THE STATE OF EDUCATION IN AFGHANISTAN AND THE APPLICATION OF A LINEAR PROGRAMMING MODEL

by

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ABSTRACT

Title of Thesis: The State of Education in Afghanistan and the Findings of a Linear Programming Model

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In this study the role of education in economic development is briefly discussed; the state of education in Afghanistan is assessed and compared with a group of Asian countries.

Through the application of a constrained maximization model the rate of return to primary education in Afghanistan is obtained. Discounted streams of income and cost, associated with different levels of education, were used as the coefficients of the equation which was set to maximize the return to education; the different categories of students and the needed teachers constrained the maximization of the afore-mentioned equation. The model thus described was also dynamic--given a group of youngsters it advanced them to higher levels of education and also generated the required number of teachers from those students.

Education in the elementary level is found to be a profitable investment for Afghanistan to undertake. The rate of return to six years of education in this model is more than five percent and for the first three years it is more than ten percent.

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The responsibility for the conclusions and opinions expressed rests entirely with the author.

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CHAPTER I

EDUCATION AND ECONOMIC DEVELOPMENT

This thesis on the role of education in the economic development of Afghanistan is both a theoretical and an empirical work. The theory is an extension of the institutionalist's view as expounded by Professor Ayres. The quantitative methods are influenced by the writings of Theodore Schultze, Gary Becker, Frederick Harbison, and Charles Myers.

The application is to Afghanistan, a country where more than 80 percent of the children of ages 7 to 12 are left without education, and the rate of illiteracy runs as high as 95 percent or even higher. This shocking situation was primarily responsible for the author's writing on education.

This chapter presents ideas about education and its relation to economic development. Chapter II is an assessment of Afghan education with emphasis on a comparison with other Asian countries. Chapter III is a discussion of a linear programming model and the methods by which the costs and returns to education in Afghanistan were calculated. The findings of the model, their implications, and the reasons for an expansion of primary

education in Afghanistan are discussed in Chapter IV. Chapter V contains a summary and policy recommendations.

Adam Smith was the first economist to recognize the importance of education to economic development. To him education was a produced means of production:

> The acquisition of talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and recognized, as it were, in his person. Those talents as they make part of his fortune so do they likewise of that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays the expenses with a profit.1/

Alfred Marshall put the matter more succinctly when he said, "the most valuable of all capital is that invested in human beings."[2]

These two great economists of the past, recognizing the paramount importance of education, dealt with it as explicitly as is quoted above. Until recently, however, most economists did not give this explicit attention to human resources in economic development. In

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[1]Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, ed. Edwin Cannon (New York: Random House, Inc., 1937), pp. 265-266.

[2]Alfred Marshall, Principles of Economics, 8th Edition (London: MacMillan and Company Ltd., 1930), p. 564.

the opinion of Harbison and Myers, "perhaps because physical capital was measurable, and a capital-output relationship was given an apparent quantitative respectability, some modern economists virtually ignored the human resource factor in economic development."[3]

The neglect of education in the study of economics has affected the development of education in poor countries in two related ways: (1) the economists who have served as advisors in these countries have tended not to appreciate sufficiently the importance of education, and (2) economic theories that have reached the native development planners have been mute about investment in man. Education in these countries would have been more highly regarded had education been emphasized more in the study of economics.

There has been a revival of interest in education among the economists in recent years. Theodore Schultze can be credited for his pioneer work in this area. He says that:

> The failure to treat human resources explicitly as a form of capital, as a <u>produced means</u> of production, as the product of investment, has fostered the retention of the classical notion of labor as a capacity to do manual work requiring little knowledge and skill, a capacity with which, according to this notion, laborers

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[3] F. Harbison and C. A. Myers, <u>Education Manpower and Economic Growth</u>, (New York: McGraw-Hill Book Co., Inc., 1964), p. 4.

> are endowed equally. This notion of labor was wrong in the classical period and it is patently wrong now. Counting individuals who can and want to work and treating such a count as a measure of the quantity of an economic factor is no more meaningful than it would be to count the number of all manner of machines to determine their economic importance either as a stock of capital or as a flow of productive services.
>
> Laborers have become capitalists not from a diffusion of the ownership of corporation stocks, as folklore would have it, but from the acquisition of knowledge and skill that have economic value. This knowledge and skill are in great part the product of investment, and combined with other human investment, predominantly account for the productive superiority of the technically advanced countries. To omit them in studying economic growth is like trying to explain Soviet idealogy without Marx."4/

Institutionalists such as C.E. Ayres have long emphasized the importance of education to economic development; in fact, education has been an inseparable part of the institutionalist theory of economic development. This theory is best summarized by C.E. Ayres as follows:

1. That the process of economic development is indivisible and irresistible.

2. That the technological revolution spreads in reverse proportion to institutional resistance.

3. Granted that technology is human skills and know-how and the complement of tools and equipment in which such skills and know-how are embodied and through which they are exercised; the equipment is useless without know-how. But given the skills and know-how

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[4]Theodore Schultze, "Investment in Human Capital," The American Economic Review, (March 1961), p. 3.

> equipment can be produced. Hence the most important factor in economic life of any people is the educational level as we now call it, of the community. A technically sophisticated community can and will equip itself with the instrumentalities of an industrial economy. There is no instance of any such community having failed to do so. Conversely, an ignorant and unskilled community cannot advance except by acquiring knowledge and skill.5/

Thus, the institutionalists view economic development as a struggle between technology and institutions.[6] Institutionalists consider education indispensible in the process of development; not only because in their view technology is an equivalent to education, but also because education renders the institutions more susceptible to change.

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[5] C.E. Ayres, The Theory of Economic Progress, 2nd Edition (New York: Schocken Books, Inc., 1965), p. xvii-xxi.

[6] Technology and institutions are used in the broadest sense of the terms here. For an excellent explanation of the term institutions, which will be used later in this paper, see the article by Walton H. Hamilton, "Institution," Encyclopedia of the Social Sciences, ed. Edwin R. A. Seligman and Alvin Johnson, VIII (1963), pp. 84-89

CHAPTER II

AFGHANISTAN'S LEVEL OF EDUCATION

Afghanistan's level of education is one of the lowest in the world. Among its neighbors, Afghanistan stands out as an island of illiteracy. This shockingly low level of education should be of primary concern to all those who desire social, political, or economic change in the country.

Table 1 lists a composite index of education for 75 countries that were studied by Harbison and Myers.[1] In the index ranging from .3 to 261.3, the number registered for Afghanistan is 1.9. The index is much higher for the neighboring countries: 17.3 for Iran, 25.2 for Pakistan, 35.5 for India, 19.5 for China, and 92.9 for the U.S.S.R.

Gunnar Myrdal, in his Asian Drama,[2] did not include a study of Afghanistan's education specifically. However, Table 2 (similar to Table 1 but with more recent

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[1]Frederick Harbison and Charles A. Myers, Education, Manpower, and Economic Growth, (New York: McGraw-Hill Book Co., Inc., 1964), p. 45-48. The index is the sum of (1) enrollment in high school as a percentage of the 15-19 age group and (2) five times the enrollment in college as a percentage of the 20-24 age group.

[2]Gunnar Myrdal, Asian Drama, (3 vols; New York: Pantheon, 1968), pp. 1792-1793.

Table 1. Quantitative indicators of human resource development: Countries grouped by levels of human resource development according to composite index

Level I, Underdeveloped	
0.3	Niger
0.75	Ethiopia
1.2	Nyasaland
1.55	Somalia
1.9	Afghanistan
1.9	Saudi Arabia
2.2	Tanganyika
2.6	Ivory Coast
2.95	Northern Rhodesia
3.55	Congo
4.1	Liberia
4.75	Kenya
4.95	Nigeria
5.3	Haiti
5.45	Senegal
5.45	Uganda
7.55	Sudan
Level II, Partially developed	
10.7	Guatemala
10.7	Indonesia
10.85	Libya
14.2	Burma
14.5	Dominican Republic
14.8	Bolivia
15.25	Tunisia
17.3	Iran
19.5	China (Mainland)
20.9	Brazil
22.6	Colombia
22.7	Paraguay
23.15	Ghana
23.65	Malaya
24.3	Lebanon
24.4	Ecuador
25.2	Pakistan
26.8	Jamaica
27.2	Turkey
30.2	Peru
31.2	Iraq
Level III, Semiadvanced	
33.0	Mexico
35.1	Thailand
35.2	India
35.5	Cuba
39.6	Spain
40.0	South Africa
40.1	Egypt
40.8	Portugal
47.3	Costa Rica
47.7	Venezuela
48.5	Greece
51.2	Chile
53.9	Hungary
53.9	Taiwan
55.0	South Korea
56.8	Italy
60.3	Yugoslavia
66.5	Poland
68.9	Czechoslovakia
69.8	Uruguay
73.8	Norway
Level IV, Advanced	
77.1	Denmark
79.2	Sweden
82.0	Argentina
84.9	Israel
85.8	West Germany
88.7	Finland
92.9	U.S.S.R.
101.6	Canada
107.8	France
111.4	Japan
121.6	United Kingdom
123.6	Belgium
133.7	Netherlands
137.7	Australia
147.3	New Zealand
261.3	United States

Source: Frederick Harbison and Charles A. Myers, Education Manpower and Economic Growth, (N.Y.: McGraw-Hill Book Co., Inc., 1964) p. 33.

Table 2. Percent of age groups enrolled in school for Afghanistan in comparison with an average of nine Asian countries: Pakistan, India, Indonesia, Burma, South Vietnam, Philippines, Thailand, Ceylon, and Malaya.

Levels of education and (ages)	Total number of students[a]	Approximate population[b]	Percent of age group enrolled in school (1/2)	Equivalent of column 3 as a simple average of nine countries[c]	Categories of education as a percent of the nine countries (3/4)
	1	2	3	4	5
Elementary education (7-12)	358,037	1,920,000	18.64	60	31
Secondary education (13-15)	33,878	720,000	4.7	17	27
High School (16-18)	11,070	672,000	1.6	8	20
University (19-22)	1,900	696,000	0.27	2.5	10

Sources: a. Survey of Progress. Dept. of Statistics, Ministry of Planning, Kabul, Afghanistan, (1965-1966).

b. Louis Dupree, "Tribalism, Regionalism and National Oligarchy: Afghanistan," in Expectant Peoples Nationalism, and Development, Ed., K. H. Silvert, (N.Y.: Vintage Books, 1967), p. 46.

c. Calculated by the author from: Gunnar Myrdal, Asian Drama, (3 vols.; New York: Pantheon, 1968), pp. 1792-1793.

data) is patterned after Mr. Myrdal's study of other Asian countries. Column 1 is the total students enrolled in different levels of education in Afghanistan. Column 2 shows the respective populations for column 1. Column 3 is column 1 divided by column 2. Column 4 is an average of Myrdal's figures for nine Asian countries; column 5 is column 3 divided by column 4.

As is indicated in column 5, Afghanistan has less than one-third as high a percentage of the elementary age group in the elementary schools as an average of the nine countries would have. As is shown in column (3), less than 19 percent of the youngsters get any formal education. It is indeed astonishing to realize that with all the efforts made in Afghanistan in recent years, the school doors are still shut to 80 percent of its youngest generation.

For the secondary level column 5 shows that Afghanistan has only 27 percent as high a percentage of the secondary age group enrolled in school as an average of the nine Asian countries would have. The secondary level of education is important in the sense that it provides a source of technicians for the economy and its meagerness deprives a country of this indispensable resource.

In the high school level Afghanistan has 20 percent as high a percentage of the age group in school as

the average of the nine countries. The high school graduates supply students for colleges, personnel for clerical work, personnel for civil service, teachers for elementary levels, etc. The small number of students in this category deprives the country of all these types of human capital. One of the vicious circles is completed due to the very small number of high school students. Lack of teachers prevents a large number from getting elementary education; yet, a shortage of teachers is due to a shortage of students in the elementary school.

In its highest level of formal education, the college level, Afghanistan has only ten percent of the students which an average of the nine Asian countries would have. The importance of the highest level of education cannot be underestimated; and the problem becomes especially acute when it is realized that Afghanistan is a victim of the "brain drain." The shortage of indigenous personnel in this category makes Afghanistan heavily dependent on college educated foreigners.

Column 3 of Table 2 shows an increasing meagerness in the higher categories of education. This is an understandable phenomenon when the base is meager to begin with, the higher categories are left with fewer resources to draw upon. That is one reason for expanding the elementary level of education so as to encompass a larger number of children. Another very important reason for

the expansion of the elementary level is that when the percentage of the enrollment in the school age group (7-12) is lower, the probability of excluding gifted individuals from getting education becomes higher.

A unique feature of the comparative statistics, summarized in Table 2, is that it compares Afghanistan with its peers -- a group of less developed Asian countries. Afghanistan is compared with a group of "underdeveloped" countries, and is found to be the most "underdeveloped" one.

Thus far we have assessed the quantitative aspects of Afghan education; the qualitative aspects of Afghan education are best assessed by Dr. Griffin who has travelled to the country:[3]

> The development of education in Afghanistan is very much in need of a plan -- a plan that concerns itself not only with the number of schools that will be opened each year but also with the kind of country Afghanistan is trying to become; not only with printing of additional textbooks but also with the kind of person the text book is intended to help develop. Efforts are now being made at many levels and by many groups of people, Afghan and foreign assistance groups, to improve schools and to too large a degree these efforts do not add up because there is no commonly understood, clearly thought-out, philosophically sound plan to which these groups can look for guidance.

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[3]The passages are from an unpublished report "Education in Afghanistan" (1963?) by Dr. W. H. Griffin, Professor of Education at Columbia University.

> At present teaching-learning in Afghanistan is largely a matter of dictation of bare facts by the teacher, note-taking by the student, memorization and recitation by the students. Examinations are given at the end of major periods in the school year and on the basis of the examinations alone students are passed or failed. Examinations are largely subjective including oral examinations. The average classroom is devoid of teaching materials of any kind except possibly a single text in some subjects. Whatever resources may be available in the way of teaching materials or library resources are liable to be locked away.... Each student has twelve to fourteen subjects to master at any one time and the school day is almost completely spent in classroom teaching.
>
> Under these conditions learning, whenever it is accomplished at all, is likely to be note-learning devoid of real understanding, lacking in the development of inquisitive mind, problem-solving skills, social consciousness and leadership abilities.

Summary

Afghanistan's present level of education leaves much to be desired. The 18.6 percent of the children in elementary school is incredibly low in today's world. It is likely also that many gifted individuals are being left without education.

An attempt should be made to plan a rational pattern of resource allocation and enrollment within the educational system -- to maximize the return to education and to find the rate of return to investment in education. The return to education is constrained by such things as the number of students and the availability of teachers. The nature of the problem suggests "constrained maximization" as a likely technique to be used.

In Chapter III a linear programming model will be constructed; the cost and return to education and the way they were arrived at will be discussed. Chapters IV and V are a continuation of Chapter III, where the findings of the model will be discussed and policy recommendations will be made. Three appendices, describing the mathematical structure of the model, streams of income, and possible improvements in the model, follow Chapter V.

CHAPTER III

THE APPLICATION OF A LINEAR PROGRAMMING MODEL TO EDUCATION IN AFGHANISTAN

Introduction

The model developed here is based on the principle of constrained maximization. Before turning to a detailed description of the model it is desirable to describe some of the terms used in the model: constrained maximization simply means that in the model one equation has been maximized subject to many constraints. The equation which has been maximized will henceforth be called the objective function. Since all the equations, the objective function as well as the constraints, are linear, the constrained maximization acquires a special name -- linear programming. The term activity will be used to describe any process which results in an output. The outputs are the students, differentiated by the level of their educational attainment.

The unit for measuring the levels of education is three years. Since the schools in Afghanistan are twelve years in duration they are divided into four levels. The first three years of elementary education also include the rural education which, incidentally, is also three years. The second level of education stands

for the grades 4 - 6. The third level of education signifies grades 7 - 9, which is also called secondary education. The fourth level of education stands for grades 10 - 12 which is equivalent to high school. Vocational schools are six years in duration and include grades 7 - 12; they are treated as third and fourth levels of education. The last category of education is the college level. Although colleges are four years in length,[1] this does not significantly affect the results. The use of three years as a unit for levels of education has reduced the size of the model (matrix) by one-third without having significant effects on the results.

Detailed Description of the Model

The objective function and its derivation is an important part of the work; it is discussed at length in Section 1, below. In Section 2, below, the discussion will concentrate on the fourteen inequalities which serve as constraints.

1. The Objective Function.

The objective function which is maximized consists of two main parts, a cost and a return section. The function consists of twenty-three unknowns: eight unknowns are the

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[1]Medical college which is seven years in duration is excluded from the model.

levels of education activities;[2] eight unknowns are the alternative activities that the students in the eight levels of education have at their disposal--they can join the non-teaching labor force; the remaining seven unknowns are the teaching activities. Equation (1) presents the objective function in its general form:

$$(1) \quad Z = \sum_{i=1}^{8} CiXi + \sum_{i=9}^{15} CiXi + \sum_{i=16}^{23} CiXi$$

where

Z is the value of the objective function;

X_1 to X_8 are the different levels of education activities, and C_1 to C_8 are their associated costs;

X_9 to X_{15} are different teaching activities, and C_9 to C_{15} are their related costs;

X_{16} to X_{23} are the levels of work that students with different levels of education would engage in as an alternative to schooling and C_{16} to C_{23} are the returns to those levels of work.

The two main parts of the objective function are the different levels of schooling and the job alternative for those levels. The former measures the cost of schooling and the latter measures the return to education. $C_1 - C_8$ have negative signs--standing for different costs associated with different levels of education; $C_{16} - C_{23}$ measure the returns to different levels of education.

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[2]Four levels for academic schools, 2 levels for vocational schools, and two levels for professional and non-professional colleges.

The coefficients for different levels of teaching activities ($C_9 - C_{15}$)[3] are zero, due to the fact that teaching costs are included in costs of different levels of schooling. So, the second term in equation (1) becomes zero. A discussion of the cost and the returns ($C_1 - C_8$ and $C_{16} - C_{23}$) is the next step in the discussion, indeed an important part of the work.

a. The Cost of Education

The cost coefficients of the objective function measure the direct cost and the opportunity cost associated with a category of education. The direct cost is a composite one, i.e. it consists of the teacher's salary, the cost of books and other equipment such as the laboratories and recreational facilities, and the rental costs of the school. All these costs were accounted for on a per capita basis. The room and board expenses were not included since these are costs which are incurred whether or not one is a student.

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[3]The seven levels of teaching activities are as follows: the graduates of the academic high schools have been allowed to teach in the elementary, and secondary levels. The graduates from colleges have been allowed to teach at all different levels: elementary, secondary, high school, and vocational schools. To make the model internally consistent, the graduates of college were allowed to teach at the college level also. This was made possible by the fact that the cost coefficients at all levels, as mentioned earlier, contained teachers' salaries. To avoid double counting the coefficients for these seven categories of teaching activities in the objective function were all zeroes.

The other part of the cost is the opportunity cost; it measures the income that is foregone by an individual while he is attending school. The income of an illiterate person is his opportunity cost while he is attending the first grade. Since education has been measured on a three-year basis, the social cost of education (direct cost plus the opportunity cost) has also been calculated for three years. Putting it differently, a stream of cost extended over a three year period was generated for each level of education. The present values of these streams of costs provided the cost coefficients (C_1 - C_8) of the objective function.

Table 3 shows the cost figures for all the categories of education. Column 1 is the direct cost and column 2 shows the opportunity costs; column 3, the sum of columns 1 and 2, is the social costs associated with all the years of education. Columns 4, 5, and 6 are the present values of column 3 summed up over each three-year period with the rates of discount being 10, 8, and 5 percent, respectively. One can readily see that the application of the three discount rates to the stream of costs (column 3) has given rise to three objective functions on the cost side. To complete the picture, the same discount rates have also been applied to the streams of income.

Table 3. Costs incurred in different levels of education in Afghanistan (Afghanis)

	(1)	(2)	(3)	(4)	(5)	(6)
				Discounted social cost summed on a three year basis		
Categories of education	Direct cost	Opportunity cost	Social cost 1 + 2	10%	8%	5%
1st grade academic	400	3,000	3,400			
2nd grade academic	400	3,000	3,400			
3rd grade academic	400	3,000	3,400			
				8,455	8,762	9,259
4th grade academic	600	7,300	7,900			
5th grade academic	600	7,300	7,900			
6th grade academic	600	7,300	7,900			
				14,760	16,162	18,584
7th grade academic	2,500	10,800	13,300			
8th grade academic	2,500	10,800	13,300			
9th grade academic	2,500	10,800	13,300			
				18,670	21,599	27,027
10th grade academic	2,500	12,200	14,700			
11th grade academic	2,500	12,200	14,700			
12th grade academic	2,500	12,200	14,700			
				15,503	18,951	25,804
7th grade vocation	3,000	10,800	13,800			
8th grade vocation	3,000	10,800	13,800			
9th grade vocation	3,000	10,800	13,800			
				19,372	22,411	28,042
10th grade vocation	4,000	16,900	20,900			
11th grade vocation	4,000	16,900	20,900			
12th grade vocation	4,000	16,900	20,900			
				22,041	26,949	36,688
1st year of college (non-technical)	11,250	15,600	26,850			
2nd year of college (non-technical)	11,250	15,600	26,850			
3rd year of college (non-technical)	11,250	15,600	26,850			
4th year of college (non-technical)	11,250	15,600	26,850			
				27,118.50	35,316	53,015
1st year of technical college	11,250	15,600	26,850			
2nd year of technical college	11,250	15,600	26,850			
3rd year of technical college	11,250	15,600	26,850			
4th year of technical college	11,250	15,600	26,850			
				27,118.50	35,316	53,015

Source: Direct and opportunity costs were reported to the author by Habiburraham Ulfat after consultation with various officials in Afghanistan in 1967. These reported figures were altered in some cases after consultations with A. Sami and A. Mayel.

b. Returns to Education

Unlike the social cost figures, the income side of the objective function measures only the private returns. The only return to education which has been accounted for is the income of the individual. Comparing private returns with social costs in an analysis of education probably results in an overstatement of costs relative to returns.

There are eight streams of income associated with the eight levels of education. Education is a produced means of production; acquiring it incurs cost, but once acquired it gives rise to income to the individual. As the return to an investment is realized for the length of the life of the capital, so does the return to education accrue throughout the life of an individual. The life expectancy is assumed to be 45 for Afghanistan; the school entrance age is usually the age of seven. The return to education starts from the year that one leaves school and enters the labor force. The length of the period in which the costs and the returns occur is 38 years (45 minus 7). This holds for all of the eight categories of pupils, each of which eventually enters the labor force.

Appendix II contains all the streams of income, here we turn to a discussion of how each of the streams

of income was arrived at:[4] the first category consists of youngsters with no education; at the same time their tender age does not enable them to join the labor market. Due to the agrarian nature of Afghanistan a youngster finds employment in the neighborhood families, who provide him with food and clothing. This pattern continues from the age of seven to about twelve or thirteen, depending on the physical growth of the youngster. After the age of roughly 13 the youngster earns an income in kind, in addition to his food and clothing. Of course, as the person's age advances so does his income, until his energy reaches its maximum. The stream of income generated herein for the first category of people is based on the pattern just discussed. The incomes in kind have been converted to Afghanis,[5] and are shown in the first column of Appendix II.

The second stream of income is associated with the category of people with three years of education. The people in this category can be called literate; this literacy enhances their employment opportunities. A person in this category has a better chance to be employed in the factories, work as a peon, become a miner, or per-

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[4]All the streams of income (opportunity cost) and direct costs were reported to the author by Habiburrahman Ulfat after consultation with various officials in Afghanistan in 1967. These reported figures were altered in some cases after consultations with A. Mayel and A. Sami.

[5]Seventy afghanis were equal to one dollar as of October 1966.

form other manual tasks. The income stream used herein for this category of people is a simple average of the incomes in several of the categories of jobs open to them. As for the increments in this group's income, the present pattern in governmental salaries for those jobs was used. The second group has an opportunity cost of the income that is foregone in the three years that are spent at school. Column 2 of Appendix II distinguishes these costs from the rest of the streams by negative signs.

People with six years of education can be safely assumed to be literate. For the stream of income of this third category of people, the pattern of governmental salaries has been strictly applied. Column 3 of Appendix II shows these incomes with the first three figures signifying the opportunity cost of the second level of education. The income streams for the five remaining categories of education[6] (comprising the five remaining columns in Appendix II) are based upon the prevalent pattern of salaries in the government. In the application of the governmental pattern of salaries, promotions have been assumed to be regular and, as is usual, to occur every three years.

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[6]The five remaining categories of people are (1) people with nine years of academic education, (2) people with 12 years of academic education, (3) people with nine years of education with the last three years in vocational schools, (4) people with 12 years of education with the last six years in vocational schools, and (5) people with college education.

In all of the eight streams of income, adjustments have been made (for the years 22 and 23) for time spent in the two years of required military duty;[7] it has been assumed that one's productivity while in military service enables him to earn his own living expenses and no more.

All of the streams of income in Appendix II have been discounted at 5, 8, and 10 percent. The present values thus found are the numerical values for $C_{16} - C_{23}$; i.e., the coefficients for the return side of the objective function. It should be noted that C_i has three rates of discount. Table 4 summarizes the present values of the returns to education for the three rates of discount which were applied.

Summary

In this section we observed how costs and returns to education were calculated. It may be recalled that $C_1 - C_8$, the coefficients of the cost side of the objective function, include both social as well as opportunity costs of education, whereas $C_{17} - C_{23}$, coefficients of the return side of the objective function, measure private returns only. This in our judgment is a built-in

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[7]For people with high school or college education, only one year of military service is required, and adjustments have been duly made.

Table 4. The discounted income streams of the population based on their level of education (afghanis)

	(1)	(2)	(3)
Groups with different levels of education	at 10%	at 8%	at 5%
No education	55,771	75,212	127,946
3 years of general elementary school	70,464	95,053	160,506
6 years of general elementary school	77,908	110,683	201,195
9 years of general elementary school	65,659	97,361	187,137
12 years of general elementary school	61,242	94,555	191,368
6 years of elementary and 3 years of vocational school	84,381	123,755	233,669
6 years of elementary and 6 years of vocational school	82,785	126,280	250,711
4 years of college (technical & non-technical)	52,478	86,205	189,935

Source: Appendix II

bias against education in our model. For, true, there are two kinds of costs to education which are accounted for, but the private return calculated here, is not the only return to education. An educated man draws our attention not only because he might have a higher income, not only because we enjoy his presence, but also because his family benefits a great deal. He is bound to give the entire family an outlook much different than if he were not educated. Look at all the joy that one gains from reading a book or pondering upon a challenging idea.

It is not our task to expound upon the good features of education, our only contention is that the money returns from education by no means account for all the benefits that go along with education. To the extent that we have been unable to account for these returns, our "returns to education" remain deficient--there are many social returns to education which we have not been able to include here.

1. The Constraints.

The objective function studied thus far has been maximized subject to 14 constraints.[8]

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[8]Appendix I contains the mathematical structure of the model: three objective functions due to the application of three discount rates, and 14 inequalities which serve as constraints. Among the 14 constraints, eight are student constraints, five are teachers constraints and one is the budget constraint for finding the cost of execution of the model.

The general form of the fourteen constraints is as follows:

$$(2) \quad Pi \geq \sum_{i=1}^{23} SiXi$$

Pi stands for the number of students. $X_1 - X_8$ indicate students in different categories. $X_9 - X_{15}$ stand for different categories of teachers. $X_{15} - X_{23}$ stand for categories of laborers distinguished by their level of education. S_i stands for the number of students in each category which is always 1. Another way of looking at (2) is that it stands for a set of production possibilities. For example, equation 1 in Appendix I, following form: $1{,}000{,}000 \geq X_1 + X_{16}$, means that the 1,000,000 students in the first school age group either can go to school and acquire three years of education (X_1), or can join the labor force without any education (X_{16}). They will acquire education only if their income after acquiring the education is greater than the sum of the direct and the opportunity cost associated with the first level of education. The second level of education has been made available to the group only after they have acquired the first level and satisfied the condition given above. The second production possibility equation, which uses the output of the first inequality as input, is signified by: $P_2 \geq -X_1 + X_2 + X_{17}$, where P_2 is the number of students in the second age group. Generally, every level

of education is a prerequisite of the subsequent level in the model. The negative variables stand for the inputs in every production possibility function, they had positive signs in the preceeding function signifying outputs. This process of outputs becoming inputs in a succeeding stage has made the model a dynamic one. Another feature of the model is linearity. The fixed nature of other coefficients and the teacher-student ratio is the basic reason for the linearity of the model.[9]

The teacher requirement has been satisfied by the model internally. Similar to the process of transfer, discussed above, the graduates of the higher levels of education were used as teachers. The graduates of high school were allowed to teach up to grade nine and the graduates of college were allowed to teach at all levels including the college level. Having the cost of teaching included in the cost of education has particularly facilitated this latter feature of the model. The teacher constraints, comprising five equations listed in Appendix I, can also be thought of as production possibility functions. The general form of these functions is presented

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[9] Samuel Bowles, A Planning Model for the Efficient Allocation of Resources in Education. N.Y. Dec. 1965. Paper delivered to the joint session of the Econometric Society and the American Economic Association.

in inequality 3.

$$(3) \quad Ti \geq \sum_{i=1}^{8} .025\ Xi - \sum_{i=9}^{15} Xi$$

Ti stands for categories of teachers, .025 is the teacher-student[10] ratio.

The last of the fourteen constraints is only an accounting device which calculates the cost of education and has no other function in the model.

In our search for the optimum stage of education we have made use of a constrained optimization technique. An objective function which maximizes returns while minimizing cost at the same time is subjected to a set of constraints. The constraints are set by the structure of education, years of schooling, and the teacher requirements. The application of different rates of discount to the costs and benefit streams has provided us with three different objective functions--discounted at 5, 8, and 10 percent. In the following chapter the findings of the model will be discussed in the light of the three discount rates applied.

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[10] Forty students to a teacher is based on the figure from the Survey of Progress, Dept. of Statistics, Ministry of Planning, (Kabul: Government Printing House, 1965-1966), and the group of nine Asian countries studied in the Asian Drama, Myrdal, op. cit., pp. 1792-1793. The present student-teacher ratio is 55 for Afghanistan and 25 for the United States.

CHAPTER IV

FINDINGS OF THE MODEL

This chapter answers a basic question: If the social rate of discount is 5, 8, or 10 percent, what is the optimum level of general education for the present pre-school age population of children in Afghanistan? To answer this question we assume that the present income differentials persist. In addition to that we round off the approximately 1,300,000 youngsters of pre-school age to 1,000,000 only. This does not change the results in a significant way, but makes it easier to state the results as percentages.

The results for the objective functions discounted at 8 and 10 percent were not significantly different. The application of a 5 percent rate of discount rendered significantly different results. Table 5 summarizes the findings of the model when applied to a population of 1,000,000. It consists of two parts: the first part contains the results for the 5 percent rate of discount (columns 1 and 2); part two shows the results for 8 and 10 percent (columns 3 and 4), which were the same.

Table 5. A summary of the findings (numbers of students and teachers).

	at 5% rate of discount		at 8 & 10% rates of discount	
Education level	Categories of students	The required teachers	Categories of students	Teachers
	(1)	(2)	(3)	(4)
Primary 1-3	1,000,000	25,000	1,000,000	25,000
Primary 4-6	1,000,000	25,000	27,046	676
Secondary 7-9	52,667	1,317	27,046	676
High School 10-12	52,667	1,317	27,046	676
Secondary 7-9 (vocational)	0	0	0	0
High School 10-12 (vocational)	0	0	0	0
University	1,350	34	693	17
University (technical colleges)	0	0	0	0

A Case for Universal Elementary Education in Afghanistan

Universal elementary education is a profitable investment for Afghanistan to undertake.

If the objective function is discounted at five percent, education in this model is extended to six years--the rate of return on six years of primary education is slightly higher than six percent.[1] In Column 1 of Table 5 all of the 1,000,000 youngsters have been given six years of education.

If the objective function is discounted for 8 or 10 percent, education in this model is extended only to three years--the rate of return on three years of primary school education is slightly higher than 10 percent.

In the case of a 5 percent discount rate, students have been given higher levels of education only to be used as teachers in the system. Out of the 1,000,000 given population only 52,668 receive education higher than the sixth grade: 50,000 receive high school education and teach at primary schools, 1,317 receive high school education and teach those who go to secondary school, 1,317 receive college education and teach at

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[1]For the American Economy the average return to education is found to be between 5 and 10 percent. Harbison and Myers, op. cit., p. 9.

high schools, and finally, 34 more receive college education to teach those who go to college. A parallel explanation can be given to the results in columns 3 and 4 of Table 5, which summarize the findings for 8 and 10 percent rates of discount.

The shadow prices for students with different categories of education are shown in Table 6. These shadow prices are the marginal value products for the respective categories of students. They indicate the contribution that one student can make to the total value of the objective function. Column 1 of Table 6 shows the shadow prices for different categories of students and different categories of teachers. In the table the shadow price for a student with three years of education, if extended to six decimal points, is Afs. 58.943815. If this is multiplied by the total population who receive three years of education, namely, 1,000,000, the product is equal to the total return to education which is listed at the end of column 1. The figure immediately above the value of the total return is the budget or total cost of education. It should be borne in mind that the total return figure is a discounted value and the budget figure is not. A similar explanation holds true for columns 2 and 3.

The shadow prices are very significant when linear programming is applied to a process of production.

Table 6. Shadow prices for pupils in different categories and their respective teachers. (1,000's of afghanis)

	at 10% rate of discount	at 8% rate of discount	at 5% rate of discount
	(1)	(2)	(3)
Student with 3 years of education	58	82	159
Student with 6 years of education	70	95	175
Student with 9 years of education	88	115	201
Student with 12 years of education	110	141	234
Student with 3 years of vocational education	130	165	268
Students with 6 years of vocational education	112	142	237
Students with university education	130	165	282
Student with technical college education	161	205	330
Teacher for grades 1-6	130	165	268
Teacher for grades 7-9	130	165	268
Teacher for grades 10-12	161	205	330
Teacher for grades 7-12 (vocational)	161	205	330
College teachers	161	205	330
Total budget required	1,669,972	1,669,972	3,820,392
Total return	58,943,815	82,167,257	159,850,960

Note: One dollar is equal to 70 afghanis as of October, 1966.

If the model is one of profit maximization the shadow prices are the maximum prices at which different inputs can be bought. But the above interpretation is less valid when the model is applied to education.

Demand for Education

Nothing has been said so far about the elasticity of demand for particular levels of education. The demand price of labor with a particular level of education is assumed to be equal to the marginal product of that category of labor. In the model the elasticity of demand for labor with six years of education is assumed to be infinity (the marginal product is assumed to be constant over the relevant range) -- when found profitable all of the 1,000,000 population were given primary education. For elementary education this is felt to be a justifiable assumption, and the reasons for it can be summarized as follows:

a. According to a recent report,[2] a child's brain has been physically set into a firm culture-bound mold by age 12, and after that it is very hard to make changes in it. In the childhood years the brain doubles in size in the first six months and again by age four. What is

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[2]Dr. Robert B. Livingston, Professor of Neurosciences at the University of California at Los Angeles, delivered this report at the convention of the American Association for Advancement of Science, in a gathering of 2,600 scientists, The Washington Post, December 30, 1968, p. A6.

considered common sense in any culture is actually what one experiences before age 12.

The six years of elementary education is then an opportune time for the development of a rational common sense in the youngsters. This golden opportunity would be utilized to its maximum if the education is extended to all the population in the age group.

b. Change in any sense of the term cannot be conceived of without having a literate society. The literate society is bound to have a more rational common sense, which provides for a healthy environment for development. How can the idea that (for good or bad) development is badly needed, be communicated to a people who are totally illiterate, whose world is as large as the village that they live in or sometimes does not extend beyond the four corners of their dwellings?

c. Education is a produced means of production. It truly is an investment in human capital. The distinguishing feature of this investment in the elementary level is that it does not have a diminishing marginal productivity. A literate society is bound to be a more rational society, a more creative society, indeed a more productive society -- elementary education has an increasing marginal productivity.

d. When the number of literate people are very few in a society, it is only natural for the literate minority to feel superior and, as a consequence, to look down upon manual work. This superiority feeling would diminish if all are made literate.

Due to the above reasons, we assumed that the demand for laborers having six years of education was infinitely elastic. How this assumption should be revised for higher levels of education is discussed in Appendix III.

CHAPTER V

SUMMARY AND POLICY RECOMMENDATIONS

The survival of an advanced society is dependent upon the extent to which the level of learning and achievements in the society are transmitted to the younger generation. Pains should be taken to see that the transmission is genuine and thorough, or else the civilized group will relapse into barbarianism and then into savagery.

Much of what has to be learned in an advanced culture is stored in symbols -- in books.[3]

The process of transmission is thorough only when the institutions of learning are keeping the younger generation abreast of the scientific and cultural advancement of the society.

In a poor country the task of educational institutions is far more difficult -- they need not only to transmit a higher state of technology and culture but also to create it, or to be more realistic, to acquire it. The previous discussion has emphasized the role and place of education in the development of a society; and

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[3]John Dewey, Democracy and Education, (New York: The Free Press, 1966), p. 8.

the first step in acquiring such a level of education for Afghanistan is a much higher rate of literacy.

A higher rate of literacy is not only desirable on the basis of all reasons given thus far, but also on the simple fact that what else can be done with children of tender age (6 - 12), whose brain is going to be molded on any pattern that the environment dictates: is not school the best of all environments to be trusted with such a task?

Is not the idea of equality of income and opportunity best solved by more education for everyone so as to give them more equal opportunities?

The results of this paper can best be summarized as a numerical endorsement of Article 26 of the Universal Declaration of Human Rights:

> Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

If the urgency of education is agreed upon, and it is also realized that a larger base for education is needed, meaning that the case for universal elementary education is accepted, then a reasonable way to go about it is to increase the number of teachers significantly. A real effort for eliminating illiteracy is definitely called for. This should be primarily directed toward

recruiting as many teachers from the already increasingly unemployed college educated elite[4] as is possible. Another possible step to take would be to let the university graduates finish their military training in as short a time as two or three months (and there are reasons to think that such a thing is well within the realm of possibility), and then go and teach in rural areas. This recommendation besides being a result of the findings has another much more plausible reason behind it -- not only would they educate many youngsters, but also the process will be very educational for the college graduates. They will come in contact with what one might call the real Afghanistan -- the village areas. This is said in the light of the fact that the college elite, due to circumstantial reasons, have lost their touch with the rest of Afghanistan. Bridges should be built and the above is a suggestion as to how to go about it. Since teaching would be a substitute for part of the military service, it could remain under the military severity -- two shift teaching could be required from every graduate.

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[4]Conversation with several compatriots has shown that the Afghanistan government is worried about this trend, although the number of college graduates does not exceed 700 per year. On one occasion it was pointed out to the author that the government has made all these entering college write a letter saying that the government will not be responsible for their future employment.

APPENDIX I

A. The objective functions:

$$Z_1 = -85X_1 - 148X_2 - 187X_3 - 155X_4 - 193.7X_5 - 220.4X_6 - 317X_7 - 271X_8 + 558X_{16} + 707X_{17} + 779X_{18} + 657X_{19} + 612X_{20} + 844X_{21} + 828X_{22} + 525X_{23}$$

$$Z_2 = -88X_1 - 162X_2 - 216X_3 - 190X_4 - 224X_5 - 269X_6 - 413X_7 - 353X_8 + 752X_{16} + 951X_{17} + 1107X_{18} + 974X_{19} + 946X_{20} + 1238X_{21} + 1263X_{22} + 862X_{23}$$

$$Z_3 = -93X_1 - 186X_2 - 270X_3 - 258X_4 - 301X_5 - 428X_6 - 620X_7 - 530X_8 + 1279X_{16} + 1605X_{17} + 2012X_{18} + 1871X_{19} + 1914X_{20} + 2337X_{21} + 2507X_{22} + 1899X_{23}$$

B. Each one of the above equations were maximized subject to the following constraints:

1. Student constraint

(1) $P_1 \geq X_1 + X_{16}$

(2) $P_2 \geq -X_1 + X_2 + X_{17}$

(3) $P_3 \geq -X_2 + X_3 + X_5 + X_{18}$

(4) $P_4 \geq -X_3 + X_4 + X_{19}$

(5) $P_5 \geq -X_4 + X_7 + X_9 + X_{10} + X_{20}$

(6) $P_6 \geq -X_5 + X_6 + X_{21}$

(7) $P_7 \geq -X_6 + X_8 + X_{22}$

(8) $P_8 \geq -X_7 - X_8 + X_{11} + X_{12} + X_{13} + X_{14} + X_{15} + X_{23}$

2. Teachers constraints:

(9) $I_1 \geqq .025X_1 + .025X_2 - X_9 - X_{11}$

(10) $I_2 \geqq .025X_3 - X_{10} - X_{12}$

(11) $I_3 \geqq .025X_4 - X_{13}$

(12) $I_4 \geqq .025X_5 + .025X_6 - X_{14}$

(13) $I_5 \geqq .025X_7 + .025X_8 - X_{15}$

(14) $BGT \geqq 1.2X_1 + 1.8X_2 + 7.5X_3 + 7.5X_4 + 9X_5 + 12X_6 + 22.5X_7 + 45X_8$

Z_1 = The objective function discounted at 10 percent

Z_2 = The objective function discounted at 8 percent

Z_3 = The objective function discounted at 5 percent

$X_1 - X_8$ = Students in different categories of education

$X_9 - X_{15}$ = Different categories of teaching

$X_{16} - X_{23}$ = Categories of job open to the students

P_1 = The number of youngsters of the school age which is equal to 1,000,000 in the model

P_2 = Students with three years of education

P_3 = Students with six years of education

P_4 = Students with nine years of education

P_5 = Students with twelve years of education

P_6 = Students with three years of vocational education

P_7 = Students with six years of vocational education

P_8 = Students with university education

I_1 = Teachers for elementary schools

I_2 = Teachers for secondary schools

I_3 = Teachers for high schools

I_4 = Teachers for voactional schools

I_5 = Teachers for university

BGT = Budget

APPENDIX II

Costs and returns to education (100's of afghanis)

Age	Students with no education	Students with 3 years of education	Students with 6 years of education	Students with 9 years of education	Students with 12 years of education	Students with college education	Students with 3 years of vocational education	Students with 6 years of vocational education
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
7	30	- 34						
8	30	- 34						
9	30	- 34						
10	35	73	- 79					
11	35	73	- 79					
12	35	73	- 79					
13	40	77	108	-133			-138	
14	40	77	108	-133			-138	
15	40	77	108	-133			-138	
16	45	84	115	122	-147		169	-209
17	50	84	115	122	-147		169	-209
18	60	84	115	122	-147		169	-209
19	60	95	126	132	156	-268.5	180	232
20	70	95	126	132	156	-268.5	180	232
21	70	95	126	132	156	-268.5	180	232
22	75	85	95	105	115	-268.5	180	232
23	80	90	100	110	120	130	110	120
24	100	115	144	150	174	186	198	250
25	100	123	162	168	192	186	216	268
26	110	123	162	168	192	204	216	268
27	110	123	162	168	192	204	216	268
28	120	141	180	186	228	204	234	304
29	120	141	180	186	228	240	234	304
30	130	141	180	186	228	240	234	304
31	130	159	216	222	264	240	270	340
32	140	159	216	222	264	312	270	340
33	140	159	216	222	264	312	270	340
34	140	167	252	258	300	312	306	376
35	150	167	252	258	300	384	306	376
36	150	167	252	258	300	384	306	376
37	150	185	288	294	336	384	342	412
38	160	185	288	294	336	456	342	412
39	160	185	288	294	336	456	342	412
40	160	203	324	330	380	456	378	448
41	170	203	324	330	380	528	378	448
42	170	203	324	330	380	528	378	448
43	170	211	360	396	424	528	444	484
44	170	211	360	396	424	600	444	484
45	170	211	360	396	424	600	444	484

Source: Total costs (direct cost plus opportunity cost) and incomes were reported to the author by Habiburrahman Ulfat after consultation with various officials in Afghanistan in 1967. These reported figures were altered in some cases after consultations with A. Sami and A. Mayel.

Notes: The negative figures show the total cost of education.

In years 22 and 23 adjustments are made for military service.

APPENDIX III

Possible Improvements in the Model:

The assumption of infinite elasticity of demand for labor with education up to sixth grade was discussed in considerable detail. It is the feeling of the author that the reasons given leave little room for disputing the case for universal elementary education. But for education beyond the elementary level, the infinite elasticity of demand can be justifiably questioned, not so much on the basis of diminishing marginal productivity but on the grounds of infeasibility. It will be a utopian state in which everyone who enters the first grade would go on up to college or even higher. This being the case, the model can be revised so as to overcome such a shortcoming. A series of step demand functions for the higher than elementary level of education can be incorporated into the model. This would enable the model to operate on some assumption other than the infinite elasticity of demand. As to what this specific assumption would be depends upon the nature of the economy in question. For Afghanistan, since the economy is more or less functioning on a planning basis, the manpower targets of the plan would specify the degree of elasticity of the demand functions.

BIBLIOGRAPHY

Ayers, C. E. The Theory of Economic Progress. New York: Schocken Books, Inc., 1965.

Bowles, Samuel. A Planning Model for the Efficient Allocation of Resources in Education. New York: Paper delivered to the joint session of the Econometric Society and the American Economic Association, 1965.

Dewey, John. Democracy and Education. New York: The Free Press, 1966.

Dupree, Louis. (ed.) Expectant Peoples Nationalism, and Development. New York: Vintage Books, 1967.

Griffin, W. H. "Education in Afghanistan." 1963?

Hamilton, Walton. "Institution," Encyclopedia of the Social Sciences. ed. Edwin R. A. Seligman and Alvin Johnson. VIII 1963.

The Washington Post. December 30, 1968.

Harbison, Frederick, Myers, Charles. Education, Manpower, and Economic Growth. New York: McGraw-Hill Book Co., Inc., 1964.

Marshal, Alfred. Principles of Economics. London: MacMillan and Company Ltd., 1930.

Ministry of Planning. Survey of Progress. Kabul: Government Printing Office, 1966.

Myrdal, Gunnar. Asian Drama. 3 vol; New York: Pantheon, 1968.

Schultze, Theodore. "Investment in Human Capital," The American Economic Review. March 1961.

Smith, Adams. An Inquiry into the Nature and Causes of the Wealth of Nations. New York: Random House, Inc., 1937.