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## INVESTMENT IN HUMAN CAPITAL AND THE APPROPRIATE DISCOUNT RATE\*

BY

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Education yields a myriad of benefits. Whatever the advantages of education, however, not all groups share in them equally. In particular, as the evidence for the United States indicates,<sup>2</sup> the Negro tends on average to leave school at an earlier age than his white counterpart.

Several different approaches have been taken in the literature to explain dropout rates and, in particular, the differential pattern as between Negroes and whites. Basically, these can be classified in one of two categories: first, the rate of return approach,<sup>3</sup> and second, one which predicts dropout rates on the basis of an individual's socio-economic status.<sup>4</sup> The first approach involves a calculation of the marginal efficiency of investment in education. If the opportunity and direct costs of an additional unit of education are less than the discounted value of those streams of income associated with it, then an individual may be expected to remain in school. In the United States, for an equivalent level of education, a white's expected annual earnings exceed those of a Negro; consequently, a Negro may drop out at an early age if he feels that the nominal improvement in earnings associated with an additional year of education does not justify the investment. Dropout rates also may be predicted on the basis of socioeconomic status. An individual who is not motivated may be expected to leave school at an early age; thus, race, income, education of parents, and urban-rural residence have been used to explain and predict dropout rates.

This paper attempts to reconcile these two seemingly divergent approaches. In particular, it develops a theory of investment in human capital which rests on the assumption that an individual will choose to remain in school if the present value of the future income stream associated with additional education exceeds that associated with the present level of education.<sup>5</sup> Section I of this paper argues that the marginal rate of time preference is a function of a person's socioeconomic status.<sup>6</sup> Section II examines the implications of this phenomenon for investment in human capital and provides a systematic technique for explaining dropout rates. Section III provides an empirical verification of the model, while concluding remarks are found in the final section.

## THE APPROPRIATE DISCOUNTING FACTOR

For simplicity and in order to facilitate the analysis, initially assume a two-period time horizon, the present and the future. An individual's preference pattern for present and future consumption is described by a utility function,

$$(1) \quad U = U(C_p, C_f),$$

where " $C_p$ " represents present consumption and " $C_f$ " represents future consumption. One may visualize an indifference map with future goods depicted along the horizontal axis and present goods graphed along the vertical axis. If environment contributes to one's present goods — future goods preference pattern ("ex ante"), then the marginal rate of substitution of present goods for future goods (at a common consumption mix) may typically be greater for a person with a penchant for future consumption than for a myopic or present-biased individual.

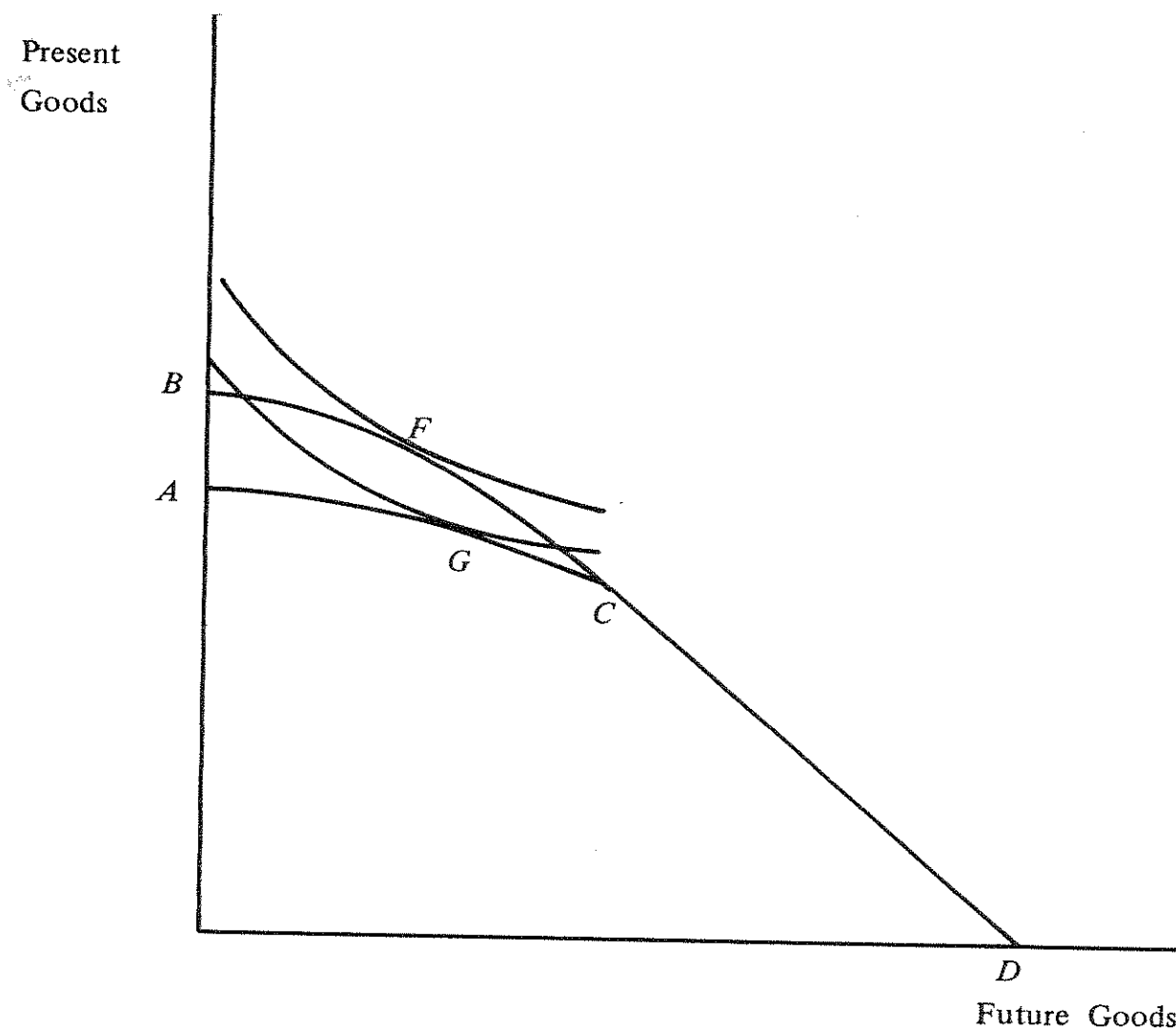


FIGURE 1

Next we turn to a student's budget constraint. Associated with every level of education is an income-pair: one for the first time period, and one for the second. If an individual consumes his entire income during the period in which it is received, his income pairs can be transformed into consumption pairs, at given price levels. This can be mapped onto the person's present goods – future goods indifference map (point *C* in Figure 1). If the student wishes to transform present goods into future goods, he can do so by either hoarding or by purchasing an interest-bearing asset; consequently, the slope of the budget constraint, which may be considered a transformation curve for trading present for future goods, from *C* to *D*, equals or is slightly less than unity (in absolute value terms). However, if the person wishes to transform future goods into present goods, the shape of the budget line must reflect the difficulty in arranging a loan. If an individual wishes to borrow in order to finance his education, the banker must receive a premium to compensate him for the risk he assumes (in addition to the loss of liquidity he incurs) in extending the loan. Consequently, the slope of an individual student's budget line for trading future goods for present (line segment *C* to *B* in Figure 1) must be less than the slope (in absolute value) for trading present for future (*C* to *D*). In addition, the slope of the budget line declines (in absolute value) as it approaches the vertical axis since the difficulty with which an individual can transform future goods into present goods is a function of the size of the loan. Moreover, the "disadvantaged" individual's budget constraint for trading future for present goods (segment *C* to *A*) may lie below that of the "privileged" individual (segment *C* to *B*) if a potential borrower's credit worthiness is determined by his race or family income.<sup>7</sup>

When we assume that an individual chooses that level of education which maximizes his utility function subject to his lifetime budget constraint, the appropriate marginal rate of time preference is found at the point of tangency between the utility function and the budget constraint. In Figure 1, a Type I individual who faces the relatively inelastic budget constraint *BC* discounts future income at a higher (marginal) rate (i.e., the slope at point *F* exceeds in absolute value the slope at point *G*)<sup>8</sup> than a Type II individual facing the more elastic constraint *CA*, assuming both share a common indifference map.

By stressing the difference in the shapes of the indifference curves, a similar conclusion may be reached by assuming that both a Type I and a Type II individual share the same budget constraint. In Figure 2, given a budget constraint, *HI*, the marginal rate of time preference among Type I individuals at *J* exceeds the marginal rate among Type II individuals at *K*. Of course, if we consider both effects simultaneously (Figure 3), these conclusions are accentuated. This conclusion is consistent with traditional supply and demand analysis. The supply curve of funds for the Type I individual lies to the left of the supply curve for the Type II person, since the lender must receive a higher rate of return on his investment to entice him to grant a loan to an individual he considers to be a poorer risk. The demand curve for a Type I individual, on the other hand, lies to the right of the demand curve for a Type II individual since the latter is more disposed to forego present consumption. While no

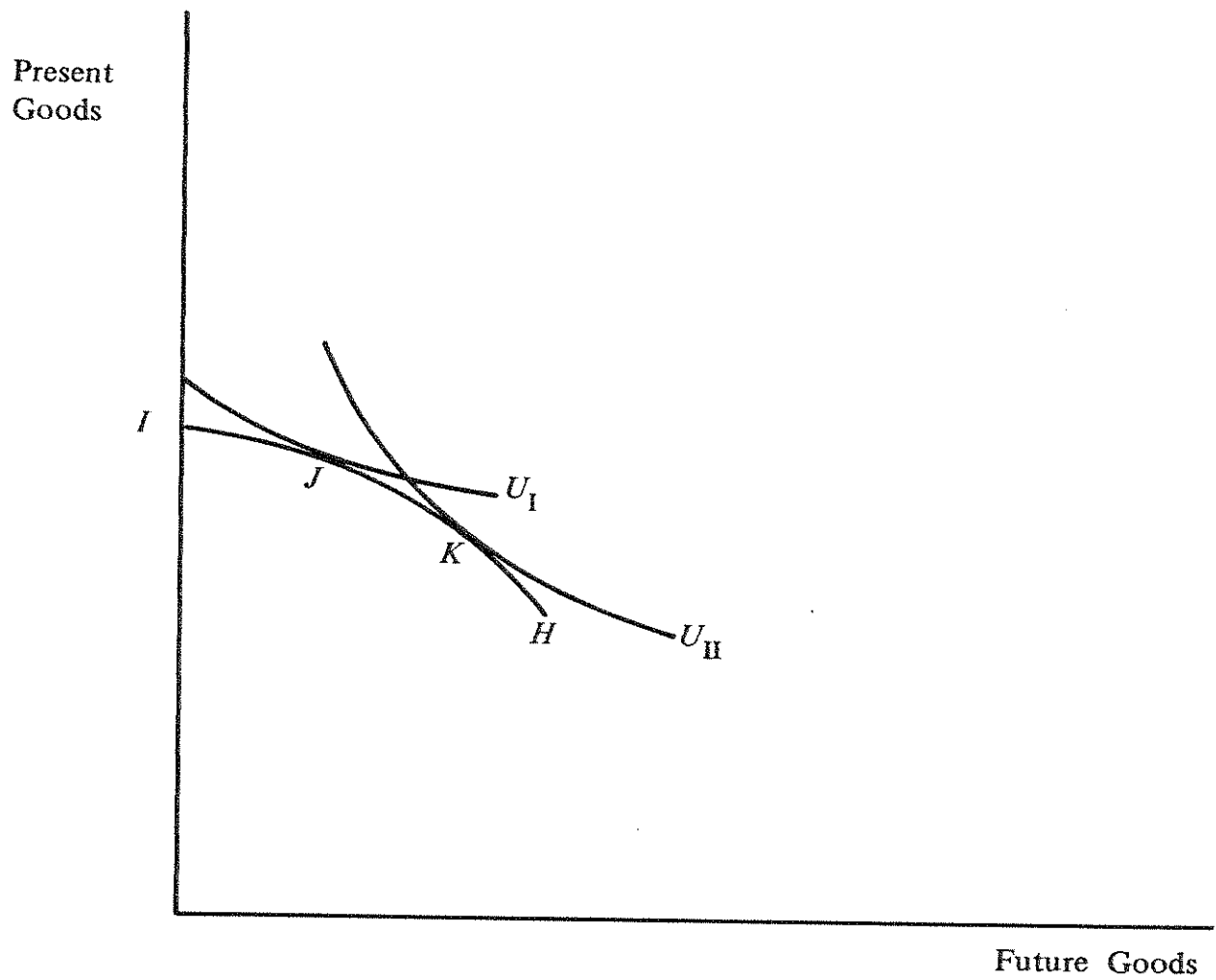


FIGURE 2

conclusion can be reached regarding the extent of borrowing by each Type, one can easily infer that the equilibrium rate of interest for the disadvantaged person exceeds that for a privileged individual.

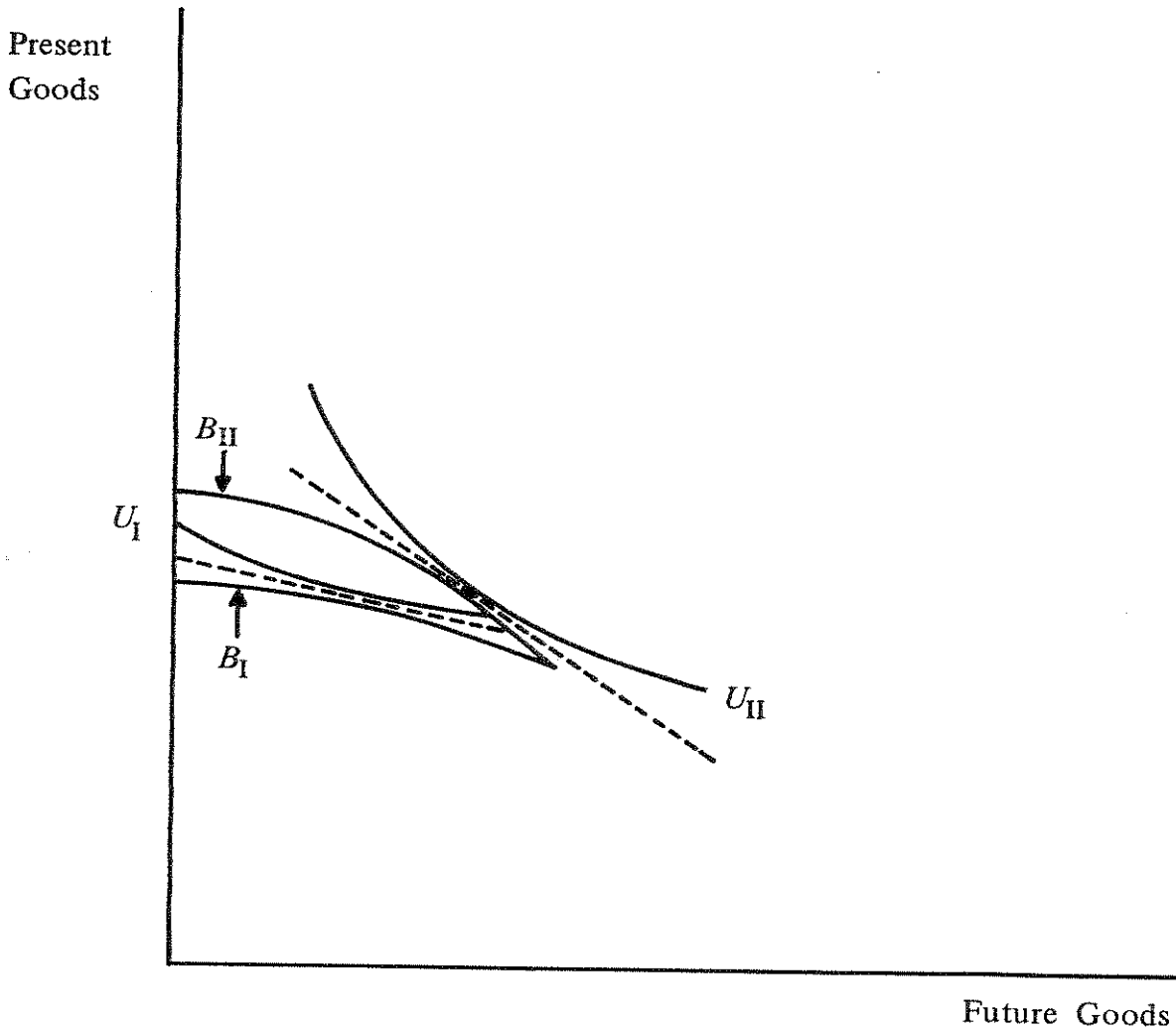


FIGURE 3

### THE DECISION TO REMAIN IN SCHOOL

Each year the individual makes a decision whether to remain in school. He presumably will do so if the discounted value of future streams of income associated with additional education exceeds that associated with the present level.

First, higher overall dropout rates among the disadvantaged may reflect in part a reduced stream of income for an equivalent level of education. If the expected income stream for any level of education is lower for the underprivileged, then they may be expected to invest less in formal education. Second, since additional returns to

successively higher levels of education accrue for the most part in the future, the appropriate discount rate is critical in decisions to invest in education. At a zero rate of interest, income increases monotonically with education, yet at a high rate of discount, the present value of income streams may be larger at low levels of education, since a student postpones earnings while attending school. Thus, at a relatively low level of discount, an additional year of education may be profitable, whereas at a higher rate of discount, this may not be the case. Thus, in Figure 4 an individual will choose to invest in an extra year of education ( $b + 1$ ) over his present level ( $b$ ) only when the rate of interest does not exceed the critical value  $r_0$ . That is, if the discount rate exceeds  $r_0$ , then education will not be continued; if it is less than  $r_0$ , then extra years of study will be chosen. This analysis allows us to deduce an inverse relationship between the discount rate and the desired level of education. We may integrate these two phenomena by discounting the disadvantaged individual's lower income streams at a higher marginal rate of discount. The result will be to further accentuate the disparity in dropout rates between the advantaged and the disadvantaged.

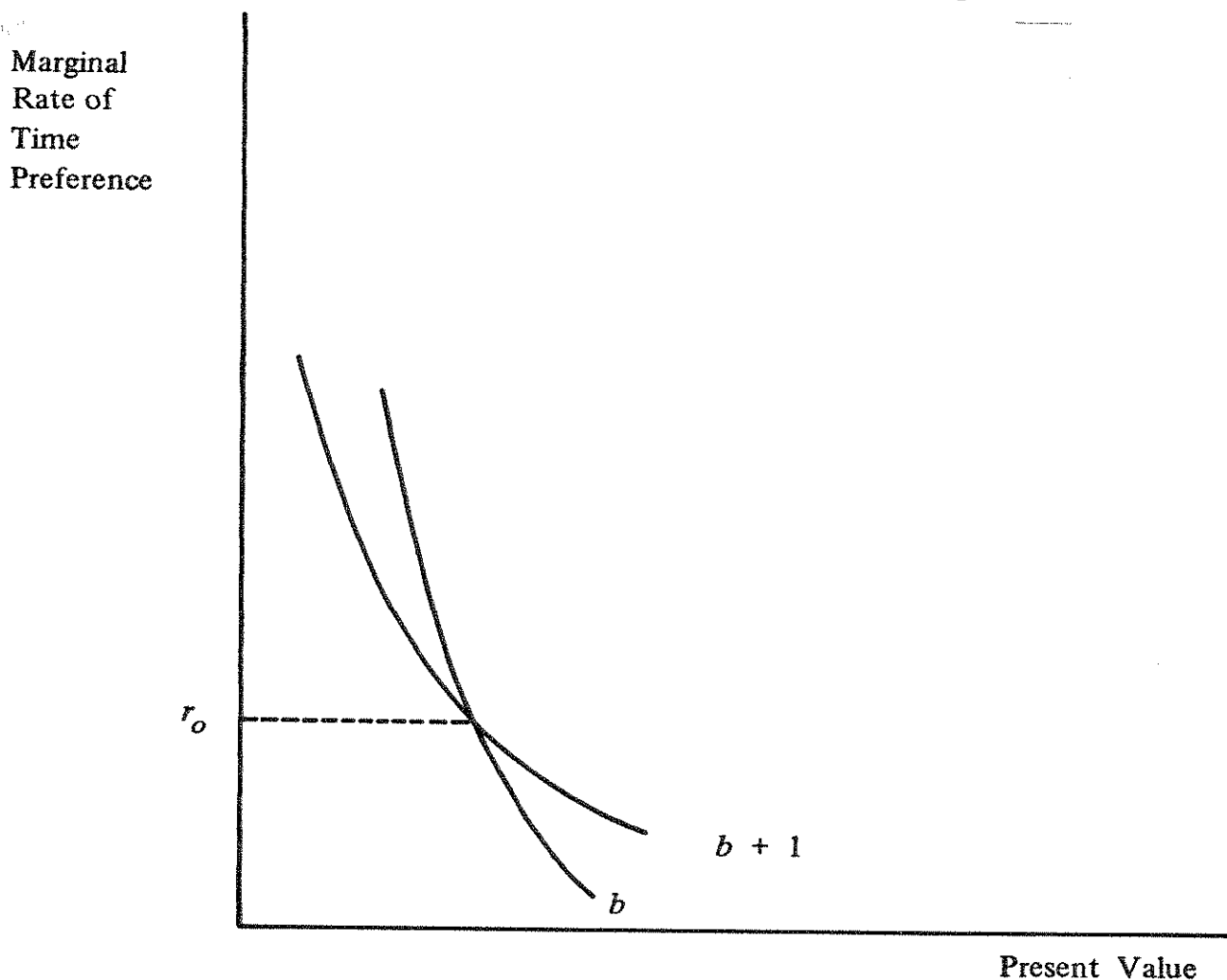


FIGURE 4

In speaking of "representative" persons from each group (Type), we have implicitly assumed that *within* each there is homogeneity with respect to time preference. Naturally, however, some individuals from each group are likely to be more successful than others of their respective groups in borrowing on "favourable" terms. We may allow for this by simply conceiving of two hypothetical distributions of time preference,<sup>9</sup> wherein, on average, the marginal rate among Type I persons is higher than among those of Type II. This presumably will generate a bi-modal distribution of educational achievement when applied to the marginal efficiency of investment schedule alluded to above.

### EMPIRICAL FINDINGS

The decision to remain in school is predicated upon a comparison of the expected returns for each level of schooling greater than the present level, with the opportunities available to one who has dropped out. Let " $Y_{tj}$ " represent income (net of direct academic expense) associated with education level " $j$ " during period " $t$ "; further, let " $R$ " be the number of years remaining until retirement and " $r$ " be the marginal rate of time preference (*MRTP*). We assume that a person will continue in school so long as for any level of education  $j$  ( $j = 2, 3, \dots, n$ ) greater than the present level ( $j = 1$ ), the following inequality obtains:

$$(2) \quad \sum_{t=1}^R Y_{tj} / (1+r)^t > \sum_{t=1}^R Y_{t1} / (1+r)^t$$

The age-income profiles for the United States are obtained from Hanoch,<sup>10</sup> who refined the raw data provided in the 1/1000 sample of the 1960 *U.S. Census of Population*. The raw data classified more than 57,000 males over age 14 according to race, region, age, and educational achievement. For convenience, and in keeping with the data available, we assume that a person performs this mental calculus (a) prior to entering high school, (b) after completing his sophomore year in high school, (c) upon receiving his high school diploma, (d) after completing two years of undergraduate education, and (e) after receiving the baccalaureate degree. The college graduate is confronted with two alternatives: he may either actively seek employment or pursue graduate study. It is assumed that in 1960, the student (age 14) has completed the eighth grade; furthermore, the student, if he wishes, may progress uninterrupted with his education (i.e., abstract from military obligations). At each critical year requiring a decision by the student, the present value of the existing level of education is calculated at alternative discount rates; in addition, the present value, net of costs, associated with all levels of education exceeding the existing one are calculated.<sup>11</sup>



Utilizing equation (2), we readily determine whether it is to the student's advantage to secure additional education. Consider the summary of our computations in Table 1. Note that the rate of discount is operationally a determinant in the decision to invest in education. If a white elementary school graduate residing in the North discounts the future at a rate of 18 per cent or more, he fails to continue his education. On the other hand, if he discounts the future at 12 through 15 per cent, he seeks his high school diploma. If he discounts the future at a rate of nine per cent, he pursues his baccalaureate. Finally, if his rate of discount is six per cent or less, he seeks admission into graduate school. Note that the last three columns in Table 1 also exhibit a diminishing marginal efficiency of investment in education.

If a white and a non-white Southerner share the same rate of time preference, we note that in some cases the latter invests in fewer years of education, whereas the converse does not occur. However, in the North, the difference in educational attainment appears to be in favour of the non-white. This may reflect the fact that, in recent years, employers in the North have offered non-white employees with advanced degrees a differential in salary.

TABLE 1. DESIRED LEVEL OF EDUCATION AS A FUNCTION OF RATE OF DISCOUNT

Marginal Rate of Time Preference (%)	<u>Desired Level of Education (in Years)</u>			
	White/North	Non-White/North	White/South	Non-White/South
0	17 <sup>+</sup>	17 <sup>+</sup>	17 <sup>+</sup>	17 <sup>+</sup>
3	17 <sup>+</sup>	17 <sup>+</sup>	17 <sup>+</sup>	17 <sup>+</sup>
6	17 <sup>+</sup>	17 <sup>+</sup>	17 <sup>+</sup>	16
9	16	17 <sup>+</sup>	16	12
12	12	17 <sup>+</sup>	12	12
15	12	12	12	8
18	8	12	12	8

In order to establish the extent to which imperfect capital markets and discriminatory hiring and promotional practices may contribute in part and in total to the unequal dropout rates between whites and non-whites, we introduce Tables 2 and 3. We measure horizontally and vertically selected rates of time preference for non-whites and whites, respectively. The entries in the body of the tables represent the differential in educational achievement of whites over non-whites for each combination of marginal rates of time preference. For example, if a white and



Thus, the data reveal, in general, a downward-sloping marginal efficiency of investment in education schedule. That is, the marginal rate of time preference is inversely related to the optimal level of educational achievement as chosen on the basis of expected returns. Moreover, it appears that a differentially high rate of discount among non-whites is operationally at least as important as discriminatory hiring and promotion practices in explaining low levels of academic achievement.

### CONCLUDING REMARKS

On the assumption that a person will choose to remain in school only if the pecuniary benefits of additional education exceed the costs, then our model and the United States data imply that an individual who discounts the future at a higher rate will choose to remain in school for fewer years. We maintain that the rate at which a person discounts the future is, in turn, a function of his present goods – future goods indifference map and the difficulty he encounters in arranging an educational loan.

A student who is otherwise capable of pursuing an education may fail to enroll for an additional year if he finds it difficult to finance his education through borrowing, this difficulty being measured by the (marginal) rate of interest he must pay (which in the limiting case may be infinite). This conclusion suggests that to a certain extent, the disparity between the dropout rates among the “advantaged” and the “disadvantaged” can be reduced if guaranteed loans for education are made more available. Under such circumstances, the budget constraint rotates to the right from point *C* in Figure 1 in such a way that, in equilibrium, the marginal rate of time preference would be lower.

Students may choose to remain in school for fewer years if the credit market contracts, “*ceteris paribus*”; conversely, students will invest in more education if credit becomes readily available. For example, in a tight-money economy, interest rates rise, but credit may also be rationed. Since banks will supply limited funds only to those individuals and firms who offer substantial collateral, the student may find that he is the first to be denied a loan. As a result, his marginal rate of time preference may rise markedly and the optimal level of educational achievement falls. On the other hand, if money becomes plentiful, the bank may extend a loan, and as a result, the student may find it advantageous to continue his education.

### FOOTNOTES

\*The authors are indebted to Dr. James C. Miller III and to Professor John J. Klein, Edwin Ulveling, Richard Bilas, and Richard Clemmer. Errors are of course solely those of the authors.

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<sup>2</sup>See U.S. Bureau of the Census, *Current Population Reports*, Series P-20, No. 169, “Educational Attainment: March 1967”, p. 2.

<sup>3</sup>See, for example, Giora Hanoch, “An Economic Analysis of Earnings and Schooling”, *Journal of Human Resources*, 2 (Summer, 1967), pp. 310-29; and W. Lee Hansen, “Total and Private Rates of Return to Investment in Schooling”, *Journal of Political Economy*, 71 (April, 1963), pp. 128-40.

<sup>4</sup>See, for example, John Conlisk, "Determinants of School Enrollment and School Performance", *Journal of Human Resources*, 4 (Spring, 1969), pp. 140-57; Stanley H. Masters, "The Effect of Family Income on Children's Education: Some Findings on Inequality of Opportunity", *Journal of Human Resources*, 4 (Spring, 1969), pp. 158-75; and Charles B. Nam, A. Lewis Rhodes, and Robert E. Herriot, "School Retention by Race, Religion, and Socioeconomic Status", *Journal of Human Resources*, 3 (Spring, 1968), pp. 171-90.

<sup>5</sup>It is important to point out some of the limitations of the analysis. Firstly, it implicitly assumes that an individual is motivated solely by the economic benefits of education. In addition, it assumes that he chooses his optimal strategy with respect to education subject only to the difficulty he encounters in negotiating a loan and his preferences regarding present vs. future income. However, in addition to the income-maximizing motive, there are non-pecuniary benefits to education. Firstly, if an individual receives psychic income from education, he is enticed by the non-economic fruits of literacy. He may enjoy the expanded employment opportunities available to a person with education even though earnings among them are equal. A high school senior may demonstrate independence from his parents by enrolling in an out-of-town college. Moreover, the decision to invest in elementary and junior high rests with the parents of a school child. It is uncertain as to the basis on which they may render their decision.

<sup>6</sup>This analysis is consistent with Gary S. Becker, "Underinvestment in College Education?", *American Economic Review* (Supplement), 50 (May, 1960), pp. 353-4.

<sup>7</sup>Hereafter, a "Type I" individual is taken to denote a "disadvantaged" person who is considered a poor credit risk, while a "Type II" individual is taken to denote a "privileged" person who is considered a good credit risk.

<sup>8</sup>For simplicity, in this diagram we assume away racial discrimination in hiring and promotion practices, so that both the budget constraint of a Type I and of a Type II individual pass through the same point *C*.

<sup>9</sup>The number of time preference distributions may of course be greater than two. The assumption here of two distributions is for simplicity only.

<sup>10</sup>The life-cycle income data were obtained from Giora Hanoch, *Personal Earnings and Investment in Schooling* (doctoral dissertation), University of Chicago, Chicago, Illinois, August, 1965.

<sup>11</sup>We adopt Hanoch's convention that a student's earnings while attending school tend to offset direct academic expenses. See Hanoch, *Ibid.*, p. 74.

<sup>12</sup>See, for example, U.S. Bureau of the Census, *Current Population Reports*, Series P-20, No. 169, "Educational Attainment: March 1967", p. 22. The non-white has traditionally invested in fewer years of education, even in the North.