaling is likely to be an important part of the return to schooling only to the extent that firms lack good information about the productivity of new workers and that they learn slowly over time.[51] They find evidence that firms do screen young workers on the basis of education, but that employers learn quickly about worker productivity. Altonji and Pierret's calculations suggest that the screening component of the return to schooling is probably only a small part of the difference in wages associated with education. Wolpin has reasoned that if education is a screening device, workers who are to be screened in the process of job acquisition will be prone to purchase more schooling than workers who are not screened. He notes that while salaried workers are screened, self-employed workers are not. Therefore, if schooling is a screening device, salaried workers will tend to purchase more schooling than the self-employed. But he finds that in fact the two groups of workers acquire about the same amount of education, which Wolpin regards as "evidence against a predominant screening interpretation" of the positive association between schooling and earnings.[52] Similarly, Wise has argued that if education does affect worker productivity as the human capital theory suggests, then college degrees of differing quality *and* student performance while attending college should be reflected in salary differentials; that is, if human capital theory is correct, workers with bachelor degrees from high-quality institutions *and* workers who achieved higher grade point averages should be more productive and therefore earn higher salaries. Examining data for some 1,300 college graduates employed by Ford Motor Company, Wise found a "consistent positive relationship between commonly used measures of academic achievement [institutional quality and grade point average] and rates

[50] Monojit Chatterji, Paul T. Seaman, and Larry D. Singell, Jr., "A Test of the Signaling Hypothesis," *Oxford Economic Papers,* April 2003, pp. 191–215. For further support of the signaling hypothesis, see Harley Frazis, "Human Capital, Signaling, and the Pattern of Returns to Education," *Oxford Economic Papers,* April 2002, pp. 298–320.

[51] Joseph G. Altonji and Charles R. Pierret, "Employer Learning and the Signaling Value of Education," in I. Ohashi and T. Tachibanaki (eds.), *Internal Labour Markets, Incentives, and Employment* (New York: MacMillan Publishing, 1998). For a study individual productivity is more important that employer learning in explaining pay increases, see Lisa B. Kahn and Fabian Lange, "Employer Learning, Productivity, and the Earnings Distribution: Evidence from Performance Measures," *Review of Economic Studies*, October 2014, pp. 1575–1613.

[52] Kenneth Wolpin, "Education and Screening," *American Economic Review,* December 1977, pp. 949–58.

4.6 World of Work — Is There More to College than Money?*

Over the past few decades, many researchers have examined the economic benefits to individuals of a college degree. Recently more attention has been focused on the noneconomic benefits of college education. College graduates may have better health status than their less educated counterparts for several reasons. First, college graduates, due to additional knowledge, may have a healthier lifestyle through better diets, greater use of seat belts, more exercise, less smoking, and less drug abuse. Second, health insurance coverage rates are higher among college graduates and thus better access to health care. Third, college graduates live and work in safer environments.

The evidence is college graduates are healthier than those with less education. College graduates have healthier behaviors such a lower rate of smoking. Among adults aged 25–64 in 2010, 27 percent of high school graduates were currently smoking, while only 8 percent of college graduates did so. With regard to health outcomes, college graduates are less likely to report that they are in fair or poor health and have lower rates of disability. In addition, they have lower rates of mortality. At age 25, a college graduate can expect to live 9 more years than a person with a less than high school education.

Finally, more educated persons are happier than those with less education. For example, college graduates are more likely to be married and have more stable marriages. They also acquire broader social networks and have more interesting jobs with good working conditions. In addition, college graduates have higher income levels. College graduates have expressed a greater satisfaction with life than those with less education. Among persons aged 25 to 64, data from 27 countries indicate those with a college education are 18 percentage points more likely to be satisfied with life than those with less than a high school degree. About 10 percentage points of this difference in satisfaction remain after adjusting for age, gender, and income.

* Based on Organization for Economic Cooperation and Development, *Education at a Glance, 2011* (Paris: OECD, 2011), Table A11.3; National Center for Health Statistics, *Health, United States, 2011: With Special Feature on Socioeconomic Status and Health, (*Hyattsville, MD: National Center for Health Statistics, 2012); and Lochner Lance, "Nonproduction Benefits of Education: Crime, Health, and Good Citizenship," in Eric A. Hanushek, Stephen Machin, and Ludger Woessmann (eds.), *Handbook of the Economics of Education,* Volume 4, (Amsterdam, Holland: Elsevier, 2011), pp. 183–282.

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of salary increase." Wise concludes that a "college education is not only a signal of productive ability, but in fact enhances this ability."[53]

Recapitulation

There is no question that human capital theory has been the basis for important insights and the cornerstone for myriad revealing empirical studies. But as the ability problem and the screening hypothesis suggest, human capital theory is not universally accepted, and some who accept it do so only with reservations. Although there is almost universal agreement about the positive association between education and earnings, there is disagreement over the *reasons* for this association. Empirical testing

[53] David A. Wise, "Academic Achievement and Job Performance," *American Economic Review,* June 1975, pp. 350–66. For evidence that education per se, as opposed to ability or screening, enhances earnings in two less developed nations (Kenya and Tanzania), see M. Boissiere, J. B. Knight, and R. H. Sabot, "Earnings, Schooling, and Cognitive Skills," *American Economic Review,* December 1985, pp. 1016–30.