THE ECONOMICS OF LABOR

Edited by
George J. Borjas

CRITICAL CONCEPTS IN ECONOMICS

ROUTLEDGE

THE ECONOMICS OF LABOR

Critical Concepts in Economics

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George J. Borjas

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Part 6

HUMAN CAPITAL

34

INVESTMENT IN HUMAN CAPITAL

A theoretical analysis[1]

Gary S. Becker

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I. Introduction

Some activities primarily affect future well-being, while others have their main impact in the present. Dining is an example of the latter, while purchase of a car exemplifies the former. Both earnings and consumption can be affected: on-the-job training primarily affects earnings, a new sail boat primarily affects consumption, and a college education is said to affect both. The effects may operate either through physical resources, such as a sail boat, or through human resources, such as a college education. This paper is concerned with activities that influence future real income through the imbedding of resources in people. This is called investing in human capital.

The many ways to invest include schooling, on-the-job training, medical care, vitamin consumption, and acquiring information about the economic system. They differ in the relative effects on earnings and consumption, in the amount of resources typically invested, in the size of returns, and in the extent to which the connection between investment and return is perceived. But all improve the physical and mental abilities of people and thereby raise real income prospects.

People differ substantially in their economic well-being, both among countries and among families within a given country. For a while economists were relating these differences primarily to differences in the amount of physical capital since richer people had more physical capital than others. It has become increasingly evident, however, from studies of income growth[2] that factors other than physical resources play a larger role than formerly believed, thus focusing attention on less tangible resources, like the knowledge possessed. A concern with investment in human capital, therefore, ties in closely with the new emphasis on intangible resources and may be useful in attempts to understand the inequality in income among people.

The original aim of my study was to estimate the money rate of return to college and high-school education in the United States. In order to set these estimates

in proper context I undertook a brief formulation of the theory of investment in human capital. It soon became clear to me, however, that more than a restatement was called for: while important and pioneering work had been done on the economic return to various occupations and education classes,[3] there have been few, if any, attempts to treat the process of investing in people from a general viewpoint or to work out a broad set of empirical implications. I began then to prepare a general analysis of investment in human capital.

As the work progressed, it became clearer and clearer that much more than a gap in formal economic analysis would be filled, for the analysis of human investment offered a unified explanation of a wide range of empirical phenomena which had either been given *ad hoc* interpretations or had baffled investigators. Among these are the following: (1) Earnings typically increase with age at a decreasing rate. Both the rate of increase and the rate of retardation tend to be positively related to the level of skill. (2) Unemployment rates tend to be negatively related to the level of skill. (3) Firms in underdeveloped countries appear to be more "paternalistic" toward employees than those in developed countries. (4) Younger persons change jobs more frequently and receive more schooling and on-the-job training than older persons do. (5) The distribution of earnings is positively skewed, especially among professional and other skilled workers. (6) Abler persons receive more education and other kinds of training than others. (7) The division of labor is limited by the extent of the market. (8)

The typical investor in human capital is more impetuous and thus more likely to err than is the typical investor in tangible capital. What a diverse and possibly even confusing array ! Yet all these as well as many other important empirical implications can be derived from very simple theoretical arguments. The purpose of this paper is to set out these arguments in some generality, with the emphasis placed on empirical implications, although little empirical material is presented. My own empirical work will appear in a later study.

First, a lengthy discussion of on-the-job training is presented and then, much more briefly, discussions of investment in schooling, information, and health. On-the-job training is dealt with so elaborately not because it is more important than other kinds of investment in human capital—although its importance is often underrated—but because it clearly illustrates the effect of human capital on earnings, employment, and other economic variables. For example, the close connection between foregone and direct costs or the effect of human capital on earnings at different ages is vividly brought out. The extended discussion of on-the-job training paves the way for much briefer discussions of other kinds of investment in human beings.

II. Different kinds of investment

A. On the job

Theories of firm behavior, no matter how they differ in other respects, almost invariably ignore the effect of the productive process itself on worker productivity. This is not to say that no one recognizes that productivity is affected by the

job itself; but the recognition has not been formalized, incorporated into economic analysis, and its implications worked out. We now intend to do just that, placing special emphasis on the broader economic implications.

Many workers increase their productivity by learning new skills and perfecting old ones while on the job. For example, the apprentice usually learns a completely new skill while the intern develops skills acquired in medical school, and both are more productive afterward. On-the-job training, therefore, is a process that raises future productivity and differs from school training in that an investment is made on the job rather than in an institution that specializes in teaching. Presumably, future productivity can be improved only at a cost, for otherwise there would be an unlimited demand for training. Included in cost are a value placed on the time and effort of trainees, the "teaching" provided by others, and the equipment and materials used. These are costs in the sense that they could have been used in producing current output if they were not used in raising future output. The amount spent and the duration of the training period depend partly on the type of training—more is spent for a longer time on an intern than on an operative—partly on production possibilities, and partly on the demand for different skills.

Each employee is assumed to be hired for a specified time period (in the limiting case this period approaches zero), and for the moment both labor and product markets are assumed to be perfectly competitive. If there were no on-the-job training, wage rates would be given to the firm and would be independent of its actions. A profit-maximizing firm would be in equilibrium when marginal products equaled wages, that is, when marginal receipts equaled marginal expenditures. In symbols

$$MP = W, \tag{1}$$

where W equals wages or expenditures and MP equals the marginal product or receipts. Firms would not worry too much about the relation between labor conditions in the present and future partly because workers were only hired for one period, and partly because wages and marginal products in future periods would be independent of a firm's current behavior. It can therefore legitimately be assumed that workers have unique marginal products (for given amounts of other inputs) and wages in each period, which are, respectively, the maximum productivity in all possible uses and the market wage rate. A more complete set of equilibrium conditions would be the set

$$MP_t = W_t, \tag{2}$$

where t refers to the tth. period. The equilibrium position for each period would depend only on the flows during that period.

These conditions are altered when account is taken of on-the-job training and the connection thereby created between present and future receipts and expenditures. Training might lower current receipts and raise current expenditures, yet

firms could profitably provide this training if future receipts were sufficiently raised or future expenditures sufficiently lowered. Expenditures during each period need not equal wages, receipts need not equal the maximum possible productivity, and expenditures and receipts during all periods would be interrelated. The set of equilibrium conditions summarized in equation (2) would be replaced by an equality between the *present values* of receipts and expenditures. If E_t and R_t represent expenditures and receipts during period t, and i the market discount rate, then the equilibrium condition can be written as

$$\sum_{t=0}^{n-1} \frac{R_t}{(1+i)^{t+1}} = \sum_{t=0}^{n-1} \frac{E_t}{(1+i)^{t+1}}, \tag{3}$$

where n represents the number of periods, and R_t and E_t depend on all other receipts and expenditures. The equilibrium condition of equation (2) has been generalized, for if marginal product equals wages in each period, the present value of the marginal product stream would have to equal the present value of the wage stream. Obviously, however, the converse need not hold.

If training were given only during the initial period, expenditures during the initial period would equal wages plus the outlay on training, expenditures during other periods would equal wages alone, and receipts during all periods would equal marginal products. Equation (3) becomes

$$MP_0 + \sum_{t=1}^{n-1} \frac{MP_t}{(1+i)^t} = W_0 + k + \sum_{t=1}^{n-1} \frac{W_t}{(1+i)^t}, \tag{4}$$

where k measures the outlay on training.

If a new term is defined,

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t}, \tag{5}$$

equation (4) can be written as

$$MP_0 + G = W_0 + k. \tag{6}$$

Since the term k only measures the actual outlay on training it does not entirely measure training costs, for excluded is the time that a person spends on this training, time that could have been used to produce current output. The difference between what could have been produced, call this MP'_0 and what is produced, MP_0, is the opportunity cost of the time spent in training. If C is defined as the sum of opportunity costs and outlays on training, (6) becomes

$$MP'_0 + G = W_0 + C. \tag{7}$$

The term G, the excess of future receipts over future outlays, is a measure of the return to the firm from providing training; and, therefore, the difference between

G and C measures the difference between the return from, and the cost of, training. Equation (7) shows that marginal product would equal wages in the initial period only when the return equals costs, or $G = C$; it would be greater or less than wages as the return was smaller or greater than costs. Those familiar with capital theory might argue that this generalization of the simple equality between marginal product and wages is spurious because a full equilibrium would require equality between the return from an investment—in this case, made on the job—and costs. If this implied that $G = C$, marginal product would equal wages in the initial period. There is much to be said for the relevance of a condition equating the return from an investment with costs, but such a condition does not imply that $G = C$ or that marginal product equals wages. The following discussion demonstrates that great care is required in the application of this condition to on-the-job investment.

1. General

Our treatment of on-the-job training produced some general results—summarized in equations (3) and (7)—of wide applicability, but more concrete results require more specific assumptions. In this and the following section two types of on-the-job training are discussed in turn: general and specific. General training is useful in many firms in addition to the firm providing it, as a machinist trained in the army finds his skills of value in steel and aircraft firms, or a doctor trained (interned) at one hospital finds his skills useful at other hospitals. Most on-the-job training presumably increases the future marginal product of workers in the firm providing it, but general training would also increase their marginal product in many other firms as well. Since in a competitive labor market the wage rates paid by any firm are determined by marginal productivities in other firms, future wage rates as well as marginal products would increase to firms providing general training. These firms could capture some of the return from training only if their marginal product rose by more than their wages. "Perfectly general" training would be equally useful in many firms and marginal products would rise by the same extent in all of them. Consequently, wage rates would rise by exactly the same amount as the marginal product and the firms providing such training could not capture any of the return.

Why, then, do rational firms in competitive labor markets provide general training, for why provide training that brings no return? The answer is that firms would provide general training only if they did not have to pay any of the costs. Persons receiving general training would be willing to pay these costs since training raises their future wages. Hence the cost as well as the return from general training would be borne by trainees, not by firms.

These and other implications of general training can be more formally demonstrated with equation (7). Since wages and marginal products are raised by the same amount, MP_t must equal W_t for all $t = 1, \ldots n - 1$, and therefore

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} = 0. \tag{8}$$

Equation (7) is reduced to

$$MP_0' = W_0 + C, \tag{9}$$

or

$$W_0 = MP_0' - C. \tag{10}$$

In terms of actual marginal product

$$MP_0 = W_0 + k, \tag{9'}$$

or

$$W_0 = MP_0 - k. \tag{10'}$$

The wage of trainees would not equal their opportunity marginal product but would be less by the total cost of training. In other words, employees would pay for general training by receiving wages below their current (opportunity) productivity. Equation (10) has many other implications, and the rest of this section is devoted to developing the more important ones.

Some might argue that a really "net" definition of marginal product obtained by subtracting training costs from "gross" marginal product must equal wages even for trainees. Such an interpretation of net productivity could formally save the equality between marginal product and wages here, but later I show (pp. 18–25) that it cannot always be saved. Moreover, regardless of which interpretation is used, training costs would have to be included in any study of the relation between wages and productivity.

Employees pay for general on-the-job training by receiving wages below what could be received elsewhere. "Earnings" during the training period would be the difference between an income or flow term, potential marginal product, and a capital or stock term, training costs, so that the capital and income accounts would be closely intermixed, with changes in either affecting wages. In other words, earnings of persons receiving on-the-job training would be net of investment costs and would correspond to the definition of *net* earnings used throughout this paper, which subtracts all investment costs from "gross" earnings. Therefore, our departure with this definition of earnings from the accounting conventions used for transactions in material goods—which separate income from capital accounts to prevent a transaction in capital from *ipso facto*[4] affecting the income side—is not capricious but is grounded in a fundamental difference between the way investment in material and human capital are "written off." The underlying cause of this difference undoubtedly is the widespread reluctance to treat people as capital and the accompanying tendency to treat all wage receipts as earnings.

Intermixing the capital and income accounts could make the reported "incomes" of trainees unusually low and perhaps negative, even though their long-run or

lifetime incomes were well above average. Since a considerable fraction of young persons receive some training, and since trainees would tend to have lower current and higher subsequent earnings than other youth, the correlation between current consumption and current earnings of young people[5] would not only be much weaker than the correlation with long-run earnings, but the signs of these correlations might even differ.[6]

Doubt has been cast on the frequent assertion that no allowance is made in the income accounts for depreciation on human capital.[7] A depreciation-type item is deducted, at least from the earnings due to on-the-job training, for the cost would be deducted during the training period. Depreciation on tangible capital does not bulk so large in any one period because it is usually "written off" or depreciated during a period of time designed to approximate its economic life. Hence human and tangible capital appear to differ more in the time pattern of depreciation than in its existence,[8] and the effect on wage income of a rapid "write-off" of human capital is what should often be emphasized and studied.

Our point can be put differently and more rigorously. The ideal depreciation on a capital asset during any period would equal its change in value during the period. In particular, if value rose, a negative depreciation term would have to be subtracted or a positive appreciation term added to the income from the asset. Since training costs would be deducted from earnings during the training period, the economic "value" of a trainee would at first increase rather than decrease with age, and only later would it begin to decrease.[9]

Training has an important effect on the relation between earnings and age. Suppose that untrained persons received the same earnings regardless of age, as shown by the horizontal line *UU* in Figure 1. Trained persons would receive lower earnings during the training period because training is paid for then, and higher earnings at later ages because the return is collected then. The combined effect of paying for and collecting the return from training in this way would be to make the age earnings curve of trained persons, shown by *TT* in Figure 1, steeper than that of untrained persons, the difference being greater the greater the cost of, and return from, the investment.

Not only does training make the curve steeper but, as indicated by Figure 1, also more concave; that is, the rate of increase in earnings is affected more at younger than at older ages. Suppose, to take an extreme case, that training raised the level of marginal productivity but had no effect on the slope, so that the marginal productivity of trained persons was also independent of age. If earnings equaled marginal product, *TT* would merely be parallel to and higher than *UU*, showing neither slope nor concavity. Since, however, earnings of trained persons would be below marginal productivity during the training period and equal afterwards, they would rise sharply at the end of the training period and then level off (as shown by the dashed line *T'T'* in Figure 1), imparting a concave appearance to the curve as a whole. In this extreme case an extreme concavity appears; in less extreme cases the principle would be the same and the concavity more continuous.

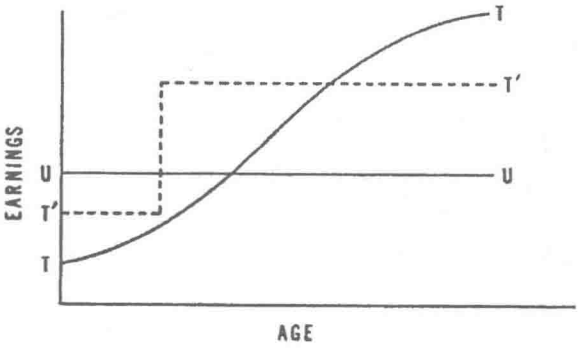

Figure 1

Foregone earnings are an important, although neglected, cost of much human capital and should be treated on the same footing as direct outlays. Indeed, *all* costs appear as foregone earnings to workers receiving on-the-job training; that is, all costs appear as lower earnings than could be received elsewhere, although direct outlays, C, may really be an important part of costs. The arbitrariness of the division between foregone and direct costs and the resulting advantage of treating total costs as a whole[10] can be further demonstrated by contrasting school and on-the-job training. Usually only the direct cost of school training is emphasized, even though the foregone cost is sometimes (as with college education) an important part of the total. A shift of training from schools to on the job would, however, reverse the emphasis and make all costs appear as foregone earnings, even when direct outlays were important.

Income maximizing firms in competitive labor markets would not pay the cost of general training and would pay trained persons the market wage. If, however, training costs were paid, many persons would seek training, few would quit during the training period, and labor costs would be relatively high. Firms that did not pay trained persons the market wage would have difficulty satisfying their skill requirements and would also tend to be less profitable than other firms. Firms that both paid for training and less than the market wage for trained persons would have the worst of both worlds, for they would attract too many trainees and too few trained persons.

These principles have been clearly demonstrated during the last few years in discussions of problems in recruiting military personnel. The military offers training in a wide variety of skills and many—such as piloting and machine repair—are very useful in the civilian sector. Training is provided during part or all of the first enlistment period and used during the remainder of the first period and hopefully during subsequent periods. This hope, however, is thwarted by the fact that re-enlistment rates tend to be inversely related to the amount of civilian-type skills provided by the military.[11] Persons with these skills leave the military more