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THE PROFITABILITY OF INVESTMENT IN EDUCATION:

CONCEPTS AND METHODS

by

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Abstract

This paper reviews the basic concept of the profitability of investment in education and enumerates the various techniques that have been used in the literature to estimate the rate of return to investment in education. The various estimating techniques are illustrated by using household survey data from Venezuela and Guatemala. The paper also reviews the controversies that have appeared in the literature regarding the use of rates of return to investment in education for designing educational policy.

Contents

Introduction

The early 1960s witnessed what has been described in the economics literature as the "human investment revolution in economic thought" (Bowman 1966). Expenditures on education, whether by the state or households, have been treated as investment flows that build human capital (see Schultz 1961; Becker 1964).

Once education is treated as an investment, the immediate natural question is: what is the profitability of this investment in order to compare it to alternatives? Such comparison can provide priorities for the allocation of public funds to different levels of education, or can explain individual behavior regarding the demand, or lack of demand, for particular levels or types of schooling.

In the three decades that followed the human investment revolution in economic thought, hundreds of estimates have been made on the profitability of investment in education in all parts of the World and for all levels and types of schooling and training (for a review, see Psacharopoulos 1994).

The purpose of this paper is to take stock of the conceptual and empirical issues surrounding the profitability of investments in education and provide a how-to compendium to assist in making further estimations. The various techniques used are illustrated by actual country data drawn from household surveys.

Basic Concepts

The costs and benefits of education investments can be analyzed in the same way that these are calculated for other types of projects. In education, a series of expenditures occur during school construction and while students are in school, and benefits are expected to accrue over the life-cycle of the graduates. For establishing education investment priorities at the margin, the net present value or internal rate of return of the prospective operation can be computed. The discussion below focuses on the rate of return in order to ease comparisons with other projects. (Education projects do not typically yield more than one internal rate of return, hence the internal rate of return criterion gives the same answer as the net present value.)

The internal rate of return of an education project can be estimated from either the private or the social point of view. The private rate of return is used to explain the demand for education. It can also be used to assess the equity or poverty alleviation effects of public education expenditures, or the incidence of the benefits of such expenditure. The social rate of return summarizes the costs and benefits of the educational investment from the state's point of view, i.e., it includes the full resource cost of education, rather than only the portion that is paid by the recipient of education.

Private Rate of Return

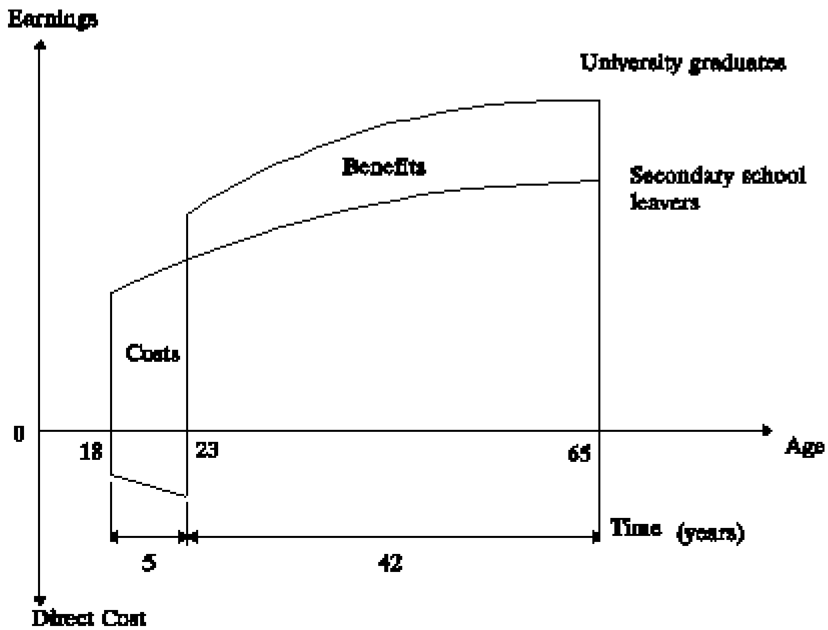
The costs incurred by the individual are his/her foregone earnings while studying, plus any education fees or incidental expenses the individual incurs during schooling. Since education is mostly provided free by the state, in practice the only cost in a private rate of return calculation is the foregone earnings.

The private benefits amount to what a more educated individual earns (after taxes), above a control group of individuals with less education. "More" and "less" in this case usually refers to adjacent levels of education, e.g., university graduates versus secondary school graduates (see Figure 1).

The private rate of return to an investment in a given level of education in such a case can be estimated by finding the rate of discount (r) that equalizes the stream of discounted benefits to the stream of costs at a given point in time. In the case of university education, for example, the formula is:

$$\sum_{t=1}^{42} \frac{(W_u - W_s)_t}{(1+r)^t} = \sum_{t=1}^{5} (W_s + C_u)_t (1+r)^t, \qquad (1)$$

Figure 1: Stylized Age-earnings Profiles



where (Wu-Ws) is the earnings differential between a university graduate (subscript u) and a secondary school graduate (subscript s, the control group). Cu represents the direct costs of university education (tuition and fees, books, etc.), and Ws denotes the student's foregone earnings or indirect costs.

A similar calculation can be made for the other levels of education. However, there is an important asymmetry between computing the returns to primary education and those to the other levels. Primary school children, mostly aged 6 to 12 years, do not forego earnings during the entire length of their studies. On the assumption that children aged 11 and 12 help in agricultural labor, two or three years of foregone earnings while in primary schooling have been used in the empirical literature.

In addition, there may be no need to estimate a rate of return to justify investment in basic education -- it is taken for granted that the literacy of the population is a goal that stands on its own merits for a variety of reasons other than economic considerations. However, as one climbs the educational ladder and schooling becomes more specialized, it is imperative to estimate the costs and benefits of post-primary school investments, especially those in the vocational track of secondary education and higher education.

Social Rate of Return

The main computational difference between private and social rates of return is that, for a social rate of return calculation, the costs include the state's or society's at large spending on education. Hence, in the above example, Cu would include the rental of buildings and professorial salaries. Gross earnings (i.e., before taxes and other deductions) should be used in a social rate of return calculation, and such earnings should also include income in kind where this information is available.

A key assumption in a social rate of return calculation is that observed wages are a good proxy for the marginal product of labor, especially in a competitive economy using data from the private sector of the economy. Civil service pay scales are irrelevant for a social rate of return calculation, although they may be used in a private one.

The "social" attribute of the estimated rate of return refers to the inclusion of the full resource cost of the investment (direct cost and foregone earnings). Ideally, the social benefits should include non-monetary or external effects of education (e.g., lower fertility or lives saved because of improved sanitation conditions followed by a more educated woman who never participates in the formal labor market). Given the scant empirical evidence on the external effects of education, social rate of return estimates are usually based on directly observable monetary costs and benefits of education (but see Summers 1992).

Since the costs are higher in a social rate of return calculation relative to the one from the private point of view, social returns are typically lower than a private rate of return. The difference between the private and the social rate of return reflects the degree of public subsidization of education.

The discounting of actual net age-earnings profiles is the most appropriate method of estimating the returns to education because it takes into account the most important part of the early earning history of the individual. However, this method requires comprehensive data -- one must have a sufficient number of observations in a given age-educational level cell for constructing "well-behaved" age-earnings profiles (i.e., not intersecting with each other).

The Short-cut Method

There is another method to arrive at approximate returns to education that is very easy to apply. Given the shape of the age-earnings profiles, one can approximate them as flat curves (see Figure 2). In such a case, the rate of return estimation is based on a simple formula:

$$\text{private } r = \frac{\overline{W}_u - \overline{W}_s}{5(\overline{W}_s)}, \qquad (2)$$

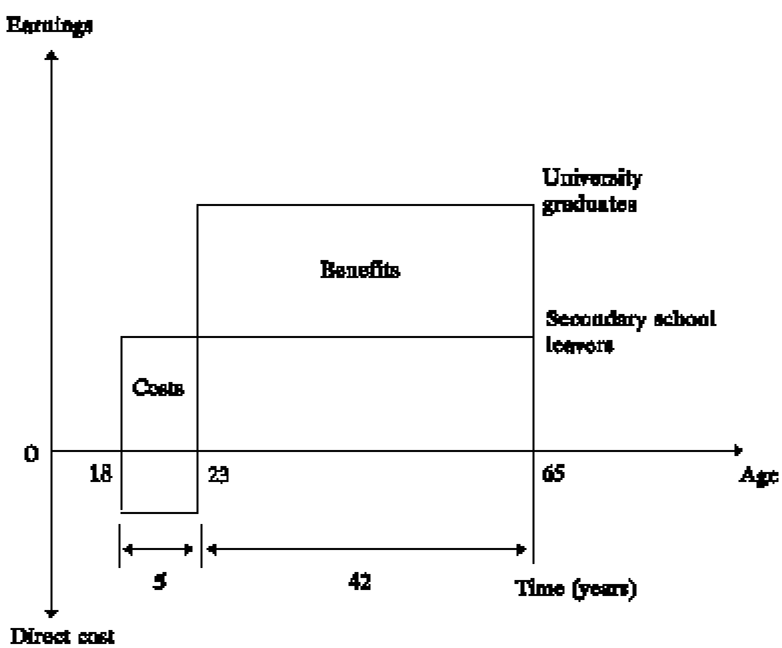
where *W* refers to the mean earnings of an individual with the subscripted educational level, and 5 is the length of the university cycle. The social rate of return in this case is simply given as:

$$social\ r = \frac{\overline{W}_u - \overline{W}_s}{5\,(\overline{W}_s + C_u)}, \quad (3)$$

where Cu is the annual direct cost of university education.

Although the short-cut method is very easy to use, it is, by definition, inferior relative to any of the other methods described above. The weakness of the method lies in the abstraction that age-earnings profiles are concave, and that the discounting process (in estimating the true rate of return) is very sensitive to the values of the early working ages entering the calculation.

Figure 2: Flat Profiles



The Reverse Cost-benefit Method

This is based on the short-cut rate of return formula and amounts to asking the question: given the cost of the investment, what level of annual benefits would produce a given rate of return (10 percent, for instance) on the investment?

$$\text{Annual Benefit} = 0.10\ (\text{Education Cost}), \quad (4)$$

or, in our case:

$$(\overline{W}_u - \overline{W}_s) = (0.10)\ [5\ (\overline{W}_s + C_u)]. \quad (5)$$

Although rough, this preliminary calculation can be made easily and can precipitate further analyses on how to reduce the costs or increase the benefits to possibly justify the investment.

The Earnings Function Method

This method is also known as the "Mincerian" method (see Mincer 1974) and involves the fitting of a function of log-wages (LnW), using years of schooling (S), years of labor market experience and its square as independent variables (see Mincer 1974). Often weeks-worked or hours-worked are added as independent variables to this function as compensatory factors. We call the above a "basic earnings function." In this semi-log specification the coefficient on years of schooling (*B*) can be interpreted as the average private rate of return to one additional year of schooling, regardless of the educational level this year of schooling refers to.

In fact, the b coefficient in the above semi-log basic earnings function corresponds to the rate of return as estimated by the short-cut method. This can be seen in the following discrete approximation,

$$\beta = \frac{\partial \ln W}{\partial S} = \frac{\text{Relative earnings differential}}{\text{Education differential}} = \left[\frac{W_s - W_o}{W_o}\right]\frac{1}{\Delta S} = \frac{W_s - W_o}{\Delta S \cdot W_o} = r, \quad (6)$$

where Ws and Wo are the earnings of those with S and O years of schooling, respectively, and (delta)S the difference in years of educational attainment between the two groups.

The earnings function method can be used to estimate returns to education at different levels by converting the continuous years of schooling variable (S) into a series of dummy variables, say Dp, Ds and Du, to denote the fact that a person has completed the corresponding level of education, and that, of course, there are also people in the sample with no education in order to avoid matrix singularity.

Then, after fitting an "extended earnings function" using the above dummies instead of years of schooling in the earnings function, the private rate of return to different levels of education can be derived from the following formulas:

$$r_p = \frac{\beta_p}{S_p},$$

$$r_s = \frac{\beta_s - \beta_p}{S_s - S_p},$$

$$r_u = \frac{\beta_u - \beta_s}{S_u - S_s},$$

where Sp, Ss, and Su stand for the total number of years of schooling for each successive level of education (primary education completed, secondary education completed, and university education completed, respectively). Again, care has to be taken regarding the foregone earnings of primary school-aged children. In the empirical analysis that follows we have assigned only three years of foregone earnings to this group.

Although convenient because it requires less data, this method is slightly inferior to the previous one as it, in fact, assumes flat age-earnings profiles for different levels of education (see Psacharopoulos and Layard 1979).

Refinements and Adjustments

Estimating the returns to investments in education, as for any other sector, involves an implicit projection of anticipated benefits over the "project's" lifetime. Since only the past earnings are observed, or, most commonly, only a snapshot of the relative earnings of graduates of different levels of schooling is observed, adjustments have been used in the literature to provide a realistic projection of earnings of graduates. The most common adjustments refer to the anticipated real growth in earnings (g), mortality (m), unemployment (u), taxes (t) and innate ability (a). Thus, starting from the observed earnings of university graduates (Wu), their projected profile is adjusted as:

$$\hat{W}_u = W_u(1 + g)(1 - m)(1 - u)(1 - t) \quad (10)$$

The age-earning profile of the control group (Ws), say secondary school graduates, has to be adjusted in the same way, with growth, mortality, unemployment and tax rates specific to that group. In addition, the resulting net benefit of higher education has been further adjusted to reflect differential ability (*a*) between the two groups of graduates,

$$\text{Net benefit of higher education} = (\hat{W}_u - \hat{W}_s)(1 - \alpha) \quad (11)$$

Extensive empirical application of the adjustments described in equations (10) and (11) above, in the early literature from the 1960s on the economics of education led to the conclusion that the pluses and minuses essentially cancel out and one ends up with a net benefit almost equal to the unadjusted one. This is understood by the fact the adjustments are dealing with differences in, for example, mortality rates or unemployment rates between the two groups of graduates, and this does not amount to much in practice.

In the 1970's, the adjustment to the gross earnings differential that drew the most attention was that for differential ability between the two groups of graduates, often known as the "filter" or "screening" hypothesis (see Arrow 1973). Researchers often attributed one-third of the private earnings differential to differential ability. But again, extensive research, starting from the work of Griliches (1970) to that of natural experiments using identical twins who have been separated early in life (Ashenfelter and Krueger 1994) has shown that the ability correction is not empirically validated, hence it is dropped in contemporary practice.

All the above adjustments refer to monetary measures. Yet education has often been compared to a public good, yielding benefits beyond what is captured by the individual's earnings. Differential externalities by level of education might alter the real structure of the social returns to education, hence leading to a different allocation decision. However, empirical work on the documentation of externalities is still in its infancy (but, see Weisbrod 1964). Some evidence that education as a whole might explain differential growth rates is being picked up in the new growth models (Romer 1992). Yet, in empirical applications for guiding allocation decisions at the margin between different levels of education, little has been done to change the general rule that the lower the level of education, the higher the social rate of return.

One might argue, for example, that university education is associated with higher externalities than primary education, in the sense that higher knowledge will lead to the classic vaccine discovery case. On the other hand, applying probabilities to one graduate discovering the vaccine to several million people being illiterate and hence a burden on others, basic education might win the race in terms of externalities.

COUNTRY EXAMPLES

Appendix Table A-1 shows the mean earnings by level of education in Venezuela using 1989 household survey data. Figure 3 below depicts the pattern involved.

Figure 3: Age-earnings Profiles by Level of Education - Venezuela, 1989

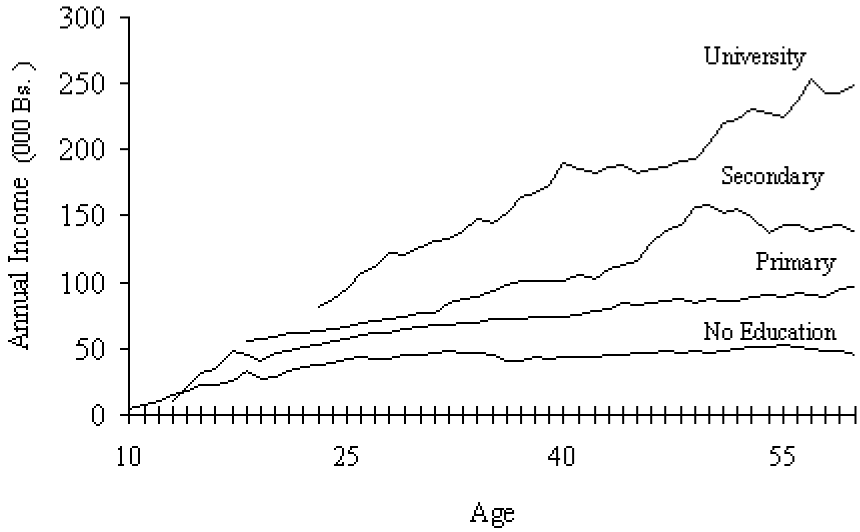


Table A-2 shows the same matrix where the social cost of the different levels of education has been entered in the early ages as negative income. Table A-1 is used for the private rate of return calculation, and Table A-2 for the social rate of return.

Note that in the case of primary education, only 3 years of foregone earnings have been assumed in either the private or the social rate of return calculation. In the social calculation, however, direct costs are incurred for 7 years (i.e., the full length of the primary education cycle).

The mean earnings by level of education irrespective of age appear in Table 1. On the basis of the information provided in Tables 1, A-1 and A-2, it is possible to estimate private and social returns to different levels of education (see Table 2). This can be done using any spreadsheet program where pairs of adjacent columns are used to apply Formula (1). A computer program is available on request from the author that does the estimation automatically, using as input the age-earnings profile matrix (see Psacharopoulos 1995).

Table 1: Mean Earnings and Direct Cost by Level of Education, Venezuela, 1989

Educational Level	Mean Earnings (Bolivares/ year)	Length of School Cycle (years)	Annual Direct Cost per School Year (Bolivares)
No Education	39,625	n.a.	n.a.
Primary	69,452	7	7,668
Secondary	106,337	5	12,170
University	178,293	5	62,795

Table 2: The Returns to Education, Full Discounting Method (percent)

Educational Level	Private Returns	Social Returns
Primary	29.4	19.5
Secondary	10.2	7.9
University	12.4	7.1

Using only the information provided in Table 1, it is possible with a hand calculator to estimate rates of return using the short-cut method. This gives the results in Table 3.

Table 3: Short-cut Estimates of the Returns to Education (percent)

Educational	Private Returns	Social Returns

Level		
Primary	**25.0**	**16.9**
Secondary	**10.6**	**11.5**
University	**13.5**	**12.0**

When individual data are available, one can fit the so-called Mincerian functions to estimate the private returns to an investment in education. When the basic Mincerian earnings function is fitted to Guatemalan data, it gives an overall private rate of return to investment in education of the order of 15 percent. (The detailed earnings functions results are reported in Psacharopoulos and Ng, 1992, Annex 3). Such a rate of return, of course, refers to the marginal year of schooling that spans all educational levels.

When the same function is fitted to different sub-groups of the population, we get the typical result of the females exhibiting a higher rate of return on their education investment relative to males. (See Table 4). The public-private sector split gives, again, the typical result that the private sector rewards more investment in human capital, whereas the public sector pay scales yield flat age-earnings profiles and a lower rate of return.

Table 4. Returns to Education in Guatemala: Basic Earnings Function Method (percent)

Entire sample	**Rate of Return**
Entire Sample	**14.9**
Males	**14.2**
Females	**16.3**
Private Sector	**14.1**
Public Sector	**8.7**

When an extended earnings function is fitted to the same data set, where the educational variable enters as a string of dummy variables rather than as a continuous variable, one gets the set of rates of return to investment in the different levels of education reported in Table 5.

Table 5: Returns to Education in Guatemala:

Extended Earnings Function Method (percent)

Education Level	**Rate of Return**
Primary	**31.0**
Secondary	**15.0**
Higher	**14.7**

The rather high rate of return to investment in primary education is due to the fact that one-third of the workforce is illiterate, hence there is a big payoff at the margin when someone completes primary education.

CONTROVERSIES

Perhaps the most debated hypothesis in the economics of education is the one referring to the so-called "screening hypothesis," namely that earnings differences might be due to the superior ability of the more educated, rather than to their extra education. Among the several tests reported in the literature, the one by Ashenfelter and Krueger (1994) using pairs of twins as units of observation deserves mention because of the quasi-experimental "design" of the sample: twins who were separated early in life and received different amounts of education were observed. The authors found no bias in the estimated returns to schooling. On the contrary, they found that measurement errors in self-reported schooling differences resulted in a substantial underestimation from conventionally-estimated returns to investment in education. (For similar results, although not based on experimental data, see Katz and Ziderman (1980) using Israeli data; Cohn, Kiker and de Oliveira (1987) using United States data; Boissiere, Knight and Sabot (1985) using Tanzanian and Kenyan data; Chou and Lau (1987) using Thai data; Bound, Griliches and Hall (1986) using United States data; Glewwe (1991) on Ghana, and Psacharopoulos and Velez (1992) using Colombian data).

The crux of the matter is that the undisputable and universal positive correlation between education and earnings can be interpreted in many different ways. As Ashenfelter (1991) put it, the causation issue on whether education really affects earnings can only be answered with experimental data generated by exposing at random different people to various amounts of education. Given the fact that moral and pragmatic considerations prevent the generation of such pure data, researchers will have to make do with indirect inferences or natural experiments. Three recent papers report the results of using natural experiments in order to asses the effect of selectivity bias on the returns to education. One example of such a natural experiment was carried out with identical twins who received different amounts of education (as to control for differences in genetic ability). In fact, Angrist and Krueger (1992) found that a rate of return to the extra years of schooling was 10 percent higher than conventional rate of return estimates. Angrist and Krueger (1991) found a very similar rate of return to investment in education to the one conventionally estimated.

Another debated issue in the literature has been the role of socioeconomic background. Card and Krueger (1992) find that, holding school quality constant, there is no evidence that parental income or education affects state-level returns to education. But Neuman (1991), using Israeli data, found that the returns to schooling are higher to those coming from more favorable socioeconomic backgrounds.

When the sample is split by gender, typically the returns to female education are higher than those for males. It should be remembered that such calculations are based on the observed wages of women who are working in the labor market. Several other women have chosen to work at home, tacitly placing a higher value on their household-activities time than on market wages. In addition, the truncation of women's earnings' samples leads to classic econometric biases documented by Heckman (1979). In recent work, correction for selectivity bias does not appear to change significantly the returns on investment in women's education (see Psacharopoulos and Tzannatos 1992). However, the fact remains that rates of return for women do not take into account household production.

Regarding the "earnings-reflect-productivity" assumption, the returns in the private/competitive sector of the economy are higher than for those who work in the public/non-competitive sector. Dabos and Psacharopoulos (1991) analyzed the earnings of Brazilian males in 1980 and found sizeable returns to education across labor market "segments," especially among rural workers and the self-employed. This finding was upheld even after correcting for dependent variable selectivity bias regarding who enters a particular economic sector.

Perhaps the best and most cited finding in this area refers to agricultural production. Jamison and Lau (1982) found that, other things being equal, four years of education for farmers translates to a nearly 10 percent increase in physical agricultural output.

On the issue of whether or not earnings really reflect productivity, Chou and Lau (1987) repeated the Jamison and Lau (1982) production function methodology for Thailand and upheld the results. They found that one additional year of schooling adds about 10 percent to farm output. In East Asia, for example, one additional year of education contributed over three percent to real GDP. (See also Azhar (1991) reporting similar results for Pakistan.)

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Table A-1: Age-earnings Profiles by Level of Education,

Venezuela 1989 (Bolivares/year)

Age	No Education	Primary	Secondary	University
10	3610	0	0	0
11	7220	0	0	0
12	10830	0	0	0
13	14440	10240	0	0
14	18050	20480	0	0
15	21660	30720	0	0
16	23520	35601	0	0
17	23469	37877	0	0
18	27122	42370	57489	0
19	30228	46116	59291	0
20	31794	48942	58575	0
21	34960	50975	60508	0
22	38031	54131	62766	0
23	41467	54544	64781	80336
24	40758	56105	66761	100328
25	41920	58237	68972	105261
26	43941	61061	69760	119689
27	42988	63808	70917	116799
28	41760	64704	72517	124479
29	42920	66335	75243	123156
30	46935	67814	80441	131632
31	50520	68955	79834	134410
32	48685	67255	87892	137396
33	43667	68643	90215	142869
34	42855	69555	94084	150093
35	41122	74418	96817	151344
36	42313	72928	96047	158180

37	38829	72389	108305	165724
38	42536	70499	102851	180251
39	44501	73360	101546	184283
40	45550	77284	97804	194548
41	42199	78429	103540	187500
42	41501	80738	111413	181436
43	45967	79879	116198	174210
44	47254	85688	113672	190298
45	49470	82868	120159	195430
46	44248	85805	137510	185111
47	44601	83548	152400	178025
48	46964	88722	159748	189884
49	49708	86274	159546	204518
50	47631	85285	155425	227195
51	48484	82225	154261	230408
52	49709	86156	149292	227355
53	55390	93201	142913	231263
54	52662	95409	133447	216012
55	50674	91418	134487	230675
56	49356	86116	145527	241332
57	48695	86057	149536	270229
58	49541	92595	142173	261698
59	46420	99668	133933	227602
60	42159	99803	133929	224172

Table A-2: Age-earnings Profiles and Direct Costs by Level of Education, Venezuela 1989

(Bolivares/year) Input to Social Rate of Return Calculation

Age	No Education	Primary	Secondary	University
6	0	-7668	0	0
7	0	-7668	0	0
8	0	-7668	0	0
9	0	-7668	0	0
10	3610	-7668	0	0
11	7220	-7668	0	0
12	10830	-7668	0	0
13	14440	10240	-12170	0
14	18050	20480	-12170	0
15	21660	30720	-12170	0

16	23520	35601	-12170	0
17	23469	37877	-12170	0
18	27122	42370	57489	-62796
19	30228	46116	59291	-62796
20	31794	48942	58575	-62796
21	34960	50975	60508	-62796
22	38031	54131	62766	-62796
23	41467	54544	64781	80336
24	40758	56105	66761	100328
25	41920	58237	68972	105261
26	43941	61061	69760	119689
27	42988	63808	70917	116799
28	41760	64704	72517	124479
29	42920	66335	75243	123156
30	46935	67814	80441	131632
31	50520	68955	79834	134410
32	48685	67255	87892	137396
33	43667	68643	90215	142869
34	42855	69555	94084	150093
35	41122	74418	96817	151344
36	42313	72928	96047	158180
37	38829	72389	108305	165724
38	42536	70499	102851	180251
39	44501	73360	101546	184283
40	45550	77284	97804	194548
41	42199	78429	103540	187500
42	41501	80738	111413	181436
43	45967	79879	116198	174210
44	47254	85688	113672	190298
45	49470	82868	120159	195430
46	44248	85805	137510	185111
47	44601	83548	152400	178025
48	46964	88722	159748	189884
49	49708	86274	159546	204518
50	47631	85285	155425	227195
51	48484	82225	154261	230408
52	49709	86156	149292	227355
53	55390	93201	142913	231263
54	52662	95409	133447	216012
55	50674	91418	134487	230675

56	49356	86116	145527	241332
57	48695	86057	149536	270229
58	49541	92595	142173	261698
59	46420	99668	133933	227602
60	42159	99803	133929	224172