Educational Expansion and Economic Growth in Developing Countries, 1960-80: An Empirical Investigation

by

Zelealem Yiheyis

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EDUCATIONAL EXPANSION AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES, 1960-80:

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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ABSTRACT

This study examines the role of education in economic growth in the context of developing countries.

Using the OLS econometric technique and cross-section data, a model, which links education with economic growth through an improvement in the productivity of labor, was estimated.

The results obtained from this empirical exercise suggest that current educational expansion and current economic growth are, at best, unrelated. On the other hand, educational expansion undertaken at least 15 years back appears to exert a positive statistical influence on current economic growth.

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Chapter I

INTRODUCTION

1.1 PURPOSE AND SCOPE

The importance of education in development has long been recognized. This recognition has led most countries, regardless of stage of development and socio-economic system, to incorporate educational expansion in the package of their development strategies. This was particularly true in the case of developing countries.

In developing countries, education received a lot more attention in the 1950's when these countries'drive for socio-economic development was incipient.[1] Education has expanded significantly since then. The expansion has been so spectacular that it is in place to ask to what extent education has helped in the development effort of these countries.

Empirical studies done on developed countries about the role of education in economic growth appear to indicate the existence of a positive relationship between education and economic growth; and the former has been regarded to have played a causal role in economic progress of these nations.[2]

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[1] World Bank. Education: Sector Policy Review. Third edition, 1980, p. 12

Nonetheless, in the case of developing countries, whether education had any positive effect on growth has not been indisputably answered, although there are studies which came up with an affirmative answer. Particularly, the rate of return to education was found to be higher in developing than developed countries.[3]

On the contrary, some skepticism has recently been expressed about the alleged growth-promoting role of education.[4] Though analyzing the impact of education on growth with the belief that it will be positive is rather an old story, investigating its effect with a suspicion about its positivity makes this research a relatively new exercise.

The purpose of the present work will be to examine the impact of education on the economic growth of developing countries in the 1960's and 1970's. The selection of this period was mainly due to a relative availability of comprehensive relevant data though the occurrence of tremendous educational expansion in developing countries has been recorded since the 1950's. Obviously, the selected period partly constitutes the era of educational expansion in developing countries.

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[2] Denison, E. F. Why Growth Rates Differ: Post War Experience in Nine Western Countries. Washington D. C. : The Brookings Institute, 1967.

[3] Ibid., P. 14.

[4] Weiler, Hans N. "Education and Development: From the Age of Innocence to Skepticism," Comparative Education, vol. 14 (October 1978).

As implied above, the choice of developing countries for this study arose mainly from the facts that:

- -the studies thus far undertaken in the same area are largely inconclusive;
- -educational expansion as an instrument of economic growth appears to have received a greater attention in these countries at least at national level;
- -over the period under study, the rate of educational expansion has been higher in this group of countries.

The study concerns itself with the quantitative aspect of educational expansion. Thus, the scope of the thesis is confined to the analysis of the impact of quantitative growth of education on the economic growth of developing countries over the period specified above.

1.2 CONCEPTS: DEFINITION AND ELABORATION

It should be clear from the foregoing that educational expansion and economic growth are the variables the study of whose relationship forms the central theme of the thesis. It is necessary, therefore, to define and clarify these variables in the context of the study.

1.2.1 Education

Education, though a widely used term, is not easily subject to being encapsulated in a single definition. The

notion of education, however, can be clarified by making reference to some of the functions it performs. Education is said to serve political, social, cultural and economic purposes.

In the sphere of politics, education is claimed to perform three main functions.

> (1) as the main agent for the political socialization of the young into the national political culture, (2) as the primary agent for the selection and training of political elites, and (3) as the main contributor to political integration and the building of national political consciousness.[5]

Education is also asserted to play a part in social reproduction, a phrase which refers to the maintenance of the existing relations of production and dominant culture and the passing of same from generation to generation, and within generation.[6]

Not only is education regarded as an instrument of political socialization and social reproduction, but it is also viewed as an agent of change and modernization. It is maintained that education exerts "an even more pervasive effect on values, attitudes and behaviour and thus acts as a key agent in the development not only of the political, but of all dimensions of modernity."[7]

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[5] Fagerlind, Ingemar & Saha, Lawerence J. Education and National Development: A Comparative Perspective. Oxford: Pergamon Press Ltd., 1983, p. 120.

[6] Datta, Ansu. Education and Society: A Sociology of African Education. New York: St.Martins Press, 1984, p. 38.

[7] Fagerlind & Saha. Op.cit., p. 97.

Through its institutional settings and trained manpower, education is asserted to advance knowledge both in theoretical and applied fields.[8]

Education is also claimed to contribute to the sustenance and acceleration of economic development. It is maintained that education, by producing skilled manpower, plays its own part in bringing about efficiency in the management of different economic activities.[9] Moreover, by enhancing the productivity of labor, education is believed to promote economic growth.

It has also been the belief of some authors that education reduces income inequality.

It should be clear by now why giving a single definition of education cannot do justice to the elaboration of the notion. As the above rundown of the functions of education indicates, education is a multi-purpose activity.

It should be noted in passing, however, that the role of education in various spheres can hardly be argued to be always positive. As Harbison notes,

> education can be either a constructive or a destructive force. It can develop people whose skills are strategic or useless for economic growth; it can help select persons for leadership roles who may promote or impose stagnation; it can favor the rich and discriminate against the poor; it can build a work-oriented or leisure-oriented mentality; it can free the mind or strangle it

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[8] World Bank. Op.cit, p. 14.

[9] Ibid., p. 13.

> with indoctrination; it can energize people or it can destroy their initiative.[10]

Having defined education by its purpose, it may be necessary to distinguish between formal and non-formal education. By formal education is meant "age-specific, full-time classroom attendance in a linear graded system geared to certificates, diplomas, degrees, or other formal credentials" as opposed to non-formal education and training which is "loosely defined as skill and knowledge generation taking place outside the formal schooling system."[11]

In the present study non-formal education is intentionally excluded. Thus, in the context of this study, by education is meant formal education. Furthermore, the study concerns itself only with second and third level education. Hence, unless stated otherwise, the term education, in the forthcoming discussions, refers to post primary levels of education.

1.2.2 Economic Growth

Despite recognition of the fact that education plays various roles in other spheres of societal life, the present study deals with education only as it relates to economic growth. It should be remembered that even if education fails to contribute to growth, it does not mean that it is a useless

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[10] Harbison, Frederick. Human Resources as the Wealth of Nations. London: Oxford University Press, 1973, p. 54.

[11] Ibid., p. 52.

undertaking in as far as there exist other functions it is believed and expected to perform.

Economic growth is usually construed to imply the quantitative aspect of economic progress as depicted by growth in GNP and other quantity-oriented indices. Some authors tend to equate economic growth with economic development.[12]

However, it is widely maintained that economic growth does not mean economic development. While economic growth refers to quantitative increments, economic development goes beyond that and encompasses change, a catchall term capturing the qualitative dimension of the development process. In this interpretation, economic development means economic growth plus change.[13]

Since the study is confined to the investigation of the impact of education on growth, other aspects of economic development such as income distribution and unemployment, though they are equally, if not more, important issues, are intentionally disregarded.

Economic growth is usually represented by the rate of increase of (per capita) national (domestic) product in constant unit of currency. However, whether the growth in (per capita) national (domestic) product can accurately reflect

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[12] Machlup, Fritz. Education and Economic Growth. Lincoln: University of Nebraska Press, 1979, p. 1.

[13] Meier, Geral M. Leading Issues in Economic Development. Fourth edition. New York: Oxford University Press, 1984, p. 6.

economic performance is open to question.

1.2.3 Developing Countries

This study adopts the conventional but arbitrary distinction between developed and developing countries. The latter group is composed of countries distinguished by a relatively lower per capita income, more variable growth rates, smaller modern and larger informal employment sectors, and other similar characteristics.[14]

Unless otherwise indicated developing countries is a generic term used in this thesis to include all countries except developed market and planned economies as well as major oil exporters like Saudi Arabia, Kuwait, United Arab Emirite, Iran and Iraq. The empirical study covers 69 developing countries.[15]

1.3 METHODOLOGY AND LIMITATIONS OF THE STUDY

The thesis basically involves an empirical research based on statistical data gathered and compiled from secondary sources. As the purpose of the thesis dictated, a model which links education to economic growth was developed and the data were assembled accordingly. In an attempt to quantify the effect of education and other explanatory variables on economic growth, the econometric technique of ordinary

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[14] Fagerlind & Saha. Op.cit., p. 72.

[15] A number of developing countries were not covered by the study by reason of paucity of required statistical information.

least squares (OLS) was employed.

The study suffers from certain limitations two of which are indicated below. First, education is expected to affect economic growth in a variety of ways: through improving the quality of labor, expediting generation and diffusion of technology, providing information and the like. The model adopted in the thesis, however, attempts to capture only that part of the effect of education on growth transmitted through the improvement of the quality of labor.

Second, the quality of education is not reflected in the model. By assuming a similar and constant or a random variation of quality across countries and over a period of time, the study deals only with the quantity of education. Since we expect growth to be affected both by quantity and quality of education, ignoring the latter can over(under)estimate the role of education.

1.4 ORGANIZATION

The thesis is organized to have six chapters including the introductory part. In the second chapter is presented a general survey of relevant theoretical and empirical studies. Special attention is given to the treatment of the impact of education on growth, and of models developed to quantify the impact. The third chapter gives an overview of the educational and economic growth efforts and achievements of developing countries between 1960 and 1980.

The fourth chapter develops the model adopted in the thesis and expounds on variable representation and problems of data measurement. The next chapter presents, validates, interprets and explains the findings of the empirical investigation. The last chapter reflects on the underlying assumptions of the model and their implications for the results obtained.

Chapter II

THE CONTRIBUTION OF EDUCATION TO ECONOMIC GROWTH: A SURVEY

This chapter briefly surveys some of the theoretical and empirical studies pertaining to the relationship between education and economic growth in general, and the causal role of education in particular.

2.1 THE IMPACT OF EDUCATION ON ECONOMIC GROWTH

There are numerous theoretical and empirical studies emphasizing the role of education in fostering economic growth. Education has long been believed to be an important instrument in the process of economic progress of both developing and developed countries.

With respect to developing countries it was noted that:

> The underdeveloped countries need high level manpower just as urgently as they need capital. Indeed, unless these countries are able to develop the required strategic human resources they can't effectively absorb capital.... The existence of such manpower, ..., is essential if the countries are to achieve a self-sustaining growth.[16]

As regards developed countries it was asserted that:

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[16] One Hundred Countries and One Quarter Billion People: How to Speed Their Economic Growth and Ours In the 1960's, p. 35, cited by Harbison, F. & Myers, C.A. Education, Manpower, and Economic Growth. McGraw-Hill Inc., 1964, pp. 16-17.

> The demand for high-talent manpower is firmly rooted in the level of technological complexity which characterizes modern social organization. In a world that is rocking with change we need more than anything else a high capacity for adjustment to changed circumstances, a capacity for innovation.... Only high ability and sound education equip a man for the continuous seeking of new solutions.[17]

The effect of education on economic growth can be studied, at a cost of generalization, in three ways. The first refers to the effect of education on labor and thereby on economic growth while the second way relates education to economic growth via the impact of the former on technological innovation, diffusion and preservation. The third link between education and economic growth is the information-providing role of education.

2.1.1 Education's Role of Improving the Quality of Labor Input

Much of the literature on the relationship between education and economic growth connect the two variables under study through some kind of improvement in the quality of labor.

Before presenting different views as espoused by various approaches, I will advance part of the summary given by Machlup as regards the impact of education on labor input. Machlup identifies several factors that account for an increase in national product of which the use of better labor is asserted to be more significantly affected by edu-

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[17] Excellence: Can We Be Equal and Excellent Too? pp.34-35, cited by Harbison & Myers. Op.cit., P. 17.

cation. The author lists five processes through which the quality of labor can be improved as a consequence of education.

> (a) better working habits and discipline, increased labor efforts, and greater reliability; (b) better health through more wholesome and sanitary ways of living; (c) improved skills, better comprehension of working requirements, and increased efficiency; (d) promotes adaptability to momentary changes, especially in jobs which require quick evaluation of new information and in general, fast reactions; and (e) increased capability to move into more productive operations when opportunities arise.[18]

For a systematic presentation of the arguments that education contributes to economic growth via non-quantitative increase in labor input, several approaches will be considered.

2.1.1.1 The Human Capital Theory

The human capital theory is by and large an application of the neo-classical capital theory to the analysis of human capital. In the economics profession the study of the economic importance of education tends to be dominated by human capital theory.

The concept of human capital finds its origin in the works of 17th century economists. One of the former economists who attempted to estimate the money value of human beings was Sir William Petty (around 1691) for whom labor was a "father of capital".[19] Adam Smith who included the

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[18] Machlup, Friz. Op.cit. pp. 7-8.

useful abilities and skills of the population in the category of fixed capital argued:

> The acquisition of such talents, by the maintenance of the acquirer during his education study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise of that of the society to which he belongs.[20]

While some of the former economists regarded human beings as capital, others included only the skills and abilities of people in the category of capital. J. S. Mill, for example, argued:

> The human being himself I do not class as wealth. He is the purpose for which wealth exists. But his acquired capacities, which exist as a means, and have been called into existence by labor, fall rightly,..., with in that designation.[21]

The contrast of the above argument was made by McCullock who asserted that:

> Instead of understanding by capital all that portion of the produce of industry extrinsic to man, which may be made applicable to his support, and to the facilitating of production, there doesn't seem to be any good reason why man himself should not, and very much be considered as forming a part of the national capital.[22]

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[19] Kiker, B. F. "The Historical Roots of Human Capital," Human Capital Formation and Manpower Development. Ed. Ronald Wykstra A. New York: Free Press, 1971, p. 3.

[20] Adam Smith, An Inquiry In To The Wealth of Nations, p.265-266, cited by Harbison & Myers. Op. cit., p.3.

[21] Kiker, B. F. Op. cit., pp 8-9, citing Mill, John Staurt. Principles of Political Economy, p. 47.

[22] Kiker, B. F. Op. cit., pp.8-9, citing McCulloch, J. R. The Principles of Political Economy, p. 66.

In present day usage, by human capital is meant "the abilities and know-how of men and women that have been acquired at some cost and that can command a price in the labor market because they are useful in the productive process."[23]

The basic proposition of human capital theory is that "people enhance their capabilities as producers and as consumers by investing in themselves."[24] Investment in human capital takes various forms. Investments made in the areas of education, on-the-job training, migration, job search, medical care, etc., are, in the main, regarded as investments in human capital. In short, human capital is the economists' jargon that alludes to the economic aspect of human resoures.

Though, as noted above, the notion of human capital goes as far back as the 17th century, its systematization as a theory did not gain momentum until the early 1960's. The human capital theory is claimed to have filled a gap in economic analysis since it presumably "offered a unified explanation of empirical phenomena which had either being given ad hoc interpretations or had baffled investigators."[25]

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[23] Parnes, H. S. People Power: An Element of Human Resource Policy. Beverly Hills: Sage Publications, 1984, p. 32.

[24] Schultz, Theodore W. "Reflections on Investment in Man," Journal of Political Economy, vol. 70 (Supplement: October 1962), p. 1.

[25] Becker, Garry S. "Investment in Human Capital: A Theoretical Analysis," Journal of Political Economy, vol. 70 (Supplement: October 1962), p. 10.

The theory of human capital asserts that education promotes economic growth. Schultz hypothesized and argued that the rise in the stock of human capital was responsible for much of the unexplained economic growth in the U.S. In his own words:

> What is that we have been doing that has given us a rate of economic growth that is three times as large as the rate of increase of labor and capital? My hypothesis is that the explanation is to be found in the large and rapid accumulation of human wealth that is being excluded from our conventional measures of 'manhours worked' and of tangible capital.[26]

The human capital theory postulates that education imparts cognitive skills which result in the enhancement of the productivity of an individual. Nelson and Phelps interpret the essence of this postulate to mean that "education enhances one's ability to receive, decode, and understand information, and that information processing and interpretation is important for performing or learning to perform many jobs."[27]

In the standard human capital theory the link between education and economic growth is the augmentation of labor productivity while the connection between the latter and education is the transmission of cognitive skills.

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[26] Schultz, T. W. "Investment in Man: An Economist's View," Readings in the Economics of Education. Ed. UNESCO, 1968, P. 73.

[27] Nelson, R. R. & Phelps, E. S. " Investment in Humans, Technological Diffusion, and Economic Growth," American Economic Review, vol. 56 (May 1966), p. 69.

2.1.1.2 Modernization Theory

Modernization theory in the context of the relationship between education and economic growth represents the views of sociologists. Modernization, for all the disagreement on what it really means, may generally be conceptualized as "the liberation of human population from the environmental, political and cultural constraints which place obstacles to its freedom to choose its destiny."[28]

This theory postulates that for a society to be modernized it should be composed of a population with modern beliefs, values and behaviour.[29] A study undertaken on modernization of six countries concluded that:

> Mounting evidence suggests that it is impossible for a state to move into the 20th century if its people continue to live in an earlier era.... Modern institutions need individuals who can keep to fixed schedules, observe abstract rules, making judgements on the basis of objective evidence, and follow authorities legitimated not by traditional or religious sanctions but by technical competence. The complex production tasks of the industrial order, which are the basis for modern social systems also make their demands. Workers must be able to accept both an elaborate division of labor and the need to coordinate their activities with a large number of others in the work force.[30]

Authors in this persuasion hold the view that modernization is a pre-condition for socio-economic development. Education as one of the agents for modernization is believed to influence the values, beliefs and behaviour of people in

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[28] Fagerlind & Saha Op. cit., p. 93.

[29] Ibid., p. 48.

[30] Ibid., P. 46, citing Inkeles & Smith, pp. 3-4.

a pattern consistent with the requirement of a modern society. In this view, education contributes to economic growth through its impact on modernization which is said to exert a positive effect on the productivity and work efficiency of the population.

2.1.1.3 Socialization Theory

This view, which, I suppose, can be construed as an aspect of modernization theory, hypothesizes education to play a socializing role. It is argued that education, when it is broadly based, makes workers flexible and causes a smooth shifting of workers from one job and industry to another.[31] Miller argues : "The educational system is a means of social mobility: through it people may move from lower to higher socio-economic groups, from where they are less needed to where they are more useful."[32]

It is also thought that education "socialize[s] workers and technicians to their work roles, and ...socialize[s] the population at large to demand and accept the social changes involved in economic development."[33]

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[31] Nelson, Richard R. "Research on Productivity Growth and Productivity Differences: Dead Ends and New Departures," Journal of Economic Literature, vol. 19 (September 1981), p. 1055.

[32] Miller, William. "Education as a Source of Economic Growth," Journal of Economic Issues, vol.1 (December 1967), p. 281.

[33] Meyer, John W. et al. "National Economic Development, 1950-70: Social and Political Factors," National Development and the World System. Ed. John Meyer & Michael Hannan, Chicago: The University of Chicago Press,1979,

2.1.2 Education and Technological Innovation and Diffusion

Beside its impact on labor, education, it is claimed, redounds to economic growth through its role in innovation and technological diffusion. Education is held to aid the increase and preservation of technological knowledge.[34] Moreover, it is one of the tools whereby the accumulated knowledge and information are disseminated.

Nelson and Phelps suggest that:

> In a technologically progressive or dynamic economy, production management is a function requiring adaptation to change and that the more educated a manager is, the quicker will he be to introduce new techniques of production....[E]ducated people make good innovators, so that education speeds the process of technological diffusion.[35]

In substantiating their argument the authors refer to technological diffusion both in agricultural and industrial sectors. In the case of agriculture, for example, it is maintained that:

> The better educated farmer is quicker to adopt profitable new processes and predicts since, for him, the expected pay off from innovation is likely to be greater and the risk likely to be smaller; for he is better able to discriminate between promising and unpromising ideas, and hence less likely to make mistakes. The less educated farmer, for whom the information in technical journals means less is prudent to delay the introduction of a new technique until he has a concrete evidence of its profitability, like the fact that his more educated friends have adopted the technique with

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p.87.

[34] Miller, W. Op. cit., p. 282.

[35] Nelson & Phelps. Op. cit., p. 70.

success.[36]

It is also contended that "the heart of the whole process of industrialization and economic development is intellectual: it consists in the acquisition and application of a corpus of knowledge concerning technique, that is, ways of doing things."[37]

Easterlin, basing his argument on the preceding quotation and the then current economic and technological phenomena, came to surmise that "explanation of the limited spread of modern economic growth turns into a question of identifying the factors that have constrained the dissemination of a new type of knowledge-that of modern technology."[38]

If technological diffusion implies economic growth and if educational expansion results in the acceleration of the dissemination of knowledge and of technological diffusion, then, this vein of thought also purports to support the claim that economic growth is a function of education.

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[36] Ibid.

[37] Easterlin, R. A. "Why is not the Whole World Developed?" The Journal of Economic History, Vol. 41 (March 1981), p. 2.

[38] Ibid., p. 4.

2.1.3 Education's Role in Providing Employers with Information

Education as a signal or a source of information for employers is espoused by one of the versions of the screening hypothesis. In this view, employers are assumed to have imperfect information about the productivity and ability of their prospective employees.[39] That is, as "cognitive skills are largely acquired on the job training, ..., employers are ...fundamentally concerned with selecting job applicants in terms of their trainability."[40] Therefore, the educational system is viewed as one of the sources of information regarding the trainability and potential productivity of job applicants.

Stiglitz advances four reasons why provision of information about individual abilities is made by educational institutions. Three of his justifications are cited below.

> The efficient allocation of scarce educational resources requires the identification of different individual's abilities,...
> with a given educational level there are returns from recognizing that some individuals learn certain skills faster than others,...
> In the interchange between teacher and student...the teacher obtains a great deal of information about his student.[41]

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[39] Arrow, K. J. "Higher Education as a Filter," Journal of Public Economics, Vol. 2, p. 194.

[40] Blaug, Mark. "The Empirical Status of Human Capital Theory: A Slightly Jaundiced Survey," Journal of Economic Literature, Vol. 14 (September 1976), p. 84.

[41] Stiglitz, Joseph E. "The Theory of 'Screening', Education, and the Distribution of Income," The American Economic Review, Vol. 65 (June 1975), p. 293.

The author regards the educational system as the major screening institution because the information to be furnished is "a natural by product of its principal activity of providing knowledge...and guiding individuals into the right occupations."[42] He argues that "screening has productivity returns "up to a certain point beyond which "increases in educational expenditure may...decrease net national income."[43] Education, therefore, contributes to economic growth by providing employers with a selection device.

2.2 QUANTIFYING THE CONTRIBUTION OF EDUCATION TO ECONOMIC GROWTH

Much effort has been made by economists to quantify the contribution of education to economic growth. From these efforts have emerged a number of measurements a partial presentation of which constitutes the purpose of this section.[44]

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[42] Ibid., p. 294.

[43] Ibid., p. 299.

[44] In outlining the measurement procedures of different approaches, notations used in the original sources are altered in certain cases. Through out the thesis, unless the context requires otherwise, < > denotes letter subscripts, a prime after a variable denotes first derivative of a variable with respect to time, and ** indicates exponentiation.

2.2.1 The Growth Accounting (Residual) Approach

This approach deals with the determination of what proportion of the GNP is attributable to measurable inputs (capital and labor) and other unspecified inputs. The growth in GNP is not accounted for only by increments in capital and labor. There is unexplained portion of GNP (residual) for which an explanation has been incessantly sought.

The growth accounting approach is based on and utilizes a production function for determining the contribution of measurable and other unspecified inputs. This approach has a number of variants some of which are outlined below.

2.2.1.1 Schultz's Method

Schultz included education in the production function in the following way.[45]

$$Y = F(K, L, rK<e>)$$

where

Y = an index of output

K = an index of capital

L = an index of labor

K<e> = the educational capital stock in the economy

r = predetermined rate of return on that capital

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[45] As summarized by Psacharopoulos, George. "Measuring the Marginal Contribution of Education to Economic Growth," Economic Development and Cultural Change, vol.20, No. 4, 1972, p. 643.

In this specification education is treated as an intermediate good which involves cost of production. His method is contrived to compute the resource cost of the stock of education "and extrapolate the contribution of education to total product by inputting a value of the flow of services from that stock."[46]

For a two year period, for example, the evaluation of the stock of education is made as follows.

Let

V_0 = the resource cost of the stock of education in the initial period,

V_1 = the resource cost in subsequent period.

Then $V_1 - V_0$ gives the actual increase in the total value of the stock of education.

Suppose that education is purely an investment good. Then, the return per dollar of educational capital is the market rate of return. The annual contribution of the additional stock of capital will be:

$$r\ (V_1 - V_0)$$

Assume that the proportional contribution of labor (S<n>) to total product is constant over time. Then the labor share's of income attributable to increasing the total stock of education becomes:

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[46] Plant, Mark & Welch, Finis. "Measuring the Impact of Education on Productivity," Education and Economic Productivity. Ed. Dean, Edwin. Cambridge, Mass. : Ballinger Publishing Company, 1984, p. 180.

$$\frac{r\ (V_1 - V_0)}{S<n>\ (Y_1 - Y_0)}$$

The proportion of share of labor due to educational expansion per person will be:

$$\frac{r\ [V_1 - (1 + N')\ V_0]}{S<n>\ (Y_1 \_ Y_0)}$$

Where

N' = The growth in labor force

$(1+N')\ V_0$ = the value of the stock of education in the subsequent period with per capita value held constant.

The contribution of an increase in the stock of education to the rise in total output is given by:

$$\frac{r[V_1 - (1+ N')V_0]}{Y_1 - Y_0}$$

$r\ V_1$ is the output that was caused by the actual education capital while $r\ (1 + N')V_0$ "is the output that would have been produced had the per capita 'amount 'of education remained constant."[47]

2.2.1.2 Denison's Variant

Denison measured the quality of labor by using income differentials of labor with different levels of schooling. According to Psacharopoulos, Denison's production function would have been:[48]

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[47] Ibid., p. 182.

[48] Psacharopoulos, G. Op. cit., p. 644.

$$Y = F[K, L, L<h> (W<h> - W<h-1>)]$$

where:

h = level of schooling

W = wage

2.2.1.3 Selowsky's Method

Selowsky specifies a production function of this form.[49]

$$Y = F[K, L_0, .., L<n>)$$

where:

$L_0, L_1, .., L<n>$ = man-hour inputs of labor with 0, 1, ..., n years of schooling respectively.

Selowsky by:

-differentiating the production function with respect to time;

-assuming that wages reflect marginal productivity; and

-introducing a residual variable;

obtains a relative growth rate in GNP which can be written as:

$$Y'/Y = AK\ K'/K + (AB + AE)\ L'/L + AL\ Q'/Q + R$$

where

AB = the share of uneducated component of labor

AE = the share of "educational inputs"

AB + AE = the share of labor in total output

Q'/Q = the relative change in an index of the quality of the labor force

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[49] Selowsky, Marcelo. "On the Measurement of Education's Contribution to Growth," Quarterly Journal of Economics, Vol. 83, 1969, pp. 450-451.

R = a residual representing the contribution of other factors to the growth rate in GNP.

Selowsky employing this growth accounting formula and assuming constant relative wage (infinite elasticity of substitution) found the contribution of education to growth to be 6.8, 2.5 and 12.9 percent for Chile, Mexico and the U.S.A., respectively, between 1960 and 1964.[50]

2.2.1.4 Psacharopoulos's Method

Psacharopoulos starts with a production function of the following kind.[51]

$$Y = F(K, L_h)$$

$$h = 0, 1, 2, \ldots$$

where L is an index of labor with education level h. Transforming the above into a growth equation he gets:

$$g_Y = INR\ F_k + g_h\ S_h + R$$

where

g_y = average annual rate of output growth

INR = the investment-output ratio

F_k = the marginal product of capital

S_h = the effects of changes both in the number and and quality of workers

$\langle h \rangle$ = the share of labor of educational level h in national income

R = the residual

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[50] Ibid., p. 458 & p. 460.

[51] Psacharopoulos, G. Op. cit. p.644.

To distinguish between the effects of the two changes mentioned, the author classifies the total labor employed in the economy into three skill categories:

h = 0, labor with zero year of schooling

h = 1, elementary school graduates

h = 2, high school graduates

The total contribution of labor can be written in the form:

$$g_0 s_0 + g_1 s_1 + g_2 s_2$$

or

$$g_0 \frac{L_0 F_0}{Y} + g_1 \frac{L_1 F_1}{Y} + g_2 \frac{L_2 F_2}{Y}$$

where

g<h> = growth rate of labor with h educational level

F<h> = the marginal product of labor.

By assuming equality of the marginal productivity and wage, i.e., Fh = Wh, and by making certain substitutions and rearrangements, the author derives a growth equation from which the contribution of change in quantity and quality of labor can be distinguished.

Psacharopoulos, applying this method to Hawaiian economy between the years 1950 and 1960 estimated the contribution of the quality of labor to growth at 31.27 and 16.11 percent for unadjusted and adjusted income differentials, respectively.[52]

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[52] Psacharopoulos, G. Op. cit., p. 652 & p. 654.

2.2.1.5 Jorgenson's Method

This method using an aggregate production function assigns the growth of output "between the contributions of capital and labor inputs and changes in the level of technology."[53] Labor is represented in the production function by types of labor input cross-classified on the basis of demographic, occupational and educational characteristics such as age, sex, employment status, occupation and education.

The growth of the quality of labor input is then assigned "among the contributions of the labor force by characteristics of individual workers."[54] By so doing the method attempts to distinguish between the contributions to economic growth of education and other changes in the composition of the labor force. Utilizing this method and U.S. data between 1948 and 1973, Jorgenson found the contribution of education to be considerable, "accounting for about half of the increase in the quality of labor input."[55]

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[53] Jorgenson, Dale W. "The Contribution of Education to U.S. Economic Growth, 1948-73," Education and Economic Productivity. Ed. Edwin Dean, Cambridge, Mass. : Ballinger Publishing Company, 1984, p. 96.

[54] Ibid., p. 97.

[55] Ibid., p. 118.

2.2.2 The Direct Returns Approach

This approach consists in the calculation of the difference between the life time earnings of people with different levels of education. Once the difference is found it is expressed as "an annual percentage rate of return on the costs involved in obtaining the education."[56]

The earnings function can be written as[57]

$$\log Y = X_0 + r_1 S + r_2 t + r_3 t^2 + Z<i>$$

where

Y = earnings

S = years of schooling

t = experience (post-school investment in human capital)

r = rate of return

X_0 = amount of earnings irrespective of schooling

$Z<i>$ = other factors

t^2 = t squared

The sign of r_3 is held to be negative.

The direct returns approach can be viewed both from private and national perspective.[58] From an individual point of view, earnings differentials are associated with different levels of education and they show the amount of personal

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[56] Bower, W. A. "Assessing the Economic Contribution of Education," Education: Structure and Society Selected readings. Ed. B. Cosin, Penguin Books in Association with The Open University Press, 1972, p. 23.

[57] Addison, J. T. & Sibebert, W. S. The Market for Labor: An Analytical Treatment. Goodyear Publishing Company,Inc.,1979,p. 131.

[58] Bower, W. Op. cit.

financial gain that can be derived from a given level of human capital investment.

Nationally, earnings differentials explained by education are regarded as reflections of the effect of education on the output of the economy, assuming that earnings reflect productivity. To reiterate, the link between earnings differential and economic growth is the assumed connection between earnings and productivity as well as between the latter and education.

2.2.3 The Producer's Surplus Approach

This approach rejects the growth accounting concept of measuring the marginal contribution of education. It proposes measuring the inframarginal contribution, since the marginal contribution, it claims, is by definition zero.

It is maintained that the application of growth accounting methods to the measurement of the contribution of intermediate inputs will yield zero net contribution of the inputs. Furthermore, it is argued, if efficient allocation of resources exists, i.e., in this case, if marginal productivities in different uses are equal, "the contribution of the last worker educated is zero."[59]

According to this approach, the contribution of education to economic growth can be correctly measured as the difference between "the amount of output that actually is pro-

[59] Plant & Welch. Op. cit., p. 172.

duced ...[and] the output level that would have been chosen had none of the additional resources been allocated to the education sector."[60]

The producer's surplus approach adopting education as an intermediate input evaluates the inframarginal contribution of education by introducing shadow prices in its estimation procedure.

Plant and Weltch quantified the contribution of increased stock of education in the U.S. to be 26.2 percent.[61]

2.2.4 The Simple Correlation and Regression Approach

The basic intent of this approach is to correlate education and economic growth and to regress the latter on the former and other relevant explanatory variables over a period of time and across countries.

Harbison and Meyers, for example, reported a very high positive correlation coefficient (0.89) between a composite index of education and GNP per capita in U.S. dollars in 75 developed and developing countries.[62]

McClelland, classifying 28 developed and developing countries according to their economic level on the basis of electricity production and using a median years of secondary

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[60] Ibid. p. 174.

[61] Ibid., p. 188.

[62] Harbison & Myers. Op. cit., p. 40.

schooling per 10,000 inhabitants as an index of education, found a fairly strong relationship between the two variables. The author reported that "the better educated countries in 1950 ... developed faster in the 1952-58 period at nearly every level, and the overall trend was highly significant."[63]

A study on developing countries carried out by D. Wheeler employing econometric technique estimated an augmented production function in which adult literacy was included to represent education. His basic model takes the following form.[64]

$$q' = a_0 + a_1 k' + a_2 l' + a_3 h' + a_4 e' + a_5 n' + u$$

where

q' = change in output

k' = change in capital

l' = change in labor force

h' = change in health status

e' = change in education

n' = change in nutrition

u = a random error term

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[63] McClelland, David C. "Does Education Accelerate Economic Growth?", Economic Development and Cultural Change, Vol. 20, No. 4, 1972, p. 266.

[64] Wheeler, David. Human Resource Policies, Economic Growth, and Demographic Change in Developing Countries. Oxford: Clarendon Press, 1984.

The estimation of his model using both a single and simultaneous equation techniques and both for a closed and an open economy showed that education has a positive impact on economic growth in developing countries.

An aggregate production function modified to include the enrollment ratio was also estimated for market economies by Assaf Razin.[65] The model estimated was derived from a production function which relates output to capital stock, labor and its quality.

Thus,

$$Y<t> = F(K<t>, A<t> L<t>)$$

where

Y = national product

K = aggregate capital stock

A = quality index of labor

L = labor force

t = time

The author postulates the quality of labor to be an increasing function of the economically active population[66] engaged in schooling. Using Euler's theorem and making certain substitution and differentiation, the author derived the following estimable equation.

$$y'/y = a_0 + a_1 K'/Y + a_2 S + a_3 N'/N$$

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[65] Razin, Assaf. "Education and Economic Growth: A New Evidence," Economic Development and Cultural Change, vol. 25, 1976-77.

[66] The author defines economically active population to be either productive or educational.

where

y'/y = the proportionate rate of per capita GNP

K'/Y = investment-output ratio

S = enrollment in second and third level schooling

N'/N = the proportionate rate of population growth

During estimation S was represented by second level enrollment ratio and was logged and found to have significant statistical influence on the growth of per capita GNP in 11 developed market economies between 1953 and 1965.

It should be noted at this juncture that the studies conducted to quantify the contribution of education both in developed and developing countries are too numerous to outline them all. The studies described above support the argument that education plays a causal role in economic growth. But there are other studies which strongly question this conclusion particularly in the case of developing countries. A study conducted by H. Correa, for example, concluded that the percentage contribution of education in Latin American countries covered in his study (except in Argentina) was low.[67] Another study undertaken on Greek data by Samuel Bowles showed that the contribution of education to Greek economic growth was virtually zero.[68]

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[67] Correa, Hector. "Sources of Growth in Latin America," Southern Economic Journal, Vol. 37(July 1970), pp. 17-31.

[68] Bowles, S. "Sources of Growth in the Greek Economy: 1951-1961," cited by Sherman, Robinson. "Sources of Growth in Least Developed Countries," Quarterly Journal of Economics, Vol. 85, 1971, p. 405.

Chapter III

EDUCATIONAL AND ECONOMIC GROWTH: BACKGROUND INFORMATION

In this chapter will be briefly described the educational and economic growth efforts and performance of developing countries between 1960 and 1980.

3.1 EDUCATIONAL EXPANSION

Developing countries have experienced a considerable educational expansion in the past several decades. The extent and the rate of expansion may be assessed using various educational performance indicators such as enrollment ratio, financial commitment, literacy rate, employment in the education sector, graduate output, etc. A brief assessment, on the basis of some of the aforesaid indicators, and a brief investigation of the causes of educational expansion will be the object of this section.

3.1.1 Assessing Educational Expansion

Enrollment

The number of students enrolled in educational institutions of developing countries has increased enormously over the two decades. This is manifest from the table provided below.[69]

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[69] The information contained in the Tables of subsection

TABLE 1

Enrollment by Level of Education in Developing Countries, 1960-80

Level of education	Year and enrollment('000)			Average annual growth rate (%)	
	1960	1970	1980	1960-70	1960-80
First	120,537	202,037	297,647	5.3	8.1
Second	23,451	54,118	97,783	8.7	6.1
Third	2,597	7,038	15,960	10.5	8.5

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

Out of the 264.8 million increase in overall enrollment in developing countries between 1960 and 1980, 177.1 million were additionally enrolled students in first level education. Enrollment at this level rose by 141 percent over the same period.

In the 1960's first level enrollment grew at an average annual rate of 5.3 percent and this rate reached 8 percent in the 1970's. Over the two decades second-level enrollment tripled. Unlike first level education, the growth rate of second level enrollment in the 1970's was found to be lower than that registered in the 1960's.

In twenty years the number of students enrolled in third-level educational institutions of developing countries increased by 13.4 million, a 515 percent increase. The rate of expansion of third level education exhibits a pattern

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3.1.1 refers to all developing countries except China and Peoples's Democratic Republic of Korea.

similar to second-level education. Both in the second and third levels of education, the average annual growth rate of enrollment tended to fall off in the 1970's. An examination of the percentage distribution of enrollment across levels

TABLE 2

Percentage Distribution of Enrollment Across Levels of Education, 1960-80

Year	Levels of education		
	First	Second	Third
1960	82.2	16.0	1.8
1970	80.0	17.8	2.2
1980	72.4	23.7	3.9

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

of education reinforces this finding.

As can be seen from Table 2, over the two decades the share of first level education in the total enrollment declined by 9.8 percentage points while the proportion of second and third level enrollment increased by 7.7 and 2.1 percentage points, respectively.

A comparison of enrollment figures of developing and developed countries[70] indicates that developing countries have experienced a higher rate of educational expansion.

[70] In this chapter, the compilation of data requires developed countries to be defined to include all European countries, U.S.S.R., U.S.A., Canada, Japan, Israel, Australia, New Zeland and South Africa.

TABLE 3

Total Enrollment in Developed and Developing Countries, 1960-80

Group of Countries	Year and enrollment('000)			Average annual growth rate(%)	
	1960	1970	1980	1960-70	1970-80
Developing	146,585	263,193	411,389	6.0	4.6
Developed	180,523	227,072	233,363	2.3	0.3

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

As Table 3 indicates, the number of students in the school system has increased more considerably in developing than developed countries. Between 1960 and 1980, the student population in developing countries rose by 180 percent as compared to a 29 percent increase in developed countries.

Both in the 1960's and the 1970's developing countries showed a higher average annual growth rate in enrollment than the developed nations. However, both groups exhibited a similar pattern in terms of the average annual growth rate in the 1960's and 1970's. In both groups of countries, the average annual growth rate slackened in the 1970's.

According to enrollment figures provided above, developing countries not only experienced a tremendous educational expansion but also at a higher rate than developed nations. Nonetheless, making a comparative analysis, which, of course, is not the major task of this section, and measuring

educational expansion on the basis of enrollment figure alone may lead to wrong conclusions.

Evidently, enrollment is significantly influenced by demographic factors. As is well known, demographic characteristics of developing countries are different from those

TABLE 4

Average Growth Rate of Total and Young (0-24 Years of age) Population in Developed and Developing Countries, 1970 and 1980

Country group	A.A.G R. of total pop.(%)	A.A.G.R. of young pop.(%)	Young pop. as % of total pop.	
	1970-80	1970-80	1970	1980
Developed	0.9	0.1	39.9	40.4
Developing	2.3	2.0	48.6	59.4

Source: Computed from UNESCO, Statistical Year book, 1983.

of developed ones.

As can be inferred from Table 4, the rate of growth of population is higher in developing than developed countries. Not only is the growth rate of population higher in developing countries, but also the proportion of the young population is bigger. In 1970, the percentage of the population aged 24 and under was 48.6 and 39.9 in developing and developed countries, respectively. These figures correspondingly changed to 59.4 and 40.4 in 1980. In both years the propor-

tion of the population which belongs to the youth age cohort is higher in developing than developed countries. Moreover, this proportion has increased in developing nations more than 10 percentage points as compared to developed countries where the percentage remained almost unaltered.

The difference in groups of countries and the change over time in the age composition of the population has dire implications for enrollment. A recognition of the possible impact of demographic factors on enrollment renders the latter an inadequate and questionable indicator of educational expansion of a given country, and a misleading yardstick for making a comparative analysis across various countries. To take care of this bias of demographic effects, one has at least to standardize enrollment for the relevant population age group. This process yields the so-called enrollment ratio.

Enrollment Ratio

UNESCO distinguishes between gross and net enrollment ratio. Gross enrollment ratio is defined as "the total enrollment of all ages divided by the population of the specific age groups which correspond to the age groups of primary and secondary schooling."[71] The net enrollment ratio, on the other hand, refers to a ratio computed "by using only that part of the enrollment which corresponds to the age groups of primary and secondary schooling."[72] Enrollment ratio of

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[71] UNESCO. Statistical Year Book, 1978-79, p. 95.

third-level education is calculated as a ratio of enrollment at third level to the population aged 20 to 24, inclusive.

As the definition accorded above implies, gross enrollment ratio in the first and second levels of schooling is arrived at by dividing the number of students by the official school age population. Consequently, "for countries with almost universal education among the school age population at the first level, the gross enrollment ratio will exceed 100 percent if the actual age distribution of pupils spreads over outside the official school ages."[73]

Since information on net enrollment ratios is less available than gross enrollment ratios, the latter will be adopted as an indicator for enrollment standardized for the relevant age group.

It is apparent from the figures given below that enrollment ratio at all levels of education increased by 17.1 percentage points between 1960 and 1980.

One would expect the immediate effect of the growth of young population to rest on primary enrollment. However, after standardizing for the relevant school age population, we observe a considerable enrollment expansion as evidenced by the rise of enrollment ratio by 25.7 percentage points between 1960 and 1980. Enrollment ratio at second and third

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[72] Ibid.

[73] Ibid., p. 96.

TABLE 5

Gross Enrollment Ratios in Developing Countries by Level of Education, 1960-80

Level of education	Year			Change		
	1960	1970	1980	1960-70	1970-80	1960-80
First	60.2	74.1	85.9	13.9	11.8	25.7
Second	12.7	22.0	31.2	9.3	9.2	18.5
Third	2.0	4.3	7.4	2.3	3.1	5.4
All levels	29.1	39.0	46.2	9.9	7.2	17.1

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

levels of education increased by 18.5 and 5.4 percentage points, respectively.

The pattern of increase in enrollment ratio in the 1960's and 1970's is similar in first and second levels of schooling. The 1970's are characterized by a slackening of the enrollment ratio at pre-tertiary levels of education. Third-level education exhibits a different trend in that the increase in enrollment ratio in the period 1970-80 exceeded that of the 1960's.

By way of comparison, one can mention that the increase in enrollment ratio is a lot higher in developing countries over the two decades.

As Table 6 shows, over twenty years under study, enrollment ratio rose by 17.1 and 8.7 percentage points in developing and developed countries, respectively. In both coun-

TABLE 6

Gross Enrollment Ratios in Developing and Developed Countries, 1960-80

Country group	Year			Change		
	1960	1970	1980	1960-70	1970-80	1960-80
Developed	65.1	71.6	73.8	6.5	2.2	8.7
Developing	29.1	39.0	46.2	9.9	7.2	17.1

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

try groups, the 1960's saw a higher increase in enrollment ratio than the 1970's. The slackening of the increase in enrollment ratio in the 1970's was more considerable in developed than developing countries.

Both enrollment and enrollment ratio bear the same fact. Even after demographic factors are taken into account, developing countries still have a higher rate of educational expansion. The higher growth rate of population recorded in developing countries has not offset the growth rate of enrollment. This indicates that enrollment expansion in developing countries was not a mere function of the population explosion.

Financial Commitment

Another way of assessing the extent of educational expansion is examining the financial commitment made to the education sector. Although resources devoted to education originate both from the public and private sectors, since the bulk of

educational expenditure in developing counties is financed by the public sector and since information on the latter is relatively readily available, public expenditures will be considered in evaluating financial outlay to the education sector.

Between 1965 and 1980, public expenditure on education in developing countries increased at a higher rate than GNP. The proportion of GNP devoted to education rose from 2.9 percent in 1965 to 4 percent in 1980.[74] By way of comparison, one can state that over the same period the percentage of GNP spent on education in developed countries increased from 5.1 to 6.1.

Table 7 discloses that the average annual growth rate of public expenditure on education over the 15 year period ranged between 5.3 (Honduras) and 14.8 (S. Korea). The mean for all countries indicated in the Table stood at 9.3 percent. Over the same period, these countries on the average enhanced their financial commitment to education by 314 percent.

Education absorbed an average of 2.4 percent of GNP in 1965 in the eight countries. The share of educational expenditure in GNP ranged from 0.8 percent (Afghanistan) to 4 percent (Algeria). The average proportion of GNP spent on education increased to 4.2 percent in 1980.

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[74] UNESCO. Statistical Year Book, 1983.

TABLE 7

Public Expenditure on Education in Selected Countries, 1965 and 1980

Country	Average annaul growth rate (%)	Educational expd. as % of GNP		Educational expd. as % of All public exp.	
	1965-80	1965	1980	1965	1980
Afghanistan	6.5	0.8	2.0	11.2	12.7
Ethiopia	9.8	1.3	3.3	8.8	10.4
Sudan	7.5	2.7	4.8	15.8	9.1
Honduras	5.3	2.9	3.2	27.2	15.0
Bolivia	7.6	2.6	3.6	24.7	25.3
S. Korea	14.7	1.8	4.0	17.2	14.1
Syria	11.1	2.9	4.6	12.4	8.1
Algeria	12.0	4.0	8.3	14.8	24.3
Mean	9.3	2.4	4.2	16.5	14.9

Source: Computed from
UNESCO, Statistical Year Book, 1978-79 & 1983.

The last two columns of Table 7 furnish us with information regarding the relative position of education in the set of public expenditure items. The share of education in public expenditure ranged from 8.8 percent (Ethiopia) to 27.2 percent (Honduras). In the same year, education on the average absorbed 16.5 percent of public budget. This share, however, appears to have declined to 14.9 percent in 1980.

Once again, the financial commitment information corroborates the conclusion drawn from the analysis of the preceding indices that developing countries experienced a considerable educational expansion between 1960 and 1980.

Teaching Staff

The growth of teaching staff can be viewed as an indication of educational expansion, since one of the basic requirements for the operation of the educational system is the availability, both in quantity and quality, of teachers. By virtue of lack of information on quality of teaching staff, only the quantity aspect will be considered nonetheless.

Between 1960 and 1980, the teaching staff at all levels of education increased by 9.8 million. The average annual

TABLE 8

Teaching Staff in Developing Countries by Level of Education, 1960 and 1980

Level of education	Year and teaching staff('000)		Average annual growth rate(%)
	1960	1980	1960-80
First	3,339	8,600	4.8
Second	1,225	4,839	7.1
Third	164	1,086	9.9
All levels	4,728	14,525	5.8

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

increase has been 5.8 percent.

According to Table 8, institutions of third level education employed teachers at a higher rate than the other two levels.

TABLE 9

Percentage Distribution of Teaching Staff Across Levels of Education, 1960-80

Level of education	Year		
	1960	1970	1980
First	76.7	63.1	59.2
Second	20.6	31.6	33.4
Third	2.7	5.3	7.5

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

It is clear from Table 9 that the percentage of teaching staff in the first level education has declined over time whereas that of second and third levels has risen. Between 1960 and 1980 the percentage of teaching staff engaged in first level education dropped by 17.5 points while that of second and third level rose by 12.8 and 4.8 points, respectively. The pattern of teaching staff distribution is congruent with that of enrollment distribution presented in Table 2 .

In comparison to developed countries, it may be mentioned that, over the same period, the teaching staff in developed countries grew at an average annual rate of 3 percent.

To summarize, on all grounds and by all measures, be it enrollment, enrollment ratio, finacial commitment, size of teaching staff, education has expanded enormously in developing countries over the two decades. It has also been

observed that second and third levels of education gained an increasing enrollment share compared with primary education. All the pertinent data examined have borne evidence to the fact that developing countries have undertaken educational expansion at a higher rate than developed nations.

3.1.2 Explaining Educational Expansion

Though a thorough investigation of the causes of educational expansion is well beyond the scope of the thesis, for the sake of completeness, some of the possible causes for educational expansion in general and in developing countries in particular will be mentioned.

A quest for an answer to the question why education has been expanding tremendously throughout the world and notably in developing countries will lead us to review and examine some of the relevant theories and historical developments.

Many of the theories of educational expansion attribute the rapid growth of education to endogenous factors while some others go so far as to include certain characteristics exogenous to the national systems.

It is maintained by some theorists that economic development fosters educational expansion.[75] In more developed economies, so the argument goes, labor markets are organized

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[75] Meyer, John W. et al. "The World Educational Revolution, 1950-1970,"1 18 National Development and the World System. Ed. J. W. Meyer & M. T. Hannan, Chicago: The University of Chicago Press, 1979, pp. 37-38.

around educational credentials, in which event, at an individual level, those who seek to obtain a good job will have to acquire a certain amount of education. Thus, the fact that educational credentials are used in labor markets implies that individuals demand education as an investment in order to crate and enhance the possibility of a higher economic reward.

Basic in this argument is the supposition that the development of an economy entails a labor market characterized by use of educational credential as a screening device, generating more demand for human capital investment and educational expansion.

This argument is extended to incorporate how economic development promotes education at the national (aggregate) level. These theories assert that since developed economies require a labor force with a high skill profile and since they, relatively speaking, can afford to allocate more resources to educational undertakings there is reason to expect educational expansion to be spurred by economic development. According to these theories, as a nation grows richer it demands and affords more education both individually and nationally. For these theories to make sense in the context of developing countries one has to establish that developing countries have grown richer over the decades under study.

The other set of theories purporting to explain educational expansion is modernization theories which claim that political and social modernization results in educational expansion.

One of the contentions of these theories is that representative governments require a high degree of political participation from their citizens for which purpose they encourage and undertake mass education as an attempt to raise the political consciousness of citizens and in the process to create a participatory citizinery.[76]

Educational expansion is also asserted to be caused by the "process of expansion and consolidation of political authorities", a process, which is believed to require "the creation of a national political culture and ideology and the creation of a national citizenship".[77]

The educational expansion effort made in developing countries may have been partly influenced by the belief that education is an agent of economic development. Bowman and Anderson observed in the early 1960's that:

> Both new nations and old ones are putting more effort and faith in education than ever before-education not only of elites but also of the masses of the world's population,.... That education is one of the few sure roads to economic progress has become a contemporary creed.[78]

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[76] Ibid., p. 38.

[77] Ibid., p. 39.

[78] Bowman, Mary J. and Anderson, Arnold C. "Concerning the Role of Education in Development," Readings in the Eco-

This creed was reinforced by the human capital and modernization theories from whose analysis and conclusions emanated policy prescriptions in favour of educational expansion. These theories were used to justify, if not promoted, educational expansion in a number of countries. Particularly, the impact of these theories on the education-related policies of international organizations such as UNESCO, OECD and the World Bank was hardly negligible.[79]

The initiation of lending program for the purpose of education was one of the new developments in the early 1960's which might have affected educational expansion in developing countries.

The involvement of the World Bank in lending programes for educational efforts was recommended in the late 1950's by an international conference on public education. The conference recommended that:

> It is indispensable for the IBRD to consider the possibility of making long-term loans for school building to countries which request them. These loans will be needed so long as the economic development of these countries has not advanced sufficiently to enable them to meet the necessary expenditure themselves.[80]

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nomics of Education. UNESCO, 1968, P. 113.

[79] Fagerlind & Saha. Op. cit., p. 47.

[80] UNESCO. International Conference on Education: Recommendations 1934-1977. Paris, 1979, p. 179.

The World Bank either in response to the above recommendation or otherwise issued a policy statement in 1963 to the effect that

> the bank and IDA should be prepared to consider financing a part of the capital requirements of priority education projects designed to produce, or to serve as a necessary step in producing trained manpower in the kinds and in the numbers needed to forward economic development in the member country concerned.[81]

In the late 1960's the Bank appeared to have widened the scope of its operation to encompass other types of education in the lending program. The then president's Memorandum issued in 1970 noted that:

> We should broaden the scope of projects considered.... We should continue to emphasize projects, which, like vocational training, produce trained manpower directly but should also consider for financing other types of projects...which should also have important long-term significance for economic development.[82]

The above two citations shed light on the World Bank's view of education as an instrument of economic development and its conviction to involve itself in lending programs for education.

According to World Bank documents, the World Bank/IDA education lending between 1963 and 1974 amounted to US$1048.7 million.

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[81] World Bank. Education: Sector Working Paper, 1974, p. 49.

[82] Ibid., p. 50, citing the President's memorandum.

External aid[83] to education in developing countries was also made available through other bilateral and multilateral sources.[84] In 1970 developing countries received US $ 1.5 billion in education external aid. The aid reached US $ 2.8 billion in 1975.

Though the amount of external aid for education in developing countries was hardly a significant proportion of the educational expenditure of these countries (in 1975 only 9% of thier educational budget), it may have had a non-negligible impact in providing an impetus to educational expansion in these countries.

One may also argue that the expansion of enrollment experienced by developing countries is at least partly attributable to demographic factors. It has been mentioned earlier that the population aged 24 years and under increased by 22 percent between 1970 and 1980 in developing countries. The percentage of the population in that age range rose from 48.6 in 1970 to 59.4 in 1980.

In fact, if one measures educational expansion by the growth in the enrollment ratio, as mentioned earlier, the effect of demographic factors is quite minimal since the enrollment ratio is an index standardized, at least partly, for the relevant age cohort. However, were one to measure educational expansion only in terms of financial commitment,

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[83] External aid includes grants, loans and credits.

[84] Ibid., p. 64.

a change in demographic composition would have a bearing on educational expansion. Suppose that a country is committed at least to maintain an enrollment ratio and all facilities at the existing level. And assume that the education system is reasonably efficient in its operation and hence resources are fully utilized. Given the commitment just to maintain the enrollment ratio without sacrificing the quality of education, a change in the composition of the population in favour of young people would require additional educational expenditure. Therefore, educational expansion as measured by educational expenditure may also be affected by demographic factors.

In summary, a host of possible causes, some of which are outlined above, can be listed in an attempt to explain the educational expansion that took place in developing countries. It should be underscored, however, that, though the aforesaid causes are generally plausible, they may not be universally relevant to each and every country in explaining its educational expansion.

3.2 ECONOMIC GROWTH

The economic performance of developing countries over the two decades will be evaluated on the basis of GDP, and energy consumption. Related information such as structure of production and situation of external debt will also be presented.

The GDP pf developing countries grew at an annual average rate of 5.3 and 5.1 percent between 1960 and 1970 and between 1970 and 1979, respectively. It is apparent that economic growth had been slackening in the 1970's as compared to the 1960's although the extent was quite marginal.

For a better assessment of the economic performance of these countries one can adopt the World Bank classification given in its World Development Report which divides developing countries into two groups, namely, low and middle income countries.

An examination of the growth of GDP of the two groups reveals that over the two decades low income countries experienced a lower average annual growth rate of GDP than

TABLE 10

Average Annual Growth Rate of GDP and Energy Consumption in Developing Countries, 1960-79

Income	GDP(%)		Energy consumption(%)	
group	1960-70	1970-79	1960-74	1974-79
Low income	4.5	4.7	4.4	8.1
Mid.income	6.1	5.5	8.4	6.3

Source: World Development Report 1981, pp. 136-65.

middle income countries. Nevertheless, low income countries had, though marginally, an increase in growth rate unlike middle income countries whose average annual growth rate

declined in the 1970's. The average annual growth rate of GDP in low income countries increased by 0.2 percentage points in the 1970's while that of middle income countries dropped by 0.6 points. In the 1970's, therefore, the economic growth gap between the two groups was narrower than it used to be in the 1960's.

Energy consumption in developing countries increased at an average annual rate of 6.4 and 7.2 percent between 1960 and 1974 and between 1974 and 1979, respectively. The corresponding figures for low income countries were 4.4 and 8.1. In middle income countries, on the other hand, energy consumption grew at an average annual growth rate of 8.4 and 6.3 percent in the periods indicated.

It is evident from Table 10 that the energy consumption of low income countries grew at a faster rate in 1974-79 than in the previous period, unlike middle income countries where the opposite trend was observed. In the latter period, low income countries saw a faster rate of energy consumption than middle income countries.

Some theorists associate structure of production to level of economic development. A shift of production structure in favour of industrial and service sectors has long been viewed as a pointer to a higher level of development. In this respect, one can observe a change in production structure in developing countries over the two decades.

TABLE 11

Distribution of GDP Across Sectors in Developing Countries, 1960 and 1979 (%)

Income	Agriculture		Industry		Service	
group	1960	1979	1960	1979	1960	1979
Low income	51	34	17	36	32	30
Mid.income	22	14	30	38	48	48

Source: World Development Report 1981, pp. 136-165.

As can be inferred from Table 11, in 1960, 36.5 percent of the GDP of developing countries originated from agriculture. In the same year, the service sector contributed 40 percent while the share of industry to GDP amounted to 23.5 percent.[85] Nineteen years later, the share of agriculture and services in GDP dropped, respectively, by 12.5 and 1 percentage points while industry's share increased by 13.5 percentage points to 37 percent. The share of industry in GDP of developing countries in 1979 was almost of the same magnitude as the share of agriculture in 1960.

At a less aggregate level, in 1960, agriculture claimed 51 percent of the GDP of low income countries as compared to its share of 22 percent in middle income countries. The share of agriculture in GDP in low income countries dropped

[85] According to World Bank classification, the agricultural sector includes agriculture, forestry, hunting and fishing as the industrial sector is composed of manufacturing, mining, construction, electricity, water and gas. The remaining economic activities are classified as services. (See World Development Report, 1981, p. 184.)

almost twice as much as in middle income countries from 1960 to 1979. Conversely, industry's share in low income countries grew by 19 percentage points where as in middle income countries the rise was only 8 percentage points.

In passing it may be stated that, unlike agricultural and industrial sectors, the share of the service sector was virtually stable over the period under consideration. In low income countries, the proportion of service in GDP declined by 2 percentage points while in middle income countries it remained constant.

An overview of the economic growth of developing countries should not bypass one of their salient problems, external debt,[86] which has a considerable repercussion on

TABLE 12

External Public Debt Outstanding and Disbursed as Percent of GNP

Income group	1970	1979
Low income	22.2	29.5
Mid.income	10.4	17.4

Source: World Development Report 1981.

[86] The forthcoming discussion refers to external public debt by which is meant "debt with an original or extended maturity of over one year owed to non-residents by public debtors-that is, governments, governments agencies, and autonomous public bodies- or by private debtors whose obligations are guaranteed for repayment by a public body." World Tables, Economic Data. Third Edition, vol. 1, p. xiii.

their economic endeavours and achievements.

It is apparent from Table 12 that the external public debt-GNP ratio in developing countries increased on the average by 7.2 percentage points in 9 years. That is, the rate of growth of external public debt was faster than the rate of growth of GNP over the 9 year period.

A differential analysis of external public debt situation in low and middle income countries discloses that:

- -Both in 1970 and 1979 low income countries owed more external public debt as percent of their GNP than middle income countries.
- -The increases of the external public debt as percentage of GNP over the 9 year period were not significantly different in both categories of countries.

To sum up, were the growth rate of GDP and energy consumption adequate indicators of economic performance, one would conclude that developing countries, on the average, have achieved modest economic growth over the two decades. The present chapter disclosed the occurrence of considerable educational expansion and modest economic growth in developing countries using the traditional performance indicators. To what extent educational expansion contributed to the economic growth of these countries will be investigated in the ensuing chapters.

Chapter IV

TOWARD AN EMPIRICAL ANALYSIS

So far the relationship between educational expansion and economic growth, and an overview of the status of education and economic growth in developing countries have been briefly presented. The present chapter will mainly deal with the modelling and related exercises required to make the necessary empirical analysis.

4.1 HYPOTHESIS AND THE BASIC MODEL

4.1.1 Hypothesis

It has been indicated earlier that educational expansion is by and large believed to be one of the vehicles of economic growth. The empirical studies conducted on developed countries give support to this belief. The role of education in the economic growth of developing countries, however, has recently been called into question.[87]

Thus, at least in the context of developing countries, the theory that education plays a causal role in economic growth is increasingly becoming more of a hypothesis than a theory which needs to be tested once again. Hence, the hypothesis desired to be tested in the present work is the old hypothesis that educational expansion influences econom-

[87] Fagerlind & Saha. Op. cit., pp.52-54.

ic growth. More specifically, the hypothesis can be stated thus: Differences in the rate of educational expansion accounts for variations in the rate of economic growth among developing countries.

4.1.2 The Basic Model

As Chapter 2 revealed, a good number of models were used to test this same hypothesis in different nations and groups of countries. In the thesis, a different model, which draws on Razin's and Wheeler's models described in Chapter 2, will be developed.[88] Like Wheeler's, the present model uses an augmented Cobb-Douglas production function. But unlike his, our model relates education and quality of labor through post-primary enrollment. Like Razin's, the present model:

- -relates education to growth through improvement in the quality of labor.
- -links education and quality of labor via enrollment.
- -defines, for the purpose of the study, economically active population to include students and the labor force.

Unlike Razin's model, which

- -represents education by second and third level enrollment ratio, the present model represents

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[88] The main reason why Razin's and Wheeler's models were considered in this study from among other alternative models is that the data required for estimation are relatively available for the countries and period under study. The models, however, were modified for reasons stated in the text.

it by enrollment in second and third level education standardized for the economically active population.

-takes into account only present values of the index of education, the model adopted in the thesis incorporates both current and lagged values of the variable.

_disregards the foreign sector, our model, like that of Wheeler, recognizes the impact of external economic factors on domestic economic performance.

The model incorporates second and third level enrollment due mainly to the fact that students enrolled in these levels, unless constrained otherwise, largely qualify, as far as their age is concerned, to join the labor force if they wish to do so. Thus, it will be possible to establish an algebraic relationship between enrollment in post-primary levels of education and the labor force. Moreover, post-primary enrollment, at least potentially, can represent adult literacy which "indicates the minimum educational equipment of the contemporary labor force."[89]

The building of the model starts with a Cobb-Douglas production function:[90]

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[89] Bowman & Anderson. Op. cit., p. 115.

[90] Since, in this case, according to some results of empirical testing, the CES production function is not found to be considerably better than its Cobb-Douglas counterpart as a representation of producation, the CES production

$$Y = AK^{a} L^{b} \qquad (1)$$

where

Y = output

K = capital stock

L = labor input

A, a and b are constant coefficients.

In the above production function, labor input reflects only the aspect of its quantity. To incorporate the quality of labor the function needs to be modified. The modification yields an augmented Cobb-Douglas production function which can be written as

$$Y = AK^{a} L\hat{}^{b} \qquad (2)$$

where

$L\hat{}$ = augmented labor, a concept meant to refer to the quantity and quality aspects of labor.

The quality of labor can be affected by a variety of factors such as education, health, nutrition, etc. Since our interest lies in the effect of education on the quality of labor, we assume, for the purpose of this analysis, that other labor-augmenting factors remain constant over time and across individual units. Thus, in effect, we suppose that the variation in the quality of labor is caused by variation in the amount of education.

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function was not considered as an alternative specification. See Wheeler. Op. cit., p.18.

The process through which education is asserted to influence the quality of education has already been discussed. Taking the assertion for granted, we can relate education with quality of labor through the following simple algebraic manipulation.

Define:

$$L = lN \quad (3)$$

$$S = sN \quad (4)$$

$$L^{\wedge} = l^{\wedge}L \quad (5)$$

where

N = economically active population

S = post-primary school enrollment

l = fraction of the economically active population who are workers

s = fraction of the economically active population enrolled in post-primary schools

$l^{\wedge}$ = a quality index of labor that relates the augmented labor to the quantity of labor.

Now, we want to express $L^{\wedge}$ in terms of S and L. We suppose that $l^{\wedge}$ and s are functionally related such that the larger s the higher will be the quality of labor in the future. Let's also hypothesize that the mathematical relationship between s and $l^{\wedge}$ takes an exponential form,[91] thus

[91] The choice of the exponential mathematical specification arises from the intuition that the growth of quality of labor due to a change in the amount of education may be

$$l^{\wedge} = s^{**}q \qquad (6)$$

where q is a constant that shows by how much the quality of labor changes due to a change in the school participation of the economically active population.[92]

By substitution we get

$$L^{\wedge} = l^{\wedge} L$$

$$= s^{**}q\ L \qquad (7)$$

Substituting this into the augmented production function yields:

$$Y = AK^{**}a\ (s^{**}q\ L)^{**}b$$

$$= AK^{**}a\ s^{**}qb\ L^{**}b$$

$$= Ak^{**}a\ L^{**}b\ s^{**}c \qquad (8)$$

where

$$c = qb$$

Since we are interested in growth rate terms, we transform the above equation to percentage expression. To do so, first, we linearize equation (8), thus

$$\log Y = \log A + a \log K + b \log L + c \log s \qquad (9)$$

Differentiating equation(9) with respect to time gives the following percentage expression.

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better represented by a constant percentage increase than a constant absolute amount.

[92] It is clear from the mathematical specification that the value of q is to be empirically determined. It can be shown,by linearizing the equation

$$\log l^{\wedge} = q \log s$$

$$d\log l^{\wedge}/d\log s = q,$$

that q is the ratio of the percentage changes in $l^{\wedge}$ and s. Hence q may be interpreted as the elasticity of quality of labor with respect to education.

$$\text{dlog } Y/dt = \text{dlog } A/dt + a\ \text{dlog } K/dt + b\ \text{dlog } L/dt + c\ \text{dlog } s/dt \qquad (10)$$

Since $\text{dlog } Y/dt = \frac{dY/dt}{Y} = \frac{Y'}{Y}$,
equation (10) can be written as

$$\frac{Y'}{Y} = \frac{A'}{A} + a\frac{K'}{K} + b\frac{L'}{L} + c\frac{s'}{s} \qquad (11)$$

However, by virtue of unavailability of data on capital stock, the coefficient of the growth of capital cannot be estimated. Of course, the numerator of the growth rate of capital expression, which is a change in capital stock can be interpreted as investment. Since the denominator K is not observable, we replace it by Y to find the investment rate or the investment-output ratio.[93] With this modification and a change of notation equation (11) can be rewritten to form the model:

$$GGDP_t = INT + a\,INR_t + b\,GLF_t + c\,GRS_t + U_t$$

where

GGDP = Y'/Y , INT = A'/A, INR = K'/Y, GLF = L'/L,

GRS = s'/s

U = the disturbance term

INT, a, b, and c are parameters to be estimated

t = time.

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[93] See "The Growth of Capital Stock" under Section 4.2.2 for detail.

As indicated above, s is assumed to improve the potential quality of labor. In other words, the current quality of labor is hypothesized to be positively affected by past values of s. This lagged relationship is justified by the simple fact that students take some years before they finish their studies and join the labor force. A distributed lag model which takes into account the effect of past values of education on economic growth would look like

$$GGDP_t = INT + aINR_t + bGLF_t + cGRS_t + dGRS_{t-1} + gGRS_{t-2} + U_t$$

where d and g are additional parameters to be estimated.

Obviously, the above two forms of our model are valid only for a closed economy. As the subsequent discussion may reveal, openness to the international market is said to have an effect on the productivity of an economy. This effect is reflected by the inclusion in the model of the growth of exports, which is believed to proxy the extent of involvement of a given economy in international trade. Thus, for an open economy, the model will take the form:

$$GGDP_t = INT + aINR_t + bGLF_t + cGRS_t + dGRS_{t-1} + gGRS_{t-2} + hGEX_t + U_t$$

where

GEX = growth rate of export

h is additional parameter to be estimated.

4.2 DATA AND VARIABLES: MEASUREMENT AND REPRESENTATION

In this section will be briefly addressed issues of data compilation, measurement and variable representation.

4.2.1 Data: Source and Compilation

The data utilized in the study were obtained from documents and publications of UN, UNESCO, World Bank and ILO. The data are cross-sectional. However, by virtue of the fact that the model deals with the growth rate in each individual unit, two time periods had to be considered. Thus, the estimation of the regression model, as its specification required, is based on changes over time in each country rather than level at each point in time.

Average annual growth rates are computed as geometric mean of observations on two years which are 5 year apart (for example, between 1975 and 1980). In the event of missing data, interpolation and extrapolation were carried out.

All financial values in the data set are in real terms in that they are expressed in constant market prices. These values are expressed in the domestic currency of each country. Since our interest lies in growth rates and, above all, since conversion of these currencies into one international currency involves some conceptual and technical problems, domestic currencies were used.

4.2.2 Variable Representation

Having commented on the source and compilation of data, the rest of the section will give a brief description of the representation of variables.

Economic Growth

Economic growth as defined in chapter 1 is usually represented by the growth rate of GDP/GNP per capita. The literature is replete with criticisms of these indices to represent economic development. Let alone measuring economic development, these indices are inadequate to represent economic growth which is only one dimension of economic development. As the scope of the thesis is confined to economic growth, we will address the issue of deficiency of these indicies as they relate to economic growth.

One of the major deficiencies of GNP/GDP as an indicator of economic growth frequently mentioned is the national income accounting procedure which excludes certain economic activities that do not take place in the market. A growth or a decline in non-market activities such as domestic and personal services are not recorded in normal national accounting procedures; hence the growth or decline in GNP/GDP does not necessarily reflect and embrace the growth in the total economic activity. In a developing country where a considerable amount of goods and services do not enter the market place GNP/GDP definitely underestimates the economic performance of that country.

The severity of this problem was voiced by Seers who argued that:

> So far as the 3rd world is concerned, much of what[the tables of national income accounts] ought to cover is virtually outside the scope of official statistics. This applies above all to output of domestic stuffs,..., not to speak of fish, forest products, etc. Extremely rough methods of estimation are often used, much of the output being assumed to rise in proportion to the increase in rural population.... Secondly, we know very little about construction in the country side by the farming community itself; this apparently amounts to a good deal if one takes account not only of building houses, but also clearing land, digging wells and ditches, constructing fences and hedges, etc. Thirdly, there are practically no basic data on domestic service and other personal services even those which are renumerated.[94]

On the other hand, improvements in accounting procedures and the possibility of more extensive reporting on the extent of production over time may inflate the growth rate of GDP/GNP and hence the latter will likely overestimate the actual growth rate of the economy. This problem gets more serious when the computation of the growth rate is over a long period of time.

Despite the drawbacks of GNP/GDP as an index of economic performance, this thesis adopts the conventional index on account of the availability of data for all countries under study. Furthermore, the weaknesses of the indices stated above are not serious drawbacks to the use of GDP/GNP since the study is confined to developing countries which by and

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[94] Seers D. "The Limitations of the Special Case," p. 23 cited by Colman, D. & Nixson, F. Economics of Change in Developing Countries. Oxford: Philip Allan Publishers Ltd., 1978, p. 9.

large employ similar accounting procedures and where there exists a considerable non-market economic activity not reflected in the GDP/GNP. Using the growth rate of the latter as an index of economic growth is likely have similar bias across these countries. That is to say, the over (under) estimation of economic growth of GDP/GNP will have a similar pattern and direction, albeit not magnitude, among the countries in question.

Thus, in the model, economic growth is represented by growth rate of GDP.

The Growth of Capital Stock

The growth of capital stock is represented by the investment rate. As shown in the previous section, the growth of capital stock is given by K'/K where K' is the change in capital per unit of time. In the absence of reliable and comparable data on capital stock, one has to resort to a proxy for this variable. The change in capital stock may be represented by the addition to the capital stock which is the gross domestic investment.

In growth models one of the basic suppositions made is that aggregate supply and demand would be balanced when there exists equality between investment in any one period and the change in national income multiplied by capital-output ratio.[95] Symbolically,

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[95] Colman, D. and Nixson, F. Economics of Change in Least Developed Countries. Oxford: Philip Allan Publishers Ltd., 1978, pp. 20-21.

$$I = (K/Y)\ Y'$$

Dividing through by Y yields

$$I/Y = (K/Y)\ (Y'/Y)$$

The expression in the left hand side is the investment rate while the second term in the right hand side can be construed as GGDP. It can easily be visualized that INR and GGDP are related through K/Y. To determine the effect of INR on GGDP one has to hold K/Y constant. Assuming a constant capital output ratio between two periods one can, therefore, represent the growth rate of capital stock by investment rate. We expect the sign of the coefficient of INR to be positive.

Growth Rate of Labor Input

The average number of persons employed or the total number of hours worked are usually used as units of measurement for employment. However, data on employment either in terms of number of persons employed or number of hours worked are so sparse that it was not possible to cover as many countries as the availability of other data enabled us to include.

The non-availability of a comprehensive statistical information about employment has impelled us to look for a proxy for this variable. The proxy adopted to represent the growth rate of labor input is the growth of labor force.

The representation of employment by labor force in the production function is based on the strong assumption that

there exists a constant rate of utilization of labor services over a given period. This means that the rate of unemployment and underemployment remain constant during that period. The growth rate of labor force is expected to have a positive effect on economic growth.

Educational Expansion

Educational expansion is represented by the ratio of post-primary school enrollment to the economically active population. The figures on economically active population were obtained by adding the number of students in post-primary level of education to the labor force. The ratio, evidently, gives us the proportion of the economically active population enrolled in post-primary schools.

The reason for standardizing enrollment for economically active population emanated from the basic hypothesis that the impact of education on economic growth is transmitted through improvement in the quality of the labor force. Thus, in an attempt to link education to labor force, enrollment was normalized by the economically active population. This normalization has a side advantage of correcting the effect of growth in the size of eligible candidates for the specified level of schooling.

The incorporation of enrollment as a proxy for educational expansion is justifiable on the following grounds.

Firstly, it goes with out saying that enrollment is one of the inputs in the production of graduates of a given study program. Training the 'raw' mind is the process of production as graduates are the 'output' of the process. Given other inputs, an increase in enrollment will lead to a rise in the number of prospective graduates. Clinging to the basic hypothesis that a labor force composed of educated manpower is more productive, a rise in enrollment, ceteris paribus, would suggest an enhancement in the potential productivity of the labor force, assuming, of course, that graduates (and drop outs for that matter) could join the labor force.

Secondly, enrollment as an input measure also shows the commitment of a given country to educational expansion.[96] The model reflects this commitment per economically active population. S/N, therefore, can be interpreted as an average educational commitment of a given country to raise the potential productivity of its labor force.

With respect to signs of GRS, we expect that in the current period the sign of the coefficient of GRS, i.e., the sign of GRS<t>, to be non-positive while the coefficients of past values of GRS are held to be positive.[97]

The Growth Rate of Exports

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[96] Hicks, Norman & Streeten, Paul. "A Basic Needs Yardstick", in Meier, Gerald M. Op. cit, p. 26.

[97] Explanation given in section 5.2.1.

The data on exports are the values of goods and non-factor services. Exports are incorporated on the model on the grounds that they

> lead to resource allocation according to comparative advantage, allow for greater capacity utilization, permit the exploitation of economies of scale, generate technological improvements in response to competition abroad and, in labor-surplus countries, contribute to increased employment.[98]

Moreover, export-promoting countries, since they tend to have a lower balance of payments deficits, are likely to attract foreign investment. Consequently, "the easing of the domestic capital constraint might play a growth-promoting role."[99] In a nutshell, export promotion is asserted to raise total factor productivity and thereby economic growth. Therefore, the sign of the coefficient for GEX is expected to be positive.

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[98] Balassa, Bela. "Exports and Economic Growth Further Evidence," Journal of Development Economics, vol. 5 (March 1978), p. 181.

[99] Ibid.

Chapter V

EMPIRICAL ANALYSIS

As outlined in the previous chapters, economic growth and educational expansion are claimed to be causally related, and educational expansion has been undertaken at a high rate in developing countries. Quantifying the effect of this expansion on economic growth of developing countries will be the task of this chapter.

5.1 FINDINGS: SUMMARY AND TEST OF VALIDITY

This section will present the findings of the empirical exercise and carry out the necessary statistical and econometric tests to validate the estimates.

An application of the OLS to the data assembled in accord with the model yielded the results appearing in the following Table and elsewhere in the chapter. The relevant results of all alternative forms of the model are reported[100] so that readers can have a clear picture of the process through which the final form was achieved. The student is convinced by the contention of Learmer and Stern who argue:

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[100] The following Table presents only the regression results for forms of model only with real variables. Results obtained by incorporating dummy variables are given elsewhere.

> It is altogether too common for researchers to report only their best results without indicating the trial- and- error process by which they were obtained.... When none of the experimentation is reported, it becomes very difficult to assess the quality of the research effort.[101]

TABLE 13

Synopsis of Findings for Regressions Only with Real Variables

Equ.	INT	INR	GLF	GRS_0	GRS_1	GRS_2	GEX	R_2
(1)	-0.978	0.172	0.180					0.562
	(1.06)	(9.11)	(0.634)					
(2)	-1.03	0.176	0.1821	-0.027				0.569
	(1.11)	(9.13)	(0.642)	(1.1)				
(3)	-1.49	0.181	0.129	-0.034	0.028	0.032		0.595
	(1.59)	(9.41)	(0.45)	(1.35)	(0.863)	(1.87)		
(4)	-1.80	0.158	0.437				0.095	0.619
	(1.99)	(8.64)	(1.57)				(3.14)	
(5)	-2.27	0.168	0.386	-0.040	0.027	0.026	0.095	0.651
	(2.48)	(9.09)	(1.38)	(1.71)	(0.908)	(1.63)	(3.15)	

(INT = intercept term, INR = investment rate, GLF = growth rate of labor force, GRS = growth rate of proxy for education, subscripts 0, 1, 2 standing for current, 5 year lag and 15 year lag, respectively; GEX = growth rate of exports. Figures in parentheses are absolute values of t-ratios.)

Before analysis of the estimates is made, carrying out appropriate tests of validity on the basis of some standard criteria is in order.

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[101] Learmer, E. & Stern, R. Quantitative International Economics. Chicago: Aldine Publishing Company, 1970, p. 36.

As indicated in the previous section, the signs of all coefficients but GRS_0 are expected to be positive. All equations reported above satisfy the a priori criteria as regards the signs of their coefficients. The fact that the estimates bear the correct sign and hence are compatible with the hypothesis does not mean, obviously, that the estimates are valid and reliable. The estimates should also satisfy some statistical criteria. One way of evaluating the model is to examine the goodness of fit.

In the equations given in Table 13 the explanatory power of the model as represented by R^2 ranges between 56.2 and 65.1 percent. This means that, depending on which equation one considers, 56.2-65.1 percent of the variation in GGDP is explained by the variables included in the equations. The corresponding values for adjusted R^2 are 54.8 and 61.7 percent.

Goodness of fit, however, does not ensure statistical reliability of the estimates. For this one has to investigate the patameter estimates vis-a-vis their standard errors, or t-ratios, in short.[102]

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[102] Despite the fact that it is common to use two-tail test in validating regression coefficients estimates, it is also justifiable to use one-tail test in as far as there exists an a priori expectation about the signs of the coefficients. (Koutsoyiannis, A. Theory of Econometrics, second edition, London: Macmillan Publishing Ltd., 1977, p. 90.) Since the signs of the estimates were expected a priori in our model, using a one tail-test rather than a two-tail test sounds appropriate and legitimate. Hence forth, therefore, unless otherwise specified, statistical significance refers to 5 percent level and one-tail test.

The list of statistically significant coefficients includes INR, GEX, and GRS_2 of equation (3).

Still another way of evaluating the model is to see its overall significance as judged by the F test. If the calculated value of F-statistc exceeds the theoretical F value, we conclude that the explanatory variables are jointly different from zero. Hence, the estimates of the model, overall, will be statistically significant.

The computed F statistic is by far greater than its critical value in all equations. Thus, we reject the null hypothesis that all the independent variables included in the regression equations have no influence on the dependent variable.

The upshot of the foregoing statistical test was that most of the variables appearing in the model are statistically significant both individually and collectively as judged by t-ratios and F statistics.

The reliability of the parameter estimates is also contingent on the validity of the assumptions of the OLS technique which was employed for the estimation of the model. While the statistical criteria used above enabled us to determine the reliability of the estimates, econometric criteria, in light of which the validity of the assumptions of the employed econometric method is investigated, in turn, enable us to assess the reliability of the statistical cri-

teria themselves. By so doing one can establish whether the estimates possess the desirable statistical properties.

The OLS technique yields best, linear, unbiased parameter estimates attendant on the fulfillment of its underlying assumptions. A classical linear regression model assumes, among others, absence of perfect collinearity among independent variables, and homoscedasticity.

Supposing that the other OLS assumptions hold true, this section will investigate, in light of econometric criteria, the extent of the violation of the aforesaid two assumptions in the estimation of the model, i.e., whether, multicollinearity and heteroscedasticity are serious problems in the regression model.[103]

Multicollinearity

Multicollinearity is said to exist when there is a linear relationship between independent variables in a given model. As indicated above, a classical multiple regression model assumes an absence of linear dependence (perfect collinearity) among the explanatory variables.

Since for most economic variables some kind of near-linear relationship is hardly uncommon, it is worthwhile to detect its existence and severity.

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[103] Since the study is cross-sectional where autocorrelation is not a major issue, investigation of autocorrelation was not accorded as much attention.

The existence of multicollinearity, depending on its degree, has serious implications for some of the statistical criteria to be employed to determine the reliability of parameter estimates. The higher the degree of collinearity the larger tends to be the estimated standard errors, and the smaller will be t-ratios, which means that the explanatory variables appear to be statistically insignificant. Moreover, a high degree of multicollinearity tends to inflate R^2 and F values precluding the rejection of the null hypothesis that all coefficients are zero.[104]

In detecting multicollinearity in the model only one of the equations, equation 5, will be considered. Two detecting methods will be applied, namely, an examination of the matrix of correlation of explanatory variables and Farrar-Glauber test.

TABLE 14

Matrix of Correlations of Explanatory Variables

Coefficients	INR	GLF	GRS_0	GRS_1	GRS_2	GEX
INR	1.000	0.065	0.232	0.128	0.033	0.217
GLF	0.065	1.000	0.020	0.203	0.000	0.272
GRS_0	0.232	0.020	1.000	0.118	0.167	0.145
GRS_1	0.128	0.203	0.118	1.000	0.109	0.103
GRS_2	0.033	0.000	0.167	0.109	1.000	0.112
GEX	0.217	0.272	0.145	0.103	0.112	1.000

[104] Intriligator, Michael D. Econometric Models, Techniques, and Applications. Englewood Cliffs: Prentice-Hall Inc., 1978, P. 153. See also Johnston, J. Econometric Methods. Third edition, New York: MacGraw-Hill Book Company, 1984, pp. 245-49.

An examination of Table 14 discloses a low degree of correlation between explanatory variables, the highest correlation being 0.272 which is observed to exist between GLF and GEX. Apparently, judged by correlation coefficients, the degree of multicollinearity among explanatory variables of the model is too low to be a problem.

To augment the above mechanism of detecting multicollinearity, which is asserted to be unreliable for a model containing more than two variables,[105] the Farrar-Glauber test was applied. This test starts with the understanding of multicollinearity as "a departure of the observed X's from orthogonality".[106] Thus, the null hypothesis to be tested is

H_0: the explanatory variables are orthogonal

against the alternative hypothesis that

H_1: the explanatory variables are not orthogonal.

The testing procedure requires calculation of Chi-square (which will have a Chi-square distribution with $v = 0.5k[k-1]$ degrees of freedom, where k = number of explanatory variables).[107] The test statistic stipulates the rejection of the null hypothesis that the explanatory variables are orthogonal in the sense that they do not exhibit a significant multicollinearity if the calculated value of Chi-

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[105] Pindyck, R. & Rubinfeld, D. Econometric Models and Economic Forecasts. Second edition, New York: McGraw-Hill Book Company, 1981, p. 89.

[106] Koutsoyiannis, A. Op.cit., p. 242.

[107] Ibid., p. 244

square is greater than the critical value at the aforesaid degrees of freedom.

The Chi-square was computed to be 17.28.[108] A comparison of the observed value of Chi-square with the tabular Chi-square value with 15 degrees of freedom[109] and at 5 percent level of significance (which is 25) shows that the observed value is less than the theoretical value. Thus, we accept the hypothesis that there is no significant multicollinearity in the equation.

By and large, both detecting techniques of multicollinearity signal that the problem of multicollinearity is not severe in the estimation of our model.

Heteroscedasticity

Heteroscedasticity refers to a violation of the assumption about the constancy of the variances of the stochastic disturbance term over a given sample.[110] The incidence of heteroscedasticity is known to have two important implications

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[108] The Chi-square was computed using the formula developed by Glauber and Farrar

$$X^2 = -[n-1-1/6(2k+5)].\ln[v.s.d.]$$

where

v.s.d.= the value of standardized determinant, which is the determinant of the matrix of correlation of explanatory variables given elsewhere. (The determinant of this matrix was calculated to be 0.7671)

n = sample size

k = number of explanatory variables.

[109] The degrees of freedom were found using the formula indicated elsewhere.

[110] Interiligator, M. Op. cit, p. 156.

for estimation of a model. Firstly, least square estimators lose their property of being best (minimum variance) among the class of linear unbiased estimators. Secondly, heteroscedasticity causes, respectively, the estimated variances of the least square estimators and tests of statistical significance such as t and F tests to be biased and invalid.[111]

Thus, before interpreting the estimates one has to test for the incidence of heteroscedasticity. In an attempt to test for heteroscedasticity the method suggested by Goldfield and Quandt was employed.

The null hypothesis to be tested is

H_0 : U<i>'s are homoscedastic

against the alternative hypothesis that

H_1 : U<i>'s are heteroscedastic.

The ratio of the residual sum of squares for the two subsamples standardized for appropriate degrees of freedom gives an F distribution with $v_1 = v_2 = 19$ degrees of freedom.[112] The rule is to reject the null hypothesis if the ratio of the residual sum of squares of the two sub-samples exceeds the theoretical F value at a chosen level of significance with degrees of freedom specified above.

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[111] Ibid.

[112] $v_1 = v_2 = [n-c-2k]/2$ where
n = size of the total sample
c = central omitted observations (=17)
k = number of parameters to be estimated.

The ratio of variances, which was found to be 0.94[113] is less than the theoretical F value (which is 2.16) at 5 percent level of significance with v<1> = v<2 >= 19 degrees of freedom. Thus, the null hypothesis can not be rejected.

The results of the application of the Goldfield and Quandt test would lead one to conclude that the assumption of homoscedasticity was not violated in the estimation of the model.

5.2 FINDINGS: INTERPRETATION AND EXPLANATION

Having assessed the validity and reliability of the estimates, the remaining space of this chapter will be devoted to give a brief interpretation and explanation of the findings.

5.2.1 A closed Economy Variant

Initially the model was estimated with an assumption of autarky. The estimation of the model only with capital and labor as the explanatory variables gave the result[114]

$$GGDP_t = -0.978 + \underset{(9.11)}{0.172}INR_t + \underset{(0.634)}{0.180}GLF_t$$

$$\bar{R}^2 = 0.548 \qquad F_{2,66} = 42 \qquad F_{0.05} = 3.15$$

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[113] The ratio of residual sum of squares of the sub-samples associated with high values to that of the sub-sample associated with low values of INR.

[114] Computed F-values are given with their respective degrees of freedom. For example, F<2, 66> = 42. Critical F-values at 5 percent level of significance are given as, for example, F<0.05> = 3.15 corresponding to the degrees of freedom stated above.

Investment rate and GLF explain 54.8 percent of the variation in the mean GGDP. Evidently, a considerable portion of variation in the dependent variable is left unexplained by the model. By the standard of cross-sectional studies where we expect a considerable variation across individual units, an adjusted R^2 of 54.8 is not a low value at all. More so, when one takes cognizance of the fact that the model deals with growth rate terms. It can easily be verified that a model which involves a cross-section of within-country changes is likely to have less explanatory power than a model which deals with cross-section of levels.[115] Thus, one can be at ease as regards the explanatory power of the model.

With respect to the individual significance of the explanatory variables, one observes that GLF is not statistically significant. As far as the magnitude of the coefficients goes, GLF appears to have a bigger value than INR. However, an examination of the standardized coefficients, a coefficient which can shed light on the relative importance of variables in a given model,[116] reveals that INR is an important variable in the model relative to GLF.

A recognition of the possible contribution of education to economic growth and its inclusion in the production function has marginally changed the values of the estimates to

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[115] Wheeler, David. Op. cit., p. 15.

[116] Pindyck, R. & Rubinfeld, D. Ibid., p. 71.

$$GGDP_t = -1.03 + \underset{(9.13)}{0.176}INR_t + \underset{(0.642)}{0.182}GLF_t - \underset{(1.10)}{0.027}GRS_0$$

$$\bar{R}^2 = 0.550 \qquad F_{3,65} = 29 \qquad F_{0.05} = 2.76$$

The incorporation of the current value of the proxy for educational expansion in the model raised the explanatory power of the model only to 55 percent, an increase of 0.2 percentage point.

As expected, the sign of GRS_0 is negative. We expect the sign of GRS_0 to be negative on two grounds. Firstly, for a given number of economically active population N, an increase in S/N, by construction, is compatible only with a decline in L/N, where L is the labor force, since N is defined as the sum of L and S. Thus, again assuming that GLF is an adequate proxy of the quantitative aspect of labor input, an increase in GRS at a given point in time, granted the economically active population, suggests a decline in the proxy of labor input, hence a slowdown in economic growth. In other words, a rise in GRS concurs with a decline in the participation of the labor force in economic activities. It should be emphasized that the above assertion is predicated on the assumption that the unemployment and underemployment rates are relatively stable over the period of time considered.

Secondly, a higher rate of educational expansion, given the resources of a country, implies redirection of resources

from alternative investment which would have a relatively immediate return. This assertion regards that much of the educational expenditure (excluding expenditure on construction of schools and similar capital expenditure) is consumption expenditure (such as teachers'salaries) rather than investment for that period of time. To put it differently, if a rise in the educational expenditure (the consumption component) requires a reduction in savings and investment, then one would expect a negative relationship between current educational expansion and economic growth. This argument explicitly assumes a certain kind of trade-off between consumption component of educational expenditure and alternative investment.

Thus, in view of a positive opportunity cost to be incurred by society both in terms of a portion of the economically active population and funds which otherwise would be engaged and invested, respectively, in alternative growth-promoting economic activities, one will be led to expect current educational expansion to exert a non-positive impact on current economic growth.

Furthermore, even when educational expansion is carried out without adversely affecting the participation of the labor force and the level of savings and investment, there appears to be no logical positive connection between the current values of the two variables under consideration.

An analysis of the t-ratios of the above equation divulges that INR is the only statistically significant variable in the model. The newly introduced variable, GRS_0 was found to be statistically insignificant. The inclusion of GRS_0 has marginally increased the magnitudes of the coefficients of the existing variables.

Despite the difficulty of pinpointing which year of educational expansion will be positively related to current economic growth, our model postulates that past educational expansion contributes to present economic performance. Thus, the estimation of the model was made to involve past values of GRS, namely, GRS_1 and GRS_2 lagged for 5 and 15 years, respectively. The equation estimated was

$$GGDP_t = -1.49 + \underset{(9.41)}{0.181}INR_t + \underset{(0.450)}{0.129}GLF_t$$

$$\underset{(1.35)}{-0.034}GRS_0 + \underset{(0.863)}{0.028}GRS_1 + \underset{(1.87)}{0.032}GRS_2$$

$$\bar{R}^2 = 0.563 \qquad F_{5,65} = 18 \qquad F_{0.05} = 2.37$$

The inclusion of GRS_1 and GRS_2 enhanced the explanatory power of the model to 56.3 percent, a rise of 1.3 percentage points relative to equation 2 and of 1.5 percentage points as compared to equation (1) from which the educational variables were excluded.

With respect to level of significance, while the existing variables remained as they were, GRS_1 and GRS_2 were found to be statistically insignificant and significant, respective-

ly. The existing variables retain their signs as the new ones have a positive sign as one would expect, particularly for GRS_2 . Evidently, despite the sign of the coefficient of GRS_1 its level of significance compels us to treat it as unrelated to economic growth. Consequently, according to the result, educational expansion in past few years has neutral effect on current economic growth. But if one ignored level of significance, for the purpose of comparing magnitudes, s/he would observe that the size of GRS increased the further the variable was lagged. Moreover, over the period under study, the combined effect of education on economic growth is positive as the positive values (0.060) appear to more than offset the negative value (0.034).

5.2.2 An Open Economy Variant

As outlined elsewhere, developing economies are by and large susceptible to international economic relations. Thus, one would expect the domestic economic performance to be affected by these relations. It goes without saying that the external factors that can possibly affect domestic economic performance may be too numerous to be included in the model. One could consider a great variety of political and economic exogenous forces that could play their own part in influencing GDP. But our model considers only one aspect of economic international interactions. As indicated above, the growth rate of exports of a country is taken to represent the extent of participation of that country in international

trade. The hypothesis that the growth of exports promotes economic growth through its effect on total factor productivity is maintained in incorporating growth of exports as an explanatory variable in the model.

A model with the growth rate of exports excluding GRS was estimated and the following results obtained.

$$GGDP_t = -1.80 + \underset{(8.64)}{0.158}INR_t + \underset{(1.57)}{0.437}GLF_t + \underset{(3.14)}{0.095}GEX$$

$$\bar{R}^2 = 0.602 \qquad F_{3,65} = 35 \qquad F_{0.05} = 2.76$$

A comparison of the foregoing equation to the benchmark equation (i.e., equation 1) reveals a noticeable enhancement of the explanatory power of the model from 54.8 to 60.2 percent. All independent variables except GLF are statistically significant. GLF, whose t-ratios were very low in the autarky model has a relatively higher t-ratio to make its coefficient statistically significant at 10 percent level of significance. The coefficient of GEX turned out to be positive as expected.

It is interesting to note that the inclusion of export in the model not only increased the explanatory power of the model but also altered the magnitudes of the existing coefficients, namely, INR and GLF. The effect was particulatly pronounced in the case of GLF whose coefficient increased from 0.180 to 0.437. On the contrary, the coefficient of INR declined from 0.172 to 0.158. Despite this alteration of the magnitude of estimated coefficients, according to the

values of standardized coeficients, INR remains to be a relatively more important explanatory variable in the model followed by growth rate of export.

Running a regression which includes exports together with the other explanatory variables yielded the estimates:

$$GGDP_t = -2.27 + \underset{(9.08)}{0.168}INR_t + \underset{(1.38)}{0.386}GLF_t - \underset{(1.70)}{0.04}GRS_0 + \underset{(0.908)}{0.028}GRS_1 + \underset{(1.63)}{0.026}GRS_2 + \underset{(3.15)}{0.095}GEX_t$$

$$\bar{R}^2 = 0.617 \qquad F_{6,62} = 19 \qquad F_{0.05} = 2.25$$

All parameter estimates have the expected signs and reasonable magnitudes. A comparison of this equation with its autarky counterpart displays that the incorporation of GEX raised the adjusted R^2 by 5.4 percentage points. Moreover, and more important, the t-ratios were affected to the extent of making GRS_0 and GRS_2 statistically significant and insignificant, respectively. In fact, at 10 percent level of significance all but GRS_1 is found to be statistically significant. The result of the present form of the model suggests that current educational expansion adversely affects economic growth.

5.2.3 Introducing Dummy Variables

So far the maximum explanatory power of the model peaked at 65.1 percent. Even though this is not a typically low value, the fact remains that a considerable portion of the variation in GGDP across countries is left unexplained.

In an attempt to investigate other possible sources of variation in GGDP among countries under study, stage of development was considered. This consideration arose from an observation of structural differences between low and middle income economies as briefly reported in Chapter 3. There are differences in the structure of production, labor force, external public debt, and in other characteristics between middle and low income economies.

To examine if stage of development has any impact on growth, countries under study were classified into two groups, namely, low and middle income countries following World Bank 1981 classification. To this effect, a dummy variable was constructed.

The equation thus estimated was

$$GGDP_t = -2.58 + \underset{(8.712)}{0.175}INR_t + \underset{(1.52)}{0.435}GLF_t - \underset{(-1.678)}{0.039}GRS_0 + \underset{(0.842)}{0.026}GRS_1 + \underset{(1.688)}{0.027}GRS_2 + \underset{(2.99)}{0.091}GEX_t + \underset{(0.87)}{0.055}D$$

$\bar{R}^2 = 0.615$ $\quad F_{<8,60>} = 16$ $\quad F_{<0.05>} = 2.10$

D = 1 if low income country

D = 0 otherwise.

The explanatory power of the model, though marginally, declined rather than increased as a consequence of a recognition of a difference in stage of development among developing countries.

A difference in stage of development does not appear to influence variation in GGDP as an examination of t-ratio manifests. Nontheless, the recognition of different stage of development and a consequent introduction of a dummy variable has improved all t-ratios and made all but GLF and GRS_1 statistically significant.

Clearly enough, the above form of the model captures intercept effects only. It assumes that both groups of countries face similar slopes, which means that the responsiveness (the relationship) of GGDP to the explanatory variables is the same in both groups of countries despite the acknowledgement of the existence of disparity in level of development. Put differently, the above introduction of dummy variables assumes that the level of the mean GGDP is different while the rate of change of the mean GGDP by the explanatory variables is the same between the two groups of countries. However, a possibility of differences in slope can hardly be precluded. Thus, slope dummies, which were meant to capture slope differential effects, were also introduced in the model to yield the following estimates.

$$\begin{aligned} GGDP_t = {} & -2.03 + \underset{(4.945)}{0.134}INR_t + \underset{(1.744)}{0.624}GLF_t \\ & - \underset{(1.376)}{0.042}GRS_0 - \underset{(0.165)}{0.011}GRS_1 + \underset{(0.283)}{0.007}GRS_2 \\ & + \underset{(3.34)}{0.198}GEX_t - \underset{(0.094)}{208}D_0 + \underset{(0.899)}{0.051}D_1 - \\ & \underset{(0.401)}{0.287}D_2 + \underset{(0.863)}{0.048}D_3 + \underset{(0.714)}{0.057}D_4 + \\ & \underset{(1.27)}{0.043}D_5 - \underset{(2.27)}{0.161}D_6 \end{aligned}$$

$\bar{R}^2 = 0.630$ $F<13,55> = 9$ $F<0.05> = 1.92$

where

D_0 : Intercept dummy

= 1 if low income country

= 0 otherwise.

$D_1 - D_6$: slope dummies, taking the values of the explanatory variables if low income country, zero otherwise.

The inclusion of dummy variables representing stage of development improved adjusted R^2 only by 1.3 percentage points. It may be inferred from the t-ratios that all dummy variables except that associated with the growth rate of exports are statistically insignificant. Therefore, except for exports one can gather that the rate of change of the mean GGDP caused by explanatory variables is similar between the two groups of countries.

The differential slope coefficient of GEX is statistically significant suggesting that the rate of change in mean GGDP by the growth rate of export is different between the low and middle income countries.

In light of the foregoing regression results, another regression, which retained only the export and intercept dummies, was run and the estimates reported below obtained.

$$GGDP<t> = -2.94 + \underset{(7.24)}{0.158}INR<t> + \underset{(1.77)}{0.503}GLF<t> -$$

$$\underset{(1.45)}{0.034}GRS_0 + \underset{(0.881)}{0.026}GRS_1 + \underset{(2.05)}{0.033}GRS_2$$

$$0.179GEX_{<t>} + \underset{(1.60)}{1.12D_0} - \underset{(1.82)}{0.121D_6}$$
$$\underset{(3.15)}{}$$

$\bar{R}^2 = 0.629$ $F_{<8,60>} = 15$ $F_{<0.05>} = 2.10$

The differential slope coefficient of exports is still statistically significant. Moreover, the t-ratio of the slope dummy has increased so much so that it turned out to be statistically significant at the 10 percent level of significance. Again, the recognition of differences in stage of development as reflected by the introduction of intercept and export slope dummy variables has made the coefficients of GLF statistically significant along with enlarging its magnitude relative to the estimates of the model where dummy variables were excluded.

A look at the t-ratios once again discloses that all variables but GRS_0, GRS_1 and D_0 are statistically significant, and from among the latter three variables, GRS_0 and D_0 are statistically significant at the 10 percent level of significance. With respect to signs, all coefficients retain their former and expected signs.

By way of comparison, this form of the model explains 62.9 percent of the variation in GGDP, the best fit so far attained next to the former form of the model where intercept and all slope dummy variables were incorporated. This form of the model not only has a better fit but also has more statistically significant variables.

In summary, the foregoing brief comparative analysis of estimates of different forms of the regression model shows that while the sign of coefficients remain the same the magnitudes tend to change from one form of the regression model to the other. More importantly, the t-ratios were found to be susceptible to the inclusion of certain variables in the model. In all forms of the model, INR and GRS_1 were consistently statistically significant and insignificant, respectively. By and large one may conclude that the estimates obtained from all the regressions are hardly repugnant.

5.2.4 A Reflection on the Final Form of the Model

Having done a brief comparative regression analysis, this subsection will reconsider and dilate upon the final form of the model which apparently enjoys a better fit and statistical significance.

In this form of the model, as in the others, INR stands out as a dominant explanatory variable followed by exports. The growth of labor force despite its large coefficient is relatively a weak variable as judged by the magnitude of partial correlation and standardized coefficients. It is interesting to note that GRS_2 has a higher partial correlation with GGDP than GLF meaning that the linear effect of GRS_2 on GGDP after the linear effect of other independent variables have been accounted for is more consequential that that of GLF.

The Investment Rate

An interpretation of the estimates of the INR coefficient need to take cognizance of the essence of the variable. INR, as stated above, was computed as a ratio of the change in total capital stock (proxied by gross domestic investment) to the initial level of GGDP. The derivation of INR is based on the assumption of a constant capital-output ratio, and so will its interpretation. Admittedly, this assumption is unrealistic, particularly over a long period of time; and no attempt will be made to defend it. However, in as far as the purpose of our model is to estimate parameters and describe relationships rather than predict values on the basis of the estimates, an assumption of a constant capital output ratio is not expected to exert a damaging effect on the validity of the model.

The coefficient of INR can be interpreted to mean that an increase of 1 percentage point in investment rate, if other explanatory variables are held constant, will lead to an increase of around 0.16 percentage points in GGDP. INR has a standardized coefficient of 0.68 which tells us that a one standard deviation change in INR will result in 0.68 standard deviation change in GGDP.

The partial correlation of INR with GGDP, which was calculated to be 0.68 concurs with the standardized coefficient in asserting the relatively large linear effect of investment on GGDP. Wheeler, in a cross section study of developing countries, estimated the coefficient of INR to be 0.146

for a closed economy.[117]

The Growth Rate of Labor Force

In interpreting the estimates associated with GLF one has to recall that GLF is a proxy rather than an actual employment indicator. GLF appears to have no statistical significance until the effect of differences in stage of development was captured through the introduction of slope dummy variables.

It is not surprising to have this result. Needless to say, the representation of actual employment by labor force is in most cases questionable. In the context of developing countries, it is more likely that an increase in labor force has a disproportionate effect on the rates of unemployment and underemployment in which event GLF overrepresents the growth of actual employment.

However, it is difficult to substantiate this assertion by statistical evidence due mainly to paucity of reliable and comprehensive data on the extent of employment, unemployment and underemployment in developing countries. Available crude data on the rate of unemployment for some countries suggests different patterns of relationship between GLF and rate of unemployment.

A glimpse at the statistical information given in Table 15 points to a situation where GLF is accompanied by an increase in unemployment rate. In fact, some countries seem

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[117] Wheeler, D. Op. cit.

TABLE 15

Rate of Unemployment and Growth Rate of Laborforce in Selected Countries, 1975 and 1980

Country	Unemployment rate (%)		GLF(%)
	1975	1980	1975-80
Egypt	2.5	5.2	1.94
Ghana	0.9	1.2	2.03
Argentina	2.3	2.3	1.41
Columbia	10.5	9.9	3.80
Jamaica	20.5	26.8	2.59
Trinadad & T.	15.0	9.9	3.05
Hongkong	9.1	3.8	3.77
S. Korea	4.1	5.2	2.53
Philippines	4.4	4.8	2.65
Thailand	0.4	0.8	2.90

Source: ILO, Year Book of Statistics, 1983 (for unemployment rate). For GLF, See Appendix A.

to have experienced a decline in their unemployment rate despite a growth in labor force. A scrutiny of Table 15 discloses that countries which had a higher growth of labor force experienced a lower increase or a decline in the unemployment rate between the years specified. However, the questionability of data aside, in the absence of information on the underemployment rate, one cannot logically and convincingly conclude that those countries which experienced a decrease in unemployment rate recorded a rise in the rate of actual employment.

The data on unemployment rate sheds light on the possible effect of GLF on employment granted a constant rate of

underemployment. However, where the underemployment rate is allowed to vary, an increase in labor force and a decrease in unemployment rate can be accompanied by a rise in under-employment with out altering the actual employment rate.

The estimates obtained for GLF should, therefore, be understood and interpreted with these issues in mind. The estimated coefficient of GLF has a value of 0.5 implying that a 1 percentage point increase in GLF, other explanatory variables being constant, will lead to a 0.5 percentage point increase in GGDP. The linear effect of GLF on GGDP after the effect of other explanatory variables has been accounted for is as low as 0.22 while the standardized coef-ficient is 0.14. A cross-sectional study of developing countries by Wheeler estimated the coefficient at 0.56.[118]

The Growth Rate of Proxy for Educational Expansion

As regards the educational expansion variable, which is the center of the thesis, interesting results have been obtained. As reiterated elsewhere, educational expansion may be represented by various indices of which GRS was used in our model. It should be emphasized that the results obtained for this index might not necessarily be true if other indicators were used. Thus, one has to be cautious not to be led by the findings to draw a sweeping conclusion about the growth-promoting role of education.

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[118] Wheeler, D. Op. cit. (The author used adult population as a proxy for labor force)

Recognizing the effect of previous education expansion, GRS was lagged as far back as data were readily available for all countries under study. All forms of the regression are unanimous as regards the sign of the current value of GRS, namely, GRS_0 . The effect of current educational expansion on current economic growth is at best zero. In many of the forms of the model, including the final one (at 10 percent level of significance), current educational expansion tend to have a depressing effect on economic growth.

Unlike GRS_0, which shows some kind of statistical significance in many of the regressions, GRS_1 has been found to bear no statistical influence on GGDP in all cases. Therefore, one may be tempted to conclude that educational expansion, as represented by GRS, which took place 5-10 years ago is unrelated to current economic growth. These findings buttress the intuition that the returns from educational expansion cannot be gained overnight.

On the other hand, educational expansion that took place 15-20 years ago was found to be positively related to GGDP. This is particularly the case in forms of the regression model which recognized differences in stage of development. This result, in the context of the model, can be interpreted to mean that past educational expansion by improving the quality of the current labor force has helped to foster current economic growth.

One may be quick to pose the question regarding the employability and the employment opportunity of the members of the labor force in general and the educated ones in particular. Indeed, so long as we relate education to output only through productivity improvement of labor, we have to assume that those (at least the majority) who have gone through or dropped out from post-primary level of education join the labor force. Once this assumption is satisfied, the implication of the status of employment is a related but another issue.

Suppose that the majority of students who enrolled in post-primary levels of education will join the labor force in 15-20 years.[119] If these persons are employed, assuming that their education will augment their productivity in one or all of the different ways outlined in Chapter 2, it is not difficult to see the relationship between past educational expansion and improvement in the quality of current labor force.

The coefficient of GRS_2 was estimated at 0.033. Were educational expansion increased by 1 percentage point in the first half of the 1960's, other explanatory variables being constant, the GGDP in the second part of the 1970's would rise by 0.03 percentage point. If one disregarded level of significance and focussed on magnitudes of coefficients

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[119] This is basically a reflection of the assertion that post-primary education is primarily an investment demand.

alone, s/he would find the total partial effect of GRS on GGDP to be 0.025.[120] A cross-sectional study conducted by Wheeler estimated the coefficient of education variable to be 0.0096.[121]

In summary, educational expansion, as represented by GRS, in the first half of the 1960's was found to partly explain the differences in GGDP among developing countries in the second half of the 1970's.

The Growth Rate of Exports

The growth rate of exports is one of the important variables explaining variation in GGDP among countries under study. For middle income countries, the coefficient of growth rate of export stands at 0.179 while for low income countries this figure goes as low as 0.058. It appears from the findings that the impact of growth rate of export on GGDP is higher in middle income countries than in low income countries.

The observation made about the statistical significance of exports in our model is consistent with conclusions arrived at in previous studies. Kruger, for instance, concluded that "there is little doubt about the link between

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[120] is the sum of the coefficients of GRS_0, GRS_1 and GRS_2 .

[121] Ibid.
The author represented education by adult literacy. In comparison to Wheeler's findings, our estimates of education's contribution to differences in GGDP among developing countries is larger. However, differences in variable representation in the two models make the results less comparable.

export performance and growth rates."[122]

To sum up, according to the findings of our empirical investigation, the variation in economic growth across developing countries is attributable, among other factors, to differences in their performance, in order of importance, in physical investment, export promotion, previous human capital investment and to differences in growth of labor force.

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[122] Kruger, Anne O. "Trade Policy as an Input for Development", Leading Issues in Economic Development. Ed. Gerald M. Meier. Fourth edition. New York: Oxford University Press, p. 510.

Chapter VI

SOME ISSUES AND THEIR IMPLICATIONS FOR THE ESTIMATES

As any empirical analysis, the present study involves some simplifications and hinges on several implicit and explicit assumptions.

It is self-evident that the validity of the results are partly determined by the validity of the assumptions where up on the model is predicated. The major assumptions implied or explicit in the model are:

- -Acquisition of some post-primary education augments productivity of individuals; and all kinds and levels of post-primary education have similar impact on the quality of labor.
- -The majority of graduates and/or dropouts from post-primary education join the labor force, and employment opportunity is reasonably available.
- -The quality of education is the same over time and across countries.
- -Economic growth does not in a significant manner influence educational expansion.

A reflection on these assumptions and an assessment of their implications for the results of the empirical exercise are in order.

6.1 EDUCATION: PRODUCTIVITY ENHANCING OR A MERE SCREENING DEVICE

One of the assumptions made in connection with the education variable is that acquisition of post-primary education amounts to obtaining productivity-augmenting skills such as the ones described in Chapter 2. This is a necessary assumption to link education to the quality of labor and thereby to test the hypothesis that education contributes to economic growth through improvement in the quality of labor. It goes without saying that violation of this assumption breaks the link between education and economic growth.

As discussed elsewhere, for human capital, modernization and alike theorists, education is a skill-transmitting and productivity-enhancing activity.

Nontheless, this assertion has been challenged by the extreme version of the screening hypothesis according to which education serves only as a filtering mechanism. In the words of Thurow "the function of education is not to confer skill and therefore increased productivity and higher wages on the worker."[123]

If this version of the screening hypothesis was true, the foundation of the aforesaid hypothesis would be shaken. The implication of the violation of this assumption for the model should be clear. The apparent correlation between past

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[123] Thurow, quoted by Cain,G. G. "The Challenge of the Segmented Labor Market to Orthodox Theory: A Survey". Journal of Economic Literature, vol.14, 1976, p. 1245.

education and current economic growth would become spurious. However, the screening hypothesis in its extreme version is not universally accepted to entirely dismiss the skill-transmitting and productivity-enhancing role of education.

Related to this is the implicit assumption that all kinds and levels of post-primary education exert similar effect on the productivity of labor. In assessing the validity of this assumption one has to distinguish between the official (formal) and the hidden (informal) curriculum of the educational system.

The formal curriculum, which varies across fields and levels of study, is designed to impart accumulated knowledge and skill and to produce trained manpower with different kinds and levels of skills. On the other hand, the informal curriculum "instills values and attitudes consistent with the economic and social structure."[124]

Depending on the socio-economic system, the attitudes and behaviour to be imparted informally and indirectly include punctuality, competitiveness or cooperativeness, bureaucratic organization, etc. From the modernization point of view, these and other similar attitudes and values have by and large an impact on productivity of labor. Thus, as far as the hidden curriculum goes, the impact of virtually all kinds and levels of post-primary education on the quality of labor may be argued to be similar in which event the afore-

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[124] Fagerlind & Saha. Op. cit., p. 85.

said assumption remains valid.

As regards the official curriculum, however, there abounds incertitude whether every kind and level of education impart similar cognitive skills. Apparently, the blanket treatment of education (regardless of kind and level) as an augmenter of cognitive skills tends to exaggerate the productivity-enhancing role of education.

The implication of the latter argument for the model is that, if the distribution of students among different fields of study and levels of education varied over the period under consideration, the three variables representing educational expansion, namely, GRS_0, GRS_1 and GRS_2 would not be indicative of an educational expansion with identical effect on the quality of the labor force.

An examination of enrollment statistics of developing countries indicates that in 1960, 16 percent of the student population were enrolled in second level education while in 1980 the percentage rose to 23.8 percent. The corresponding figures for third level education were 1.8 and 3.9 percent. Though both levels of education enjoyed a certain expansion, the increase in percentage distribution is much more accentuated in the case of second level education.[125]

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[125] UNESCO, Statistical Year Book, 1978-79 & 1983.

Regarding field of study, an investigation was made into the distribution of enrollment between vocational and non-vocational streams in the second level and among various

TABLE 16

Percentage of Distribution of Enrollment at Second Level of Education in Developing Countries by Type of Education, 1965 and 1980

	Type of Education		
Year	General	Teacher training	Vocational
1965	87.9	2.9	9.2
1980	87.9	1.9	10.2

Source: UNESCO, Statistical Year Book, 1978-79 & 1983.

fields of specialization in the third level of education.

As can be seen from Table 16, the proportion of enrollment in general education was stable between 1965 and 1980 while the percentage of students in vocational education increased from 9.2 to 10.2 at the cost of teacher training. One may, therefore, conclude that the percentage distribution of enrollment among streams in second level of education was virtually stable.

In tertiary level of education, though we do not have comprehensive data, an examination of the enrollment statistics of a few countries shows a shift in emphasis away from social sciences and related fields to natural, health and

other related fields. For instance, in 1965, the mean percentage of enrollment in social science and related fields was 63.4 as compared to 52.8 recorded in 1980. The corresponding figures for natural and related sciences were 30.4 and 34.2.[126]

By way of summary, an examination of the percentage distribution of students between levels and among various fields of study reveals that there was a relative expansion in secondary education and a shift of emphasis toward vocational education and natural sciences and related fields. However, the degree of the relative expansion and the shift of emphasis were not too considerable to render the estimates of GRS incomparable as regards their effect on productivity of labor.

6.2 LABOR MARKET CONDITION

The other basic and rather strong assumption required to hold to link education and labor quality is employment opportunity for graduates and dropouts from post-primary education. Thus, in assessing the impact of education on productivity of labor on economic growth, one may wish to discern the effect of the former on employment. In this connection are adduced two opposite arguments.

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[126] The relevant data for 15 developing countries along with the contextual classification of fields of study are given in Appendix B.

Some authors hold the view that educational expansion can promote the creation of employment opportunity. For Adiseshiah, for example,

> education contributes directly to employment by providing the demand for teachers who often constitute a sizeable portion of the educated labor force, particularly in developing countries. It also generates employment in an indirect way by promoting mobility, a positive form of shiftlessness, creating a much needed mandarinate, and developing a capacity for innovation, experimentation and self-reliance.[127]

On the contrary, some suggest that educational expansion tends to raise "... expectations such that many young people have false hopes about jobs", thereby creating unemployment.[128]

However, both arguments lack strong empirical evidence. Regardless, educated unemployment has been observed in developing countries. The existence of educated unemployment is known to be "one of the major problems facing the less developed economies today."[129]

In 1975, in Argentina, for instance, the rate of unemployment for people with secondary and post-secondary schooling was 5.7 and 3.3 percent, respectively. The corresponding figures for Venezuela in 1969 were 10.2 and 2.3 percent. In 1972-73, India experienced unemployment rate of

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[127] Adiseshiah, Malcolm S. It is Time to Begin. The Human Role in Development: Some Further Reflections for the Seventies, Paris: UNESCO, 1972, p. 80.

[128] Fagerlind & Saha. Op. cit., p. 80.

[129] Ibid., p. 79.

53.6 and 10 percent for its labor force with secondary and higher education, respectively.[130] The unemployment situation in 1975-80 period, which is the current period of this study and for which the pertinent data were not readily available, is expected to be worse.[131]

Amidst educated unemployment talking about the contribution of education to economic growth becomes, to say the least, unconvincing. The wider the extent of this unemployment, the weaker the link between education and economic growth. In the extreme case where all post-primary education graduates and dropouts are unemployed, it follows from the specification of our model that education and quality of labor are unrelated and hence are the former and economic growth.

However, the rate of educated unemployment is far less than 100 percent implying that there is room for improvement in the quality of labor force to be reflected in actual employment. It might, therefore, be argued that, as far as our model is concerned, the existence of educated unemployment, though it attenuates the role of education in growth, does not necessarily imply a zero contribution in so far as substantial and persistent educated unemployment is not proved to exist.

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[130] Squire, Lyn. Employment Policy in Developing Countries: A survey of Issues and Evidence". A World Bank Research Publication, Oxford University Press, 1981, p. 71.

[131] Fagerlind and Saha. Op. cit., p. 79.

The upshot of the foregoing is that so far as there is no employment discrimination against the educated personnel and, particularly, if there is preference for educated ones in recruitment and, moreover, if the latter excel in productivity, then despite the existence of educated unemployment, education may be said to play a causal role in economic growth, albeit at a lower rate than would be the case with a zero rate of educated unemployment. Thus, the implication of the existence of educated unemployment for our model and the results is contingent upon the size, persistence, and the change in the rate, of educated unemployment.

6.3 THE CONSTANCY OF THE QUALITY OF EDUCATION

It was attempted to capture the quality of labor by incorporating education into the model. However, the quality of education is not reflected in the modelling exercise. It was rather presumed that the quality of education is the same over the period and across countries under study.

To have an inkling about the status of the quality of education, two possible but, admittedly, inadequate indicators for selected countries were examined. These indicators are student-teacher ratio and unit-cost.

Given an optimal level of operation and other things being equal, an increasing student-teacher ratio may be associated with a declining quality of education.

TABLE 17

Student-teacher Ratio in Selected Countries BY Level of Education, 1965 and 1980

Country	Level and year			
	Second		Third	
	1965	1980	1965	1980
Burundi	11	14	3	6
Ethiopia	20	41	6	14
Mozambique	15	36	4	5
Sudan	17	20	9	4
Elsalvador	18	24	7	19
Panama	21	21	20	15
Columbia	13	20	7	10
Hongkong	22	29	9	12
Philippines	31	40	23	29
Singapore	24	18	16	10

Source: World Bank Tables, social data, 1984.

It is clear from Table 17 that the student-teacher ratio has increased between 1965 and 1980 except for Singapore, where both second and third level student-teacher ratio and Sudan and Panama, where third level student-teacher ratio declined. Obviously, an increase in student-teacher ratio signifies more enrollment expansion relative to teaching staff.

Another way of looking at the issue of quality of education is to assess the unit-cost (per pupil recurrent expenditure). A decline in real unit-cost, ceteris paribus, is said to signify a tendency for quality deterioration. The per pupil recurrent expenditure on education was comput-

TABLE 18

Growth Rate of Per Student Recurrent Expenditure between 1965 and 1980 (1975 = 100)

Country	Level of education	
	Second	Third
Algeria	-56.6	-35.8
Sudan	-13.6	-41.3
Costa Rica	52.5	7.8
Elsalvador	30.0	-22.6
Honduras	-52.8	-56.1
Jamaica	-21.5	120.7
Nicaragua	-76.3	-72.2
Bolivia	13.2	-27.5
S. Korea	227.3	32.0
Syria	38.5	345.8
Thailand	-26.1	-28.8

Source: Computed from UNESCO, Statistical Year Book, 1978-89, 1983 & 1986, and World Tables, 1980.

ed.[132]

The unit-cost declined between 1965 and 1980 in all countries but S. Korea, Syria and Costa Rica. In many of the countries indicated in Table 18, the financial commitment made to the education sector was found to grow at a slower rate than enrollment. Given an optimal level of unit-cost, other things being equal, the decline in unit-cost might be construed as an indicative of possible quality deterioration.

[132] The per student recurrent expenditure is calculated as a ratio of recurrent expenditure on education allocated to a level to enrollment of that level.

As alluded to above, the aforesaid two indicators can not be taken seriously mainly because a rise in the student-teacher ratio and a decline in unit-cost could be, to a certain degree, a sign of fuller utilization of teaching staff, and cost-effectiveness, respectively.

Were one to judge quality of education on the basis of the two indicators s/he would gather that the level of quality of education over a period of time and across countries is dissimilar. Evidently, if there was a decline in the quality of education over the period under investigation, GRS would not represent the same variable at different points in time. Similarly, were the quality of education different across countries, we would not expect educational expansion to be represented by a common and uniform index. The following example may help clarify this point.

Assume, for example, that educational expansion in Country A as represented by GRS was 5 percent as compared to 10 percent in Country B. Suppose, further, that the quality of education in Country A remained passably constant while in country B, the quality of education deteriorated by 50 percent. If an index combining both quantity and quality of educational expansion were devised and used one could easily see that the rate of educational expansion in both countries was of the same magnitude. Unlike the quantity-oriented index which implies a 5 percentage point difference, the combined index insinuates no variation in educational expan-

sion between the two countries over the given period of time. The implication of quality difference among countries and over time for the findings of the model is, therefore, self- evident.

6.4 ECONOMIC GROWTH DOES NOT AFFECT EDUCATIONAL EXPANSION

Thus far, in assessing the causal relationship between education and growth, only one direction of causality was considered. This is the causation that runs from educational expansion to economic growth. The previous discussion, therefore, emphasized the investment component of the demand for post-primary education, which amounts to adopting educational expansion as a means rather than an end in itself.

Reverse causation is also plausible. Education can be argued to be influenced by economic growth. This line of argument stresses the consumption component of the demand for education, viewing education partly as a normal consumer good whose demand increases with a rise in income both at a national and individual level.

Kamarov contends that:

> It is the economic system, in all countries, which constitutes the main material basis for educational development. It supplies both the material resources for building and equipping schools and providing educational premises and facilities...and the national income to meet government expenditure on public education and instruction. And as the various branches of the economy increases, so a country will have more funds at its disposal for financing the development of all

types of national education.[133]

On an individual level, also, economic growth, it is argued, by providing higher level of employment and income, increases the demand for education. According to Komorov,

> a country's economy represents the main market for its labor and, accordingly, the principal source of people's incomes. Its development increases the available employment, which in turn increases the country's real income. And the result of all these is to make it easier for people to receive education, even when it has to be paid for; for before sending children to school a family must have a certain income, which it can not obtain unless there is permanent employment available for all of its members who are capable of working.[134]

It is also held that educational expansion is necessitated by the consequences of economic growth which requires the acquisition of skills, behaviour and values consistent with a grown economy. The following citation should elaborate this point.

> As technical progress is made in production, workers require an increasingly high standard of general education and vocational training, and there is a growing need for a highly qualified workers.... Modern production is unable to expand unless there are enough highly educated and qualified senior personnel, and unless the general level of all workers is raised.[135]

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[133] Komorov, V. A. "The Relationship between Economic Development and the Development of Education," Readings in the Economics of Education, UNESCO, 1968, p. 86.

[134] Ibid.

[135] Ibid.

This line of argument, as noted above, leads us to believe that education not only affects but is also affected by economic performance. The experience of some countries appear to support a causation from economic growth to educational expansion as the observation of Fagerlind and Saha suggests.

> The expansion of formal schooling was a result rather than the cause of industrialization in Britain. Available evidence suggests that a similar relationship prevailed in the transformation of schooling in U.S. in the late 19th century.[136]

If economic growth were to influence educational expansion in a significant manner, the implication of this for our model is that the results obtained by application of the OLS method would be biased and inconsistent due to the presence of simultaneity bias.

To investigate the extent of this problem, GRS_1 was regressed on GGDP and the growth of the proportion of the total population aged 10-24.[137] The regression estimated was

$$GRS_0 = 1.91 + 0.301GDDP<t> + 1.19GAGE$$
$$(0.730) \qquad (0.327)$$
$$\bar{R}^2 = -0.02 \qquad F<3,66> = 0.305 \qquad F<0.05> = 2.76$$

where GAGE = the population aged from 10 to 24.

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[136] Fagerlind & Saha. Op.cit., p. 37.

[137] GAGE is expected to affect GRS positively. The higher the growth rate of the proportion of the population aged 10-24, the larger will be GRS provided that the change in this proportion does not proportionately affect the size of the economically active population which is the denominator of the expression for GRS. Recognizing the possible impact of GGDP on GRS, the model was estimated by 2SLS technique. But the results were not found to be significantly different from that of the OLS.

As can be seen from the statistics, the explanatory variables both individually and jointly are statistically insignificant. There seems to be no reason to suspect a presence of an impact of growth on education in the context of the data used. Therefore, in the context of the data which were used for the estimation of the model, one may conclude that economic growth does not in any significant manner influence educational expansion. Thus, having biased and inconsistent problem resulting from simultaneity bias can be dismissed as a problem.

In winding up this chapter it may be stated that the underlying assumptions, at least some of them, are not glaringly unrealistic to render the estimates of the regression invalid.

Chapter VII

CONCLUSIONS

The focal point of the thesis was evaluating the role of education in economic growth in the context of developing countries between the years 1960 and 1980.

The brief survey of the relevant literature showed that the causal role of education in economic performance has been recognized and theoretically and, in certain cases, empirically justified.

The overview on the educational expansion and economic growth efforts and achievements of developing countries over the two decades brought forth the information that developing countries experienced a considerable educational expansion and a modest economic growth.

To evaluate the causal role of education in economic growth of developing countries models were considered, selected, modified and estimated using the OLS econometric technique. The choice of the model was largely dictated by the availability of data required for estimating the model and the relative plausiblity of assumptions in the context of developing countries under study.

The model selected and modified was one which links education to growth through improvement in the quality of the labor force. Post-primary enrollment standardized for economically active population and GDP were adopted to represent educational expansion and economic growth, respectively. Apart from education the model contains such explanatory variables as physical investment, labor force and exports.

The estimation of the model with alternative forms yielded results which seem to suggest that differences in current educational expansion among developing countries were not responsible for variation in their economic growth. On the other hand, it appears to be the case that variation in GGDP among developing countries was partly explained by differences in educational expansion carried out 15-20 years earlier. Thus the hypothesis that differences in educational expansion account for variation in economic growth among developing countries is, as expected, rejectable in the short run but acceptable in the long run context.

In conclusion, it may be inferred, in light of the estimates obtained, that, in the short run, the effect of educational expansion on economic growth is zero, if not negative. But in the long run, education, if utilized, is likely to have a positive contribution to economic growth.

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Appendix A

SAMPLE COUNTRIES AND BASIC COMPILED DATA

Country	GGDP	INR	GLF	GRS_0	GRS_1	GRS_2	GEX	GAGE
Algeria	7.76	60.35	5.24	7.74	7.53	8.14	6.04	0.735
Angola	0.680	13.20	2.02	13.71	5.57	15.66	3.30	0.060
Burkia F.	2.67	18.37	1.48	9.33	7.93	19.16	6.61	0.216
Burundi	4.88	15.06	1.36	5.73	9.32	12.28	-5.83	0.054
Cameroon	8.16	37.32	1.57	8.15	11.78	-0.87	10.61	0.265
Cen.Af.R.	0.552	11.75	1.73	12.45	13.24	18.33	13.16	0.123
Chad	-6.76	8.40	1.75	5.15	5.50	-74.52	-1.39	0.363
Congo	4.08	50.30	1.93	71.06	15.54	18.98	11.28	0.166
Egypt	10.54	44.26	1.94	4.05	5.84	9.33	8.69	-0.182
Ethiopia	3.01	11.70	1.26	5.17	7.65	37.56	61.43	-0.006
Ghana	0.717	8.79	5.22	1.41	34.00	-3.46	-8.97	0.231
Guinea	2.45	12.38	2.03	2.37	4.78	16.57	6.60	0.138
Ivory C.	6.80	36.83	3.33	4.63	5.17	18.71	4.02	-0.127
Kenya	5.65	33.62	3.14	8.01	7.94	16.55	1.32	0.056
Liberia	2.12	29.24	3.38	5.87	11.73	19.39	2.28	-0.127
Lesotho	9.55	40.66	1.87	7.74	14.56	3.58	20.42	0.145
Madagsc	1.35	19.11	2.20	3.77	5.31	12.94	-3.57	0.047
Malawi	5.40	21.35	2.58	-0.005	4.63	24.19	8.67	0.172
Mali	5.33	19.45	1.82	1.31	8.01	4.10	13.81	0.151
Mauritn.	2.14	41.02	2.02	8.43	-17.07	27.14	-1.93	0.162
Mozamb.	0.106	8.83	4.81	4.53	6.19	7.39	0.57	0.330
Niger	7.17	38.47	2.96	16.84	11.71	16.10	1.95	0.032

Nigeria	3.43	25.52	1.68	19.3	5.51	6.92	3.61	0.251
Rwanda	4.14	24.47	2.94	-5.23	1.00	3.27	8.81	0.558
Senegal	1.00	14.52	2.62	2.18	3.29	19.34	0.811	0.039
Siera L.	1.54	17.63	1.90	3.45	5.66	14.86	-3.61	0.013
Somalia	4.06	17.56	3.16	3.38	2.48	23.07	-3.51	-0.060
Sudan	6.25	22.55	2.14	3.88	11.98	4.98	4.67	-0.083
Togo	2.49	31.57	1.63	8.29	20.68	16.97	10.53	0.182
Tunesia	6.49	35.12	3.06	3.97	-0.858	9.82	7.75	0.122
Uganda	-3.29	2.73	2.02	-36.46	0.86	-10.10	-7.32	0.095
Tanzania	4.28	23.41	2.57	-34.13	61.21	0.804	-7.21	0.038
Zambia	-0.97	14.25	2.27	2.65	4.62	30.84	-3.78	0.102
Cost R.	5.24	36.85	4.07	-1.21	11.14	0.350	4.36	0.588
Domn. R.	4.84	32.02	3.63	1.98	8.57	3.39	4.42	0.894
Elsalv.	1.04	15.80	2.83	-0.435	-6.03	7.33	0.502	0.420
Guatam.	5.72	15.11	3.34	7.02	2.73	8.80	5.53	0.031
Haiti	4.79	17.88	1.45	3.18	4.68	-0.10	6.65	0.474
Honduras	7.20	30.55	3.39	11.88	4.56	6.44	9.15	0.485
Jamaica	-3.02	9.85	2.59	0.257	17.24	10.72	4.95	2.930
Mexico	6.66	38.69	2.97	5.48	5.98	14.88	12.16	0.530
Nicarag.	-3.63	12.77	4.00	6.62	5.59	15.08	-11.15	0.205
Panama	5.93	32.29	2.52	2.39	8.25	4.58	8.86	0.605
Tri.&Tb.	8.03	55.56	3.05	1.95	3.03	9.55	-3.57	0.246
Argentina	1.95	27.29	1.41	-1.01	5.54	-32.29	11.23	2.69
Bolivia	3.22	13.17	2.43	2.67	4.89	72.78	0.86	-0.019
Brazil	6.88	80.28	-0.377	6.60	-8.91	8.90	5.36	0.196
Chile	7.46	34.27	2.72	-0.019	7.09	6.77	14.76	0.487
Columb.	5.53	30.10	3.80	1.77	8.74	11.11	4.97	0.574
Ecuador	6.44	38.82	3.35	4.43	10.82	-29.71	1.23	0.429

Parag.	10.53	50.39	2.71	5.74	4.16	12.51	9.42	0.107
Peru	1.87	16.40	2.69	4.35	4.35	49.86	4.05	0.476
Uruguay	4.45	25.04	0.395	-2.86	2.01	9.94	8.74	0.105
Venez.	3.47	34.25	3.89	1.61	5.41	5.40	-3.59	0.340
Afghan.	1.51	15.86	2.15	6.17	-4.80	6.09	13.04	0.560
Burma	6.33	21.77	1.60	2.46	1.85	8.60	12.57	0.222
Hong K.	12.71	51.21	3.77	0.257	5.14	3.55	16.62	-0.559
India	3.49	25.42	2.04	1.24	2.13	24.78	7.68	0.444
Indones.	7.92	37.58	3.01	6.04	4.85	13.52	4.04	0.646
Jordan	12.32	74.25	3.38	5.84	6.90	7.83	24.23	0.751
S. Kor.	7.58	46.083	2.53	1.59	5.82	3.98	17.47	0.810
Pakist.	5.90	17.82	2.83	-0.507	2.54	-8.32	7.58	0.356
Philip.	6.27	38.91	2.65	3.09	2.49	9.38	12.77	-0.224
Singap.	8.74	57.02	2.48	-3.04	1.34	9.37	13.87	-0.381
Syria	5.97	36.39	3.92	0.833	4.58	13.46	-3.48	0.231
Thailand	7.56	36.51	2.93	7.58	10.04	2.83	15.57	0.551
Turkey	2.79	27.56	1.67	2.10	3.38	6.39	0.99	0.482
Greece	4.33	28.90	1.14	0.72	3.96	5.77	8.92	-0.092
Portugal	5.01	24.79	0.71	-30.19	1.36	5.62	10.84	-0.252

Source: Compiled From

- UNESCO, Statistical Year Book, 1970, 1978-79, 1983 & 1984 (for enrollment).
- World Bank, World Bank Tables, 1980 (for GDP, labor force and exports)
- ILO, Economically Active Population, 1950-2025, third edition vol. 1-4. (for population aged 10-24)

Appendix B

DISTRIBUTION OF ENROLLMENT BY FIELD OF STUDY, 1965 & 1980

Country	Year and field of study					
	SS & R.		NS & R.		A. F. F.	
	1965	1980	1965	1980	1965	1980
Algeria	54.2	42.2	44.5	56.4	1.3	1.3
Egypt	54.5	64.0	32.3	26.3	12.7	8.8
Ethiop.	66.8	43.4	21.8	39.6	11.4	17.0
Ivory C.	72.6	72.3	27.4	22.6	0.0	4.3
Kenya	47.2	50.6	40.1	39.8	12.1	5.4
Mozam.	22.9	30.8	65.7	23.2	11.4	4.1
Senegal	59.1	67.2	40.9	30.9	0.0	1.9
Togo	100.0	61.7	0.0	27.2	0.0	5.8
Costa R.	88.4	57.4	9.7	24.2	1.9	6.2
Nicarag.	73.1	32.3	22.1	22.9	4.8	2.6
Panama	66.9	58.2	31.0	32.8	2.1	1.5
Chile	60.6	42.6	27.7	50.5	3.0	2.1
Ecuador	50.3	53.9	34.9	38.1	7.6	6.3
Hong K.	57.0	43.1	39.4	56.2	7.8	0.0
Jordan	77.1	72.1	17.9	22.6	2.6	2.1

Source: Compiled from UNESCO, Statistical Year Book, 1970 & 1983.

SS & R. stands for social and behavioural science, education science & teacher training, humanities, religion & theology, fine and applied arts, law, commercial and business administration, home economics & domestic science and service trades.

NS & R. includes natural science, mathematics & computer science, engineering, architecture & town planning, medical & health related science, trade, craft & industrial programmes, transport and communications.

A. F. F. stands for agriculture, forestry and fishery.

Note: In the event of the presence of unallocated enrollment among the three broad fields of study, the total for a given year and country is short of 100 percent.