SOURCES OF ECONOMIC GROWTH IN LESS DEVELOPED COUNTRIES

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TO

MY MOTHER

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CHAPTER : 1

INTRODUCTION

Economic growth as a policy objective is sought eagerly by all countries of the world, more so by the developing part of it. But though it was possible to make a list of factors such as labour, capital, education, technological advance etc., that have contributed to economic growth in the past, it was not until the latter part of 1950's economists started to investigate the quantitative contribution of each single factor in the growth process. It was felt that such a quantitative assessment would assist in policies designed to foster economic growth as they would point to the likely direction that policies should take.

Pioneering work in the field of sources of economic growth, was done by Kuznets (1956), Abramovitz (1956), Solow (1957) and Denison (1962). Though the approaches adopted by them were different, they were united in the ends they sought. They were all interested in getting numerical estimates and hence the relative importance of the various factors contributing to economic growth.

Economic growth is generally taken to mean the growth of the national product. A major feature however is that the contributions to growth of different factors vary, both with respect to their magnitude and relative importance, between developing and developed countries.

Thus, while analysing the growth literature one finds that in developed countries the following conclusions can be drawn:

a) Capital input turns out to be less important than labour input in the growth process.

b) Quality improvements in the factors, such as education seems to make a high positive contribution to growth.

c) It is also observed that productivity factors contribute a great deal to output growth.

In the case of developing countries, the story is entirely reverse.

a) Capital contributes more to output than labour.

b) Education's contribution to output is meagre.

c) Productivity factors contribution though significant is not as high as in developed countries.

It is because of the fact that a contradiction exists in the growth process between developing and developed countries, one is motivated to attempt a source of growth analysis for developing countries.

The Approach

The approach followed in the analysis of sources of growth is generally the production-function approach. It is a theoretical method which facilitates an understanding of the sources of growth, and tries to quantify the contribution of these sources to any measured growth rate. The approach has been used extensively and usefully in developed countries and it is now beginning to be employed in the context of developing countries.

One of the desirable properties of any macro-economic hypotheis, apart from being consistent with the observed facts, is that it should be consistent with, and derivable from micro-economic theory. What we are calling the production-function approach to the analysis of growth in the aggregate processes in part this desirable property, in that it borrows the concept from the theory of the firm. Just as it can be said for a firm that output is a function of the factors of production - land, labour, capital and the levels of technology - so aggregate output can be written as a function of factor inputs and the prevailing technology, i.e.

$O = f\ (R, K, L, T)$ where

O = output; R = land; K = capital; L = labour; T = technology

Inspite of the fact that production-function approach provides for an emprically testable model, it has certain shortcomings.

Starting from an aggregate production-function begs the question of aggregation. Thus the use of production-function approach may require in the words of a pioneer in production-function application, Solow - "a willing suspension of disbelief".

Again in most of the cross section studies using the production-function approach, an assumption of uniform production-function throughout the sample is often made, which may not be quite true.

But all we wish to say at this juncture is that this study makes use of the production-function approach mainly because, inspite of the shortcomings of the approach it provides an emprically testable model.

Most of the studies until recently which make use of the production-function approach have been done so in the context of advanced countries. Though in recent years, valuable studies have been conducted for the developing world (Robinson, 1971; Oyejide, 1986; Hwa, 1983) there are only a few of them. Again it is felt that even in these studies trade factors have not been given much of an importance. Inspite of the fact that there are few studies which have examined the effect of export on growth (Balassa, 1978; Oyejide, 1986; Hwa, 1983), there is practically no study which studies both export and import factors under the framework of a production-function. Thus this attempt should be seen as adding to the literature on sources of economic growth in the case of developing countries, with particular emphasis on examining the role of trade factors in the growth process.

Research in developing countries has been hampered, by a shortage of reliable emprical data, and perhaps an even greater suspicion of the aggregate production-function and its implicit assumptions than in developed countries. The assumption that factor shares can be used as weights to measure the relative contribution of labour and capital to growth is often hotly debated.

Since it is felt that the price of labour almost certainly exceeds its marginal product, while the price of capital falls short of it so that the share of income going to labour exceeds the elasticity of output with respect to labour and share of income going to capital understates the elasticity of output with respect to capital.

Second, the aggregation of inputs and outputs is generally more difficult and there are greater problems of resource under utilisation to content with than in case of developed countries. But the production-function approach it is found, despite its drawbacks, does yield verifiable hypotheses. Further, considering the importance of economic development for the developing countries it is opined that it is worthwhile to get even rough estimates of the quantitative importance of the different factors in the growth process.

This work is thus an attempt to measure, though not exhaustively, the sources of economic growth in less developed countries. The study makes use of the production-function approach to the analysis of growth and is a cross sectional study based on a sample of 30 developing countries in Asia and Latin America.

The underlying model tends to be mechanistic and ignores important social and political differences among countries. Consideration of these factors is left out of this study for two reasons. First the emphasis here is on comparisons with existing published studies using the traditional production-function approach, second the present state of knowledge about quantifying non-economic factors requires, we feel, more indepth study of how these factors influence the growth process, which is beyond the scope of our study.

In the final analysis, this study should be seen as a preliminary investigation, setting its target on a more exhaustive study in the future.

In Chapter II, we present a brief survey of the literature, Chapter III discusses the analytical framework of the study, Chapter IV deals with data sources and definition of variables, Chapter V examines our results and finally in Chapter VI, we discuss our conclusions and areas of future research.

CHAPTER : 2

SURVEY OF LITERATURE

Ever since Kuznets (1956), Abramovitz (1956), Solow (1957) reported their findings, a fairly substantial body of emprical evidence relating to the sources of growth has accumulated. The studies, however,differ in the time periods for which they have analysed the growth process, the data used and the methodology employed. Further until recently most of the evidence available pertained to fairly advanced countries and it is largely from this evidence, wisely or not, that conclusions have been drawn on development strategy for developing countries. But of late there has been a few studies which devote their attention to developing countries. Inspite of the fact that the studies undertaken for developing countries use different approaches and often dubious data, it is heartening to note that the conclusions from these studies point in roughly the same direction, a direction in variance to that reached in studies for developed countries.

To provide a systematic survey of this disparate and growing field, the following plan has been adopted in this chapter. First we will survey the sources of growth studies in developed countries. Next we will survey growth studies in developing countries.

Sources of Growth Studies in Developed Countries

The pioneering works in the field of sources of growth have been attempted in the context of advanced countries. Important among these studies are the works of Kuznets (1956), Abramovitz (1956), Solow (1957) and Denison (1962).

The writings of Kuznets (1956) present data concerning growth, which are a basic source of information for students in the field. But though Kuznets has certain hypothesis concerning growth, the drawback of his work lies in the fact that these hypothesis are tested only in terms of simple statistics, often because of the difficulty of stating the hypothesis in a quantifiable manner as also lack of data which would enable its testing.

Thus while considering the effect of the distribution of income by size among individuals and households on economic growth he notes that no single summary measure of inequality in the size distribution of income for a given country at a given time is adequate. Thus his final measure contains only grouping of countries according to the shares of the top and bottom ordinal groups (groups distinguished by the order position of their per unit income). As Kuznets himself admits such a measure does not allow him to clearly evaluate the effects of the size distribution of income on economic growth. His emprical work thus involves an approach which rejects all but the barest essentials of economic theory. The serious shortcomings of Kuznets's work therefore is that no theory of growth emerges from the book and no competing hypotheses are explicitly rejected or confirmed by the vast amounts of evidence collected. Kuznets has always chosen the approach of collecting economic data which others may use to submit hypothesis to test. It is here that his contribution has been the greatest.

Inspite of the descriptive nature of his work, his work is important in that it leads him to certain broad conclusions, which we summarise below.

Kuznets analysed and identified six characteristic features of the growth process that every contemporary developed nation has experienced. These are:

a) A changing production structure due to changes in income elasticities of demand (people generally buy a greater proportion of manufactured goods and less of food stuffs as income grows).

b) High rates of increase in total factor productivity especially labour productivity due to shorter man hours and investment in education.

c) Rapid social and ideological transformation.

d) Regarding size distribution of income and economic growth, he notes that early periods of development are characterised by rapid growth in non agricultural sector and greater inequality within it. In the later periods inequality diminishes due to (a) narrowing of intersectoral inequalities of product per worker; (b) declining property income share, (c) institutional changes that reflect decisions regarding social security and full employment.

e) The limited international spread of economic growth.

f) High rates of growth of per capita output.

Further Kuznets has always cautioned against the use of cross sectional analysis in historical study. He feels that only economic history captures innovational changes. But here we wish to point out that neither cross section nor time series is very useful evidence without an underlying theoretical framework upon which to hang it.

Further Kuznets work seems to confirm other people's studies of a high residual factor in the growth process. In general the growth of output whichcannot be explained by economic inputs (land, labour, capital etc), has been traditionally identified as a residual in the growth processes. In most of the studies undertaken for advanced countries, this residual factor seems to explain most of the growth. Kuznets data seems also to point in this direction.

In the final analysis Kuznets's work apart from reaching certain broad conclusions which are interesting, makes no attempt either to compare his work with that of other studies, nor advanced any testable hypotheses. We will conclude in the words of Baldwin (1966), "hypothesizing on the basis of scanty data is still a highly valuable part of working toward a general theory......Kuznets does not of course, deny the value of such an approach but he probably minimises its value more than do most economists".

Solow (1957) and Abramovitz (1956) make use of an aggregate production-function approach to the analysis of sources of growth. Since Solow (1957) and Abramovitz (1956) seem to reach essentially the same conclusion, we will briefly review the work of Solow (1957).

The theoretical basis of Solow's (1957) work can be outlined as below.

If Q represents output and K and L represent capital and labour outputs in physical units, then the aggregate production-function can be written as:

$$Q = F(K, L, t)$$

The variable t for time appears in F to allow for technical change. Technical change is here used as a shorthand expression for any kind of shift in the production-function. Thus slowdowns, speedups, improvements in the education of the labour force and all sorts of things will appear as "technical change".

He then assumes technical change is neutral. Shifts in the production-function (here technical change) are defined as neutral if they leave marginal rates of substitution untouched but simply increase or decrease the output attainable from inputs. In that case, the production-function takes the special form.

$$Q = A(t)\, f(K,L) \qquad \ldots(2.1)$$

and the multiplicative factor A (t) measures the cumulated effect of shifts over time. Differentiating (2.1) totally w.r.t. time and dividing by Q he obtains

$$\dot{Q}/Q = \dot{A}/A + A\, \partial f/\partial K\ \dot{K}/Q + \partial f/\partial L\ \dot{L}/Q$$

where dots indicate time derivatives.

Defining $W_k = \partial Q/\partial K\ \dot{K}/Q$ and $W_1 = \partial Q/\partial L\ \dot{L}/Q$

as the relative shares of capital and labour and substituting in the above equation (note $\partial Q/\partial K = A\, \partial f/\partial K$, etc).

We obtain:

$$\dot{Q}/Q = \dot{A}/A + W_k\ \dot{K}/K + W_1\ \dot{L}/L \qquad \ldots(2.2)$$

Further since it is assumed that factors (K and L) are paid their marginal products, W_k and W_1 add upto one which implies F is homogenous of degree one and Euler's theorem holds.

Now letting $Q/L = q$, $K/L = K$

$W_1 = 1 - W_k$; $\dot{q}/q = \dot{Q}/Q - \dot{L}/L$ etc.,

$$\dot{q}/q = \dot{A}/A + W_k\ \dot{K}/K \qquad \ldots(2.3)$$

Now all Solow needs to disentangle the technical change index A(t) are series for output per man, capital per man and the share of capital.

Applying this model to the U.S. economy for the period 1909-1949, Solow reached the following conclusion. Gross output per capita doubled over the interval with 87½ percent of the increase attributable to technical change and the remaining 12½ percent to increased use of capital per head.

Commenting on this result, Abramovitz (1956) remarked: "This result is surprising in the lopsided importance which it appears to give to productivity increase and should be; in a sense sobering, if not discouraging to students of economic growth. Since we know little about the causes of productivity increase, the indicated importance of this element may be taken to be some sort of measure of our ignorance about the causes of economic growth in the United States, and some sort of indication of where we need to concentrate our attention".

The findings of Abramovitz and Solow disturbed economists brought up in the belief that investment and capital accumulation played a crucial role in the growth process. Even allowing for the statistical difficulties of computing a series of capital stock, and the limitations of the function applied to the data, (eg: the assumption of constant returns and neutral technioal progress, plus the high degree of aggregation), it was difficult to escape from the conclusion that the growth of capital stock was of relatively minor importance in accounting for the growth of total output.

Economists who followed Solow were much interested in looking at how far Solow's conclusions were valid for advanced countries. Work has proceeded on two fronts. On the one hand, attempts have been made to disaggregate the residual factor, measuring factor input in the conventional way; on the other hand attempts have been made to adjust the labour and capital input series for such thing as changes in the quality of factors (like education) and their composition so that much more measured growth is seen to be attributable to increases in the factor inputs in the first place.

The work of Denison (1962) tries for example, to incorporate both lines of research. Since in some sense Denison's work can be seen as an extension of Solow's work, this approach has come to be called the Solow-Denison approach in the literature.

Denison (1962) in dealing with data from the real world, keeps a large measure of freedom to add variables and incorporate them in his analysis. He describes himself as a standardizer not an aggregate production-function economists, although his analysis does incorporate an implicit production-function, even though he does not work with an explicit production-function.

Denison (1962) framework can be sent forth as

$$Y = f\ (K, L, A) \qquad \ldots(2.4)$$

In this formulation A (technological change, advances in knowledge, residual etc.) is a true residual, not a function of time, as in Solow's (1957) analysis. A is also independent of either K or L or A remains totally disembodied. Denison adds a term for improvements in resource allocation (though he does not incorporate any theory about what processes may foster or inhibit improved allocation). Finally he introduces economies of scale as a simple proportionality to the level of national income attained.

Differentiating equation (2.4) w.r.t. time and extending it to incorporate Denison's elaborations would give us

$$dY/Y = u\left[\beta dL/L + (1-\beta)\ dK/K + dZ/Z + dA/A\right] \ldots(2.5)$$

β = Elasticity of output w.r.t labour

$1-\beta$ = Elasticity of output w.r.t capital

u = Scale factor

dY/Y = Output change

dZ/Z = Rate of improvement in resource allocation

dA/A = Rate of advancement in knowledge

$$dA/A = 1/u\ dY/Y - \left[\beta\ dL/L + 1-\beta\ \ dK/K + dZ/Z\right] \qquad \ldots(2.6)$$

Here it should be seen that Denison's labour and capital index is a composite one which includes in it quality factors affecting labour (like education) and capital (vintage factors).

Applying his framework to the U.S. economy for the period 1929-57, he finds the following results, summarised in Table (2.1.).

One can see from the Table (2.1) that about 68% of total growth can be attributed to growth in factor input and 32% of total growth is explained by productivity factors. Thus we see that the contribution of residual factor to growth falls from 87½% in Solow's case to about 32% in Denison's study. Even this 32% is broken up into its component parts, namely economies of scale, industry shift from agriculture, and advances of knowledge. Thus one can see from Denison's analysis that only 20% of growth attributed to advance in knowledge, is a residue in any real sense.

<u>Educations Contribution to Growth in Developed Countries</u>

The low value for the residual in Denison's analysis is obtained by him, because of the fact that in his analysis quality factors like effect of education on labour, employment, hours of work etc., have been explicitly included in order to show that greater contribution to output comes from the factors of production rather than some unknown residual.

We will now, examine in detail at how Denison arrives

Table 2.1 : Allocation of Growth Rate of Total Real National Income Among the Sources of Growth, (1929-57)

	% Points in Growth Rates	% of Growth Rate
Real national income	2.93	100
Increase in total inputs	2.00	68
Labour adjusted for quality change	1.57	54
a) Employment and hours	0.80	27
1. Employment	1.00	34
2. Annual hours	-0.53	-18
3. Effect of shorter hours on quality on man hours work	0.33	11
4. Effect of shorter hours on quality of man-year's work	-0.20	-7
b) Education	0.67	23
c) Increased experience and better utilisation of women workers	0.11	4
Land	0.00	0
Capital	0.43	15
a) non farm residential structure	0.05	2
b) Other structures and equipment	0.28	10
c) Inventions	0.08	3
d) U.S. owned assets abroad	0.02	1
Increase in output per unit of input	0.93	32
a) Restriction against optimum use of resources	-0.70	-2
b) Reduced waste of labour in agriculture	0.02	1
c) Industry shift from agriculture	0.05	2
d) Advance of knowledge	0.58	20
e) Changes in lag in application of knowledge	0.01	0
f) Economies of scale-independent growth of national markets	0.07	2
g) Economies of scale-growth of national markets	0.27	9

Source: Denison, The Sources of Economic Growth in the United States.

at an index for education. The major conceptual problems regarding measurement of contribution of education and results of emprical work attempted to measure the contribution of education to growth in developed countries are also discussed.

In order to take account of the fact that additional education increases an individual's ability to contribute to production and his earnings, Denison takes the differences in average earnings among males 25 years of age or more, classified by their age and number of years of school completed as a measure of differentials in the average contribution to production made by individuals comprising them.

In order to allow for the effect of other factors on income differences, Denison makes the bold assumptions that 60% of the reported income differentials represent differences in incomes from work due to differences in education as distinguished from associated characteristics.

It is seen from Table (2.1) that under these assumptions Denison gets a very high contribution of education to economic growth. Thus for the period 1929-57 for the U.S. economy he finds 0.68 percentage points or 23% of the 2.93 percentage point growth rate of national product as the direct contribution of more education.

The main specific assumption underlying these results is that differences in labour earnings due to differences in education equal three fifths (60%) of the observed differentials in money income among adult males of the same age classified by years of education.

In general criticisms have been levelled against the rather bold assumption made by Denison that 40% of the differences in mean income of the people are due to factors other than education. There is no emprical evidence given by Denison in support of this rather bold assumption. It is felt that income differences may not be due to education alone, other factors like ability, energy, motivation, parental education, parental age of marriage etc., have also a role to play. Denison's calculation of education's contribution to growth is also incomplete in the sense that it ignores on the job training or training outside formal educational institution. Lastly Denison's calculation seems to take account only that part of returns to education which is captured by individuals, it does not consider gains from education accruing to the society as a whole.

Jorgenson and Grilliches (1967) incorporated data on education for each year from 1945-65 in an econometric time series analysis. They used chain-linked Divisia index procedure. This is in marked contrast to Denison's work, which studies growth only between two calendar periods. The procedure adopted by Jorgenson Grilliches thus allow for adjustment in weights, when real wages associated with one level of education versus another rose or fell (They assume relative wages are good approximation of productivity ratios). The emprical result of Jorgenson Grilliches for the period 1945-65 for the U.S. economy was that, of the annual growth rate of 3.59% points, just over a tenth of it was due to improvements in the quality of labour force. While for a similar period (1950-62) Denison gets an estimate of the contribution of education to growth as 15%.

Schultz looked at education as an investment in human capital. Thus he asked himself the question: What had been the investment in schooling and what were the returns from such an investment?

An important contrast between the Schultz and Denison approaches in conceptualisation and in associated emprical treatment of education is that Denison omits yields attributable to that part of investment in new members of the labour force that was required to maintain the mean levels of schooling of the base year. Denison credits this educational "maintenance" component simply to increase in numbers employed. The downward bias, it is felt, can be substantial.

One of the problems encountered in measuring the contribution of education to economic growth is the use of suitable lags. This is felt necessary because it is logical to expect that the effect of education on growth will be often felt after a lag. Economists are not certain as to the period of lag one has to work with. In general 5 year or 10 year lag period is often considered acceptable. Most often, however, the lag period used is dictated by the availability of data.

A serious problem however in single-equation approaches measuring the effect of education on growth is that the casuation may run in both directions. That is, education may influence income and income may in turn influence education. This is referred to as simultaneous equation bias in the literature. In order to overcome this bias one must work with a simultaneous equation model.

Further educational expenditures can be viewed at both from the angle of a consumption expenditure or as an investment in human capital formation. Its net effect on growth will therefore depend on whether the cost of education as a consumption expenditure is greater or less than the benefits of education, viewed as an investment in human capital. Thus any study which seeks to measure the contribution of education to growth must also take this benefit-cost factor into account.

These then are some of the major conceptual and methodological problems involved in estimating the contribution of education to growth.

We will now take up briefly, some of the studies which have attempted to measure the contribution of education to growth.

Schultz (1961) stressed that the investment in human capital explained to a great extent differences in earnings among people. He offers the example of young men entering the labour force having an edge over older workers because they posses greater amount of education. Further he points out that the curve relating income to age tends to be steeper for skilled than for unskilled persons, which seems to point to investment in on the job training. Thus Schultz is of the opinion that the widely observed increases in national output have been large compared with the increases of land, man hours and physical reproducible capital, and investment in human capital is probably the major explanation for the difference. Schultz estimated that education accounted for 21-40% of national income growth in the United States over the period 1929-56.

Razin (1977) tests the hypothesis that there exists a relationship between the rate of increase in the productivity of labour and the fraction of economically active population engaged in schooling.

He starts from an aggregate production function of the form

$$Y_t = F\ (K_t, A_t\ L_t) \qquad \ldots(2.7)$$

where Y, K and L stand for the national product, the aggregate capital stock and labour force, respectively and A_t is the index of the (average) quality of labour. All variables are regarded as functions of time.

Using Euler's theorem, he gets

$$F_1\ (\ )K + F_2 L\ (\ )\ A_L = \theta Y \qquad \ldots(2.8)$$

where if θ greater than, equal to, or lower than one, returns to scale are increasing, constant or decreasing, respectively. Letting a be the fraction of economically active population engaged in schooling, b the fraction of total population in economic activities, and N the total population. Labour force L is then related to the total population N by

$$L_t = S_t\ N_t \qquad \ldots(2.9)$$

where $L_t = (1 - a_t)\ b_t$ is the fraction of the total population in the labour force. It is assumed S_t is relatively constant overtime.

Suppose the rate of increase over time in the index of labour productivity A is related to a in such a way that the higher the a , the higher the rate of increase in A. This relation is denoted by an increasing function $\phi(\cdot) > 0$

$$\dot{A}_t = A_t \phi(a_t), \phi(\cdot) > 0 \qquad \text{...(2.10)}$$

dot over the symbol denotes time derivative.

When there are M different forms of schooling with type i having a fraction a_i of the economically active population. Then,

$$\dot{A}/A = \sum_{i=1}^{M} \phi_i(a_i) \, A_i L_i / AL, \quad AL = \sum_{i=1}^{M} A_i L_i \qquad \text{...(2.11)}$$

Equation (2.11) assumes different types of labour are perfect substitutes.

The per capita national product is given by

$$y_t = Y_t/N_t \qquad (2.12)$$

upon differentiating (2.12) using (2.7) to (2.11) with a constant S_t we get the relative rate of increase over time in y

$$\dot{y}_t/y_t = r\,(\dot{K}_t/Y_t) + S_L \phi(a_t) + (\theta - 1 - S_K)\,\dot{N}_t/N_t \qquad (2.13)$$

where $S_L = AL\,F_2(\ )/F(\ )$, $SK = KF_1(\ )/F(\ )$ are under competition, the distribution income shares of labour and capital $r = F_1(\ )$ is the rate of return on capital.

(2.13) tells us that in Razin's analysis, the three major variables accountable for the proportional rate of growth of per capita income are (1) Investment income ratio $\dot{K}/Y$,

(b) The fraction of economically active population engaged in schooling a (c) The proportional rate of population growth $\dot{N}/N$.

A summary of the developments of the variables $G(\dot{y}/y)$, $i\ (\dot{K}/Y)$, $e(a)$ and $n\ (\dot{N}/N)$ is presented in Table 2.2.

There are positive association between the growth of per capita GNP on the one hand and the investment GNP ratio and the percentage of the population aged 15-19 enrolled in the secondary level of education on the other. There does not seem to be significant association between the growth of per capita GNP and the growth of the population.

The regression equation fitted to 132 observations (12 years, 11 countries) reveals

$$G = -101.135 + \underset{(5.4)}{1.8831\dot{i}} + \underset{(4.3)}{23.0 \log e} + \underset{(4.9)}{0.78\ n} \qquad \ldots(2.14)$$

t values are given in brackets.

$R^2 = 0.54 \quad F\ (3,\ 128) = 51 \quad df = 128$

In the equation the coefficient of the education variable loge is positive and highly significant as is the coefficient of the investment variable i. Also positive and significant is the coefficient of the rate of growth of population.

Thus the major conclusion which emerges from Razin's work is that there is a positive and highly significant association found between growth of per capita GNP and education.

Table 2.2 : Growth of Product Investment Product Ratio Population Growth and School Enrollment by Country (1953-65)

Country	Index No. of GNP in 1965 at constant prices (1953=100)	Mean Ratio of Gross domestic capital formation and GNP	Index No. of pop. in 1965 (1953=100)	Percentage of pop. aged 15-19 enrolled in secondary education 1959	1960
Australia	128	0.258	130	57	75
Belgium	142	0.192	108	59	79
Canada	121	0.240	132	43	64
Denmark	152	0.205	109	63	74
France	156	0.205	115	76	75
Israel	216	0.317	156	75	75
Netherlands	152	0.255	117	44	82
Switzerland	151	0.256	120	31	39
United Kingdom	134	0.171	107	72	74
United States	125	0.182	121	60	76
West Germany	178	0.253	115	77	77

Source: Razin, 1977

Denison (1967) studies the sources of growth in nine western countries (including America) for the period 1950-62.

A summary of the major findings is shown in Table 2.3. From the Table (2.3) it can be seen that education appears as a positive contributor to growth. There seems to have been an expansion of the number of years schooling per man in all countries and Denison has done a useful job in comparing the growth of the stock of education between countries. To calculate the contribution of the expansion of education to growth, earnings weights are applied to the distribution of the labour force by amounts of schooling making the assumption that 60 percent of earnings differentials between people of the same age are due to differences in number of years of schooling they have received. Given the present state of our knowledge of the causes of income differentials, Denison's opinion (assumption) can perhaps be allowed to go unchallenged. On the other hand, it seems a little unlikely that the percentage earnings differentials due to differences in education will be the same in every country when different attitude prevails in different countries towards the reward of ability and educational attainment.

From the Table (2.3) Denison concludes that education by itself contributed 0.49 percentage points (15%) to growth in the United States, 0.23 percentage points (5%) in North-West Europe and 0.29% points (12%) in the United Kingdom. Denison feels that

Table 2.3 : The Allocation of the Sources of Growth (measured in percentage points)

Country	Rate of growth of national income 1950-62 (%)	Con. of total labour input & effect of hlth & nutri.	Contribution of labour input disaggregated into					Con. of total capital input	Con. factor input disaggregated as			Cont. of total factor productivity growth	Cont. of resource shifts to total productivity growth
			Emp. grow.	Hlth. nut.	Working hrs	Age/ Sex	Edu.		Dwellings	Equip. inventories	International assets		
Belgium	3.20	0.76	0.40	0.09	-0.15	0.08	0.43	0.41	0.02	0.45	-0.06	2.03	0.20
Denmark	3.51	0.59	0.70	0.07	-0.18	-0.07	0.14	0.96	0.13	0.81	0.02	1.96	0.41
France	4.92	0.43	0.07	0.15	-0.02	0.10	0.29	0.79	0.02	0.75	0.02	3.70	0.65
Germany	7.26	1.37	1.49	0.28	-0.27	0.04	0.11	1.41	0.14	1.35	-0.08	4.48	0.76
Italy	5.96	0.96	0.42	0.28	0.05	0.09	0.40	0.70	0.07	0.66	-0.03	4.30	1.04
Netherlands	4.73	0.87	0.78	0.04	-0.16	0.01	0.24	1.04	0.06	0.88	0.10	2.82	0.21
Norway	3.45	0.15	0.13	0.14	-0.15	-0.07	0.24	0.89	0.04	0.92	-0.07	2.41	0.54
United Kingdom	2.29	0.60	0.50	-0.03	-0.15	-0.04	0.29	0.51	0.04	0.52	-0.05	1.18	0.06
United States	3.32	1.12	0.90	0.02	-0.17	-0.10	0.49	0.83	0.25	0.53	0.05	1.37	0.25

Source: Denison Why Growth Rates Differ.

growth of education in the United States has been a much greater stimulus to growth than in Europe, and faster growth in Europe than in America can not be explained by a faster rate of expansion of education. Education thus appears to be a relatively untapped source of growth in Europe.

The work of Jorgenson and Grilliches (1967) however strikes a discordant note. They point out that if quantities of output and input are measured accurately, growth in total output may be largely explained by growth in total inputs, leaving very little of output to be explained by productivity factors (like education health etc.).

Table 2.4 below summarises their results.

Table 2.4 : Total Output, Input and Factor Productivity U.S. Private Domestic Economy 1945-65
Average Annual Rates of Growth

	Output	Input	Productivity
1. Initial estimates	3.49	1.83	1.60
Estimates after correction for:			
2. Errors of aggregation	3.39	1.84	1.49
3. Errors in investment goods prices	3.59	2.19	1.41
4. Errors in relative utilisation	3.59	2.57	0.58
5. Errors in aggregation of capital services	3.59	2.97	0.58
6. Errors in aggregation of labour services	3.59	3.47	0.10

Source: Jorgensen and Grilliches, 1967.

They first present their initial estimates of rates of growth of output, input and total factor productivity. Then they point out that these estimates include many of the errors made in attempts to measure total factor productivity without fully exploiting the economic theory underlining the social accounting concepts of real product and real factor input. Then they start to weed out the various errors as presented in Table 2.4 (like errors of aggregation, relative utilisation, capital and labour services etc.).

Thus, it can be seen that the rate of growth of input initially explains 52.4% of the rate of growth of output. After elimination of aggregation errors and correction for changes in the rates of utilisation of labour and capital stock, the rate of growth of input explains 96.7% of the rate of growth of output; changes in total factor productivity explain the rest.

Based on these estimates for the period 1945-65, Jorgenson and Grilliches come to the conclusion that if the economic theory underlying the measurement of real product and real factor input is properly exploited, the role to be assigned to growth in total factor productivity is small.

The major conclusions one can arrive at from a survey of growth literature in case of developed countries in general, and the role of education in particular, are as follows:

a) The studies for advanced countries tend to confirm the relative unimportance of capital compared with other growth-inducing variables. Even allowing for changes in its composition, and embodiment, capital growth rarely accounts for more than one half of the measured growth of output. Denison who adjusts capital stock for changes in its composition (Table 2.3) estimates a contribution of aproximately 25% in the United States over the period 1950-62, and only 15% for the period 1929-57 (Table 2.1) before adjustments. It is only just under 20% (Table 2.3) over the period 1965-72 for North West Europe. Again Solow (1962) using an embodied model finds the weighted contribution of embodied technical progress for plant and machinery less than that of disembodied progress.

b) Education appears to contribute highly to growth. Thus Denison for the period 1929-57 for the U.S. economy finds that education's contribution to growth is around 23% (Table 2.1). For the period 1950-62 (Table 2.3) again Denison finds that education contributes 15% to growth in USA, 5% in North West Europe and 12% in the United Kingdom. The rather low contribution of education to growth in North West Europe is mainly because education seems to be a relatively untapped source of growth in Europe. Denison's estimates are also supported by Razin (1977).

c) Finally inspite of the contradictory evidence suggested by Jorgenson and Grilliches (1967) productivity seems to be a major contributor to growth in developed countries. Solow (1957) estimated that about 87½% of growth can be attributed to technical progress on productivity. Later Denison(1962) scaled this figure down to about 32% (Table 2.1). Denison's rather low estimate of productivity compared to Solow's is due to the fact that he incorporates quality factors (like education, hours of work etc.,) while calculating labour's contribution to growth. But it can be seen that inspite of these improvements incorporated into his analysis, Denison's estimate of 32% for productivity seems to be quite high.

Next we will take up a survey of growth literature in the developing countries. In particular we will try to emphasise on the role of education and trade factors in the growth process.

Sources of Growth Studies in Developing Countries

Maddisson (1970), studies 22 developing countries over the period 1950-65. His approach is conventional except for the adjustment of employment growth for such factors as migration of labour from agriculture to industry and improvements in health and education to obtain a measure of growth of effective labour force. Applying weights of 0.5 to the growth of labour force and capital growth rate in each country, Maddisson concludes that acceleration of investment (proxy for capital growth) has been the most important engine of growth in the post war developing world.

Over all the growth of effective labour force is estimated to have contributed about 35% to average measured growth rate and capital growth 55% leaving a residual contribution of 10% attributable to increased efficiency in resource allocation.

The contribution of factor inputs and increased efficiency to measured growth in each of the individual countries is shown in Table 2.5.

Maddisson also makes the novel distinction in his analysis between growth that has been induced by policy changes and growth that would have occurred spontaneously. It appears that on average, policy-induced growth in the form of induced investment, improvement in health and education, accounted for 40% of measured growth. However, other policies like import restrictions, misguided subsidization had a negative effect on growth in some countries as shown in Table 2.5.

Robinson (1971) starts from a general aggregate production-function of the form

$$Y = F(K,L) \qquad \ldots(2.15)$$

and introduces (a) structural changes and (b) foreign exchange constraint into his model.

Table 2.5 : The Contribution of Factor Inputs and Increased Efficiency to Economic Growth (1950-65)

(measured in percentage points)

Country	Growth rate	Human resources	Non-Residential capital	Growth due to change in efficiency
Argentina	3.20	1.05	2.80	-0.65
Brazil	5.20	2.35	3.05	-0.20
Ceylon	3.60	1.60	2.00	-0.20
Chile	4.00	1.05	2.45	-0.50
Colombia	4.70	1.80	2.90	-0.10
Egypt	4.35	1.55	2.80	1.15
Ghanna	4.20	1.50	3.00	-0.30
Greece	6.40	1.30	2.85	2.25
India	3.50	2.35	2.35	-1.20
Israel	10.70	3.20	5.60	1.90
Malaya	3.5	2.05	1.80	-0.35
Mexico	6.10	2.45	3.20	0.45
Pakistan	3.7	1.70	1.85	0.15
Peru	5.6	1.20	3.40	1.00
Phillipinnes	5.0	2.40	2.55	0.05
South Korea	6.2	2.90	2.20	1.10
Spain	7.5	1.20	3.80	2.50
Thailand	6.30	1.70	3.50	3.30
Taiwan	8.5	2.70	7.40	0.20
Turkey	5.2	1.75	2.55	0.95
Venuzuela	6.7	3.10	4.65	-1.05
Yugoslavia	7.10	1.70	4.85	0.55
Average	5.55	1.94	3.06	0.55

Source: Maddison, Economic Progress and Policy in Developing Countries, Table 11.11, p. 53.

His analysis is a cross sectional regression analysis of 39 less developed countries.

a) Structural Change: To incorporate structure change into the model, he develops a two-factor, two-sector growth model.

He divides the economy into two sectors (a) industrialised manufacturing sector (b) agricultural sector. The supply of each factor in each sector grows at some natural exponential rate due to population increase and investment thus providing the underlying sources of growth. Factors can be transferred from one sector to other, thus changing the rates of growth of both sectors.

b) Foreign Exchange Constraint: Since foreign exchange can be produced from domestic sources and used to increase the capital stock or fill gaps in demand, it has to be allocated and valued like any other scarce resource. Thus, resources devoted to increasing the supply of foreign exchange is treated in Robinson's analysis as analogous to usual investment and the marginal productivity of such investment estimated. But since investment in foreign exchange is a difficult variable to measure directly, Robinson proposes an indirect measure. Starting with the postulate that all foreign exchange has an opportunity cost and assuming that the gap in the balance on current amount (net foreign balances) will be financed to equate, at the margin the return to and cost of foreign exchange, the average level of net foreign balances that a country is willing to sustain over time will reflect the amount of investment in foreign exchange that the country finds productive. Thus the level of net foreign balances is used as a measure at the margin of investment in foreign exchange.

The detailed results of Robinson's emprical work is given in Table 2.6.

The Table includes both Robinson's work attempted for developing countries and the work of Denison for U.S.A. and North West Europe.

The rate of transfer of capital (DKS) and labour (DLS) and net foreign balance (NFBR) make significant contribution to growth.

From Table 2.6 which includes the contribution of net foreign balances (NFBR) we see that labour (19%) and capital (32%) together contribute 51% of total growth. While factor mobility measured by DKS and DLS contributes 18% to growth, NFBR contributes 14% leaving a residual contribution of 17% (reflected in constant term).

Robinson feels that labour contribution to growth is low in his analysis compared to that of Denison because of the fact that he gets a low estimated coefficient for labour in the

Table 2.6 : Average Sources of Growth

Contribution to growth (%)	Developing countries 1958-66	1958-66	Denison's study U.S.A.	North-West Europe
Labour	1.00	0.95	1.12	0.83
Capital	2.56	1.56	0.83	0.86
DKS	0.20	0.22	-	-
DLS	0.57	0.68	-	-
Factor transfers	-	-	0.25	0.46
NFBR	-	0.70	-	-
RY	4.95	4.95	3.32	4.78
Residual	0.62	0.84	1.12	2.63
Share of contributions (%)				
Labour	20	19	33	18
Capital	52	32	25	18
DKS and DLS	16	18	-	-
Factor transfers	-	-	7	10
NFBR	-	14	-	-
Others	12	17	35	54

Source: Robinson, 1971

regression equation, an elasticity much lower than Denison estimates from share data. Robinson feels that lower growth elasticities for labour in developing countries is justified because it is opined that a growing economy with disequilibrium in the factor markets will have growth elasticities that differ widely from factor shares.

Robinson points out that his calculation of factor mobility to growth is comparable to Denison's contribution to growth from "contraction of agricultural inputs". For the period 1950-62 Denison finds factor transfers to contribute about 7% of the growth rate of the United States and 10% for North-West Europe. While Robinson's calculation of the contribution of factor mobility to growth ranges from 16% to 18%, which seems significantly higher.

Bruton's (1967) study concentrates entirely on the five Latin American countries of Argentina, Brazil, Colombia, Chile and Mexico over the period 1960-64. Bruton's main interest is to explain differences in productivity growth between the countries. His conclusions are as follows:

a) Pure productivity growth explains very little of growth, it is only changes in the degree of utilisation of capacity that matters.

b) The major source of growth in developing countries is the growth of factor inputs themselves due to both its role on the supply side as well as its part in preventing or reducing under utilization.

c) Inputs are not carriers of sources of productivity growth as is commonly believed.

d) Total productivity growth averages 1.4% per annum for the five countries which represents a contribution to measured growth of approximately 25%.

Lampman (1967) applying the Denison framework to Phillipines economy for the period 1955-65 finds capital formation accounted for 20%, land 6% and labour 54% to growth. While technical progress is seen to contribute 20% to growth.

Next we will point out some of the problems connected with the estimation of the contribution of education to economic growth in developing countries which will be followed by a review of emprical work undertaken to measure contribution of education to growth in developing countries.

Education and Economic Growth in Less Developed Countries

The conceptual problems mentioned earlier in connection with estimating the contribution of education to growth equally applies to the case of developing countries. Thus, the problem of choosing an appropriate lag, the simultaneity bias arising out of two-way causation of education and growth, in case earnings differentials is taken as a proxy, then the problem of estimating how much of these differentials apply to effect of education etc., are still relevant problems faced by the researcher in his search for an appropriate index of education in developing countries.

However, there are certain problems specific to developing economies. Since the high rate of unemployment among the educated masses may deter people from spending on education, the essential question of man power planning arises. The predominant class bias of education in most developing countries may keep out less privileged sections from getting educated. Further with the stress of education only at the primary level in most developing countries, the contribution of education to growth may not be much. The greatest emprical problem to the researcher however is the non availability of data on most grades of education.

Finally, since educational expenditure can be considered both as consumption expenditure and investment in human capital, a cost-benefit type of approach to education becomes necessary especially in case of developing countries. The essential question becomes one of ascertaining whether an approach to development which emphasises the development of human resources (HR) has a long run rate of return higher or lower than other investment opportunities available to a country. There are instances of countries which have given much emphasis to social sector programs and have also had low growth rates (Burma, Cuba, Srilanka, Tanzania, for example). Thus, it is felt that direction of more resources to health, education etc., might increase non-development consumption expenditures and reduce investment and economic growth. There might be in essence some form of trade off between developing human resources and economic development, on the other hand these expenditures. could be viewed as investment in human capital having positive returns. Investment in human capital could then have a positive or negative effect on growth, depending on whether the returns from human capital are greater or less than returns from other non-human capital investments.

The available emprical evidence examining the contribution of education to growth in developing countries has been conflicting.

Let us have a brief look at some of the emprical work.

Kruger (1968) found that differences in human capital explained about half of the differences in per capita G.N.P, between the United States and a sample of developing countries.

Hayami and Ruttan (1970) found that differences in technical and general education could explain about one-third of the differences in agricultural productivity between developed and developing countries.

H. Correa (1970) found that while health and nutrition factors were very important, education advances appeared unrelated to output growth for a group of Latin American countries.

Another popular approach consists of estimating the rate of return from investment in education, based on measuring lifetime earnings of people at various educational levels. These benefits are discounted and compared to the private and social costs of education, including foregone earnings while at school to estimate the rate of return from investment in human capital. Using such an approach in a survey of 17 countries, Psacharopoulos (1973) found an average social returns of 25% for primary education. These returns range, however, from 6.6% (Singapore, 1966) to 82% (Venezuela, 1957).

Morawetz (1977) comes to rather uncertain conclusions from a large number of regressions of social indicators and GNP while unable to pinpoint a clear relationship between the two he did conclude that GNP per capita was not a good proxy for human resoruces.

Contribution of Education to Economic Growth-Emprical Evidence

Selowsky (1969) calls attention to the fact that earlier studies of the role of education in economic growth have dealt only with the effects of increases in the educational level of the labour force. They thus have neglected that part of the contribution of education that stems from maintaining the average level of schooling of the labour force. The effect of neglecting this component is to underestimate the total contribution of education to growth.

He begins by specifying a production-function of the following form:

$$Y = F(K, L_0, L_1 \ldots\ldots\ldots Ln) \qquad \ldots(2.16)$$

where Y is aggregate output, K is the flow of service of the physical capital stock and L_0, L_1 ......Ln are man hours input of members of the labour force with 0, 1, ...n years of schooling respectively

Diff (1) w.r.t. time, we get

$$Y' = f_K K' + f_{Lo} L_o' + f_{L1} L_1' \ldots\ldots\ldots f_{Ln} L_n' \qquad \ldots(2.17)$$

f's are partial derivatives, he then assumes that wages reflect marginal productivities

$$Y' = f_K K' + \sum_i W_i L_i' \qquad \ldots(2.18)$$

where W_i is the real wage of individuals with i years of schooling

Defining $L = \sum_i L_i$ so that $L' = \sum_i L_i'$

Equn. (2.18) is written as

$$Y' = f_K K' + W_o L' + \sum_i (W_i - W_o) L_i'$$

where $f_K K'$ is the contribution of physical capital to growth,

W_oL' is the contribution of the uneducated component of all members of the labour force and $\sum_i (W_i - W_o) L_i'$ is the contribution of education.

The contribution of education is then disaggregated into two components:

$$a_i = L_i/L \quad ; \text{ then } \sum_i a_i' = 0$$

$$\sum_i (W_i - W_o) L_i' = L' \sum_i (W_i - W_o) a_i + L \sum_i W_i a_i' \quad \ldots(2.19)$$

$L \sum_i W_i a_i$ is the contribution of growth of changes in the relative distribution of workers by years of schooling

$L' \sum_i (W_i - W_o) a_i$ is the contribution to output stemming from the educational effort entailed in maintaining a constant relative distribution of the labour force by years of schooling.

$$Y' = f_K K' + \left[W_o + \sum_i (W_i - W_o) a_i\right] L' + \sum_i W_i a_i' \quad \ldots(2.20)$$

The average wave W is $\sum_i W_i a_i$ Equation (2.20) can therefore be written as

$$Y'/Y = \alpha_K K'/K + (\alpha_B + \alpha_E) L'/L + \alpha_L Q'/Q + R$$

$\alpha_B = W_o L/Y$ = share of uneducated people in total output

$\alpha_E = (W - W_o)/Y\ L$ = Share of educational inputs in total output

$\alpha_B + \alpha_E = \alpha_L$ = Share of labour in total output

Q'/Q = $Wiai/W$ = The relative change in the index of quality of labour force

R = Residual summarising the contribution of other forces to the growth rate

Given that α_L is constant the behaviour of α_E through time is only function of W_o/W or the proportion of average wage represented by the payments to 'bodies'. The lower the value of σL (elasticity of substitution) the stronger will be the decline in this ratio when going back in time. (α_E) People without education become relatively abundant. In other words, share of educational inputs embodied in labour force is higher the smaller is the value of σL, the reason being that these inputs receive relatively high price when they are scarce.

Applying this model to the case of Chile and Mexico, he finds the following result summarised below.

From Tables 2.7 and 2.8, Selowsky concludes that the total contribution of education is a function of different assumptions concerning σ_L. In the case of Chile, this contribution increases for the overall period 1940-64 by 63% (from 18.9% to 29.8%) when using $\sigma_L = 2$ instead of $\sigma_L = \infty$. For Mexico for the same period, this increase is equal to 47%.

Williamson (1969) while reviewing postwar Phillipine economic progress includes explicitly improvements in the average quality of labour (chiefly education) into the produc-

CHILE

Table 2.7 : Contribution of Education to Growth Rate (1940-64)
(value in parentheses show % contribution)

Elasticity of substitution	Source	Average 1940-64
$\sigma_L = 2$	$\alpha_L . Q'/Q$	0.54 (14.5)
	$\alpha_E L'/L$	0.57 (15.3)
	Total	1.11 (29.8)
$\sigma_L = 4$	$\alpha_L . Q'/Q$	0.41 (11.0)
	$\alpha_E L'/L$	0.52 (14.0)
	Total	0.93 (25.0)
$\sigma_L = 6$	$\alpha_L . Q'/Q$	0.36 (9.7)
	$\alpha_E L'/L$	0.56 (13.5)
	Total	0.86 (23.2)
$\sigma_L = 10$	$\alpha_L . Q'/Q$	0.33 (9.2)
	$\alpha_E L'/L$	0.48 (12.8)
	Total	0.81 (22.0)
$\sigma_L = \infty$	$\alpha_L . Q'/Q$	0.25 (6.8)
	$\alpha_E L'/L$	0.45 (12.1)
	Total	0.70 (18.9)

Source; Selowsky, 1969

MEXICO

Table 2.8 : Contribution of Education to Growth Rate
(1940-64)
(value in parentheses show % contribution)

Elasticity of substitution	Soruce	Average 1940-64
$\sigma_L = 2$	$\alpha_L \cdot Q'/Q$	0.32 (5.0)
	α_E L'/L	0.52 (8.1)
	Total	0.84 (13.1)
$\sigma_L = 4$	$\alpha_L \cdot Q'/Q$	0.24 (3.7)
	α_E L'/L	0.47 (7.3)
	Total	0.71 (11.0)
$\sigma_L = 6$	$\alpha_L \cdot Q'/Q$	0.22 (3.4)
	α_E L'/L	0.43 (6.7)
	Total	0.65 (10.1)
$\sigma_L = 10$	$\alpha_L \cdot Q'/Q$	0.43 (6.7)
	α_E L'/L	0.65 (10.1)
	Total	0.20 (3.0)
$\sigma_L = \infty$	$\alpha_L \cdot Q'/Q$	0.16 (2.5)
	α_E L'/L	0.41 (6.4)
	Total	0.57 (8.9)

Source: Selowsky, 1969

tion-function. Thus he modifies the Cobb-Douglas production-function as follows to include quality improvements in education:

$$Q_t = A^*_t K^a_t (L_t q_t)^b N_t^{1-a-b} \qquad \ldots(2.21)$$

where Q is the national income, K and L are quantities of capital available and the employed labour force, N stock of cultivated land, A^*_t an index of productivity defined in such a way as to exclude the effects of education. q_t a measure of quality improvements like education in the labour force.

Transforming (2.21) into growth terms

$$\partial Q/Q = \partial A^*/A^* + n\,(\partial q/q) + b\,(\partial L/L) + a(\partial K/K) + (1-a-b)\,(\partial N/N) \qquad \ldots(2.22)$$

$\lambda_L = \partial q/q$, then

$$\partial A/A = \partial A^*/A^* + b\,\lambda_{Lt} \qquad \ldots(2.23)$$

Then he proceeds to estimate $b\lambda_{Lt}$ for the Phillipines economy.

Like Denison (1962), he takes the reported earnings differentials by education level, as a proxy for measuring education's contribution to growth. But since these differentials represent not only the effect of education, but also such factors as ability, motivation, family connections and social position, he makes the assumption that only half of the Phillipine earnings differentials is due to investment in education. While the remainder is attributable to factors associated with educational attainment.

The data in Table 2.9 below illustrates by taking an elementary school education (5-7 years) as base, then a male Phillipine labour with no formal education according to index of earnings differentials will on the average earn only 79, while any elementary school graduate earnings is about 221. If the elementary school graduate completes university education, he can expect to double his productivity.

Table 2.9 : Education and Earnings in the Phillipines, 1966

Highest grade achieved	Unadjusted index of earnings differentials	Adjusted index of earnings differentials
0	66	79
1-4	97	98
5-7	100	100
8-11	222	173
12-15	302	221

Source: Williamson, 1969

Finally to estimate λ_{Lt} he computes what the average earnings of males 25 years and older would have been if the earnings at each institutional level had remained at a constant percentage of that of the elementary school graduate. The difference in average earnings so computed is then used to isolate the effects of increased formal schooling on average labour productivity.

Thus taking the coefficient of labour growth to be 0.2 and capital growth to be 0.7 (from factor share data, assuming competitive market condition to prevail). Williamson's results based on Table (2.10) can be summarised for the Phillipines economy for the period 1947-65.

Capital formation, accounts for a much larger share of output growth than normally is the case in developed countries. Education appears to have a low yield, though Williamson believes that it has contributed in very large measure to growth rates. Finally, it is clear from Table (2.10) that Phillipines found it increasingly difficult to generate total factor productivity improvements after mid fifties, which Williamson feels may have been due to the increasing inability of the Phillipine economy to utilise scarce resources effectively.

Hicks (1980), examines cross-country evidence for 83 developing countries for both growth of per capita GDP and

Table 2.10 : Observed and Predicted Growth Rates for the Phillipines (1947-1965)

(in percentages) a = 0.2, b = 0.7 (assumption)

Year	a(dK/K)	b(dL/L)	(1-a-c)dN/N	b(λLt)	dQ/Q	dA*/A*
1947-48	0.58	2.45	0.20	0.70	10.7	6.77
1948-49	0.80	2.45	0.20	0.70	6.1	1.95
1949-50	0.38	2.45	0.28	0.70	9.1	5.37
1950-51	0.12	2.45	0.20	0.70	3.9	0.43
1951-52	0.56	2.45	0.20	0.70	7.2	3.29
1952-53	0.76	2.45	0.20	0.70	8.4	4.29
1953-54	0.92	2.45	0.20	0.70	4.8	0.53
1954-55	1.04	2.45	0.20	0.70	7.9	3.51
1955-56	1.08	2.45	0.60	0.70	8.9	4.07
1956-57	0.86	4.20	0.26	0.98	2.9	-3.40
1957-58	0.70	0.91	-0.01	0.98	2.5	0.08
1958-59	0.54	2.03	1.31	0.98	7.6	2.74
1959-60	1.32	-0.35	-0.39	0.98	0.9	-0.66
1960-61	1.44	4.69	0.30	0.84	5.9	-1.37
1961-62	1.14	4.13	0.11	0.84	3.2	-3.02
1962-63	1.10	1.40	0.01	0.84	5.0	1.65
1963-64	1.36	2.45	0.02	0.84	3.3	-1.37
1964-65	1.68	2.45	0.18	0.84	4.9	0.25

Source: Williamson, 1969

two indicators of human resource development life expectancy and literacy for the period 1960-77.

The model used by Hicks is not a production-function approach. Instead he develops a simple model in which the growth of per capita output or per capita GDP is related to three factors: the growth rate of imports, the level of investment with respect to GDP and the level of human resources (HR) found to exist in the base period,.

Where adult literacy during the base period (1960) is taken as a proxy for human resource development, the model looks as follows:

$$GRYPC_t = \text{Constant} + a_1 INVRT_t + a_2\ GRIMP_t + a_3 LTT_{60}$$

$GRYPC_t$ = Growth rate of per capita real GDP over time period t

$INVRT_t$ = Average investment rate

LTT_{60} = Literacy rate at 1960

$GRIMP_t$ = Growth rate of imports

a's = Coefficients

K = Constant term

The regression results are as follows:

$$GRYPC_t = -1.02 + \underset{(6.2)}{0.2451}\ GRIMP_t + \underset{(1.8)}{0.0680}\ INVRT_t + \underset{(3.3)}{0.0223}\ LTT_{60} \quad \ldots(2.24)$$

t values are given in brackets

$\bar{R}^2 = 0.590$ N = 55, t = 1960-77

The overall regression thus explains 60% of the total variance. The growth rate of imports continues to be dominant variable explaining variations in the growth rate of output. However, the investment rate appears to have rather small coefficients and low t ratios. Literacy rate however has a high t value of about 3.3.

Based on these evidences, Hicks concludes that policies directed at human resource development can raise the growth rate of output since they represent an investment in human capital.

Nadiri (1971) has brought together and surveyed some of the other production-function studies for developing countries. The only major difference between the studies covered by Nadiri and Maddisson's study (1970) is that in the studies covered by Nadiri, the contribution of resource shifts from agriculture to industry is separately identified.

The major conclusion of Nadiri's survey is that the contribution of education to growth is relatively small and also small compared to contribution in developed countries. This he feels may be due to emphasis on education at the primary level (if one assumes primary education does not contribute much to growth), unemployment among the educated and the predominant class bias of most developing countries.

The other conclusions which emerge from Nadiri's survey are:

a) Except for the fast growing countries of Japan, Israel and Mexico, the contribution to measured growth of total labour input growth is shown to be greater than the contribution of capital-input growth. This may be because capital is given a lower weight than labour , reflecting capital's lower share of national income. However, Nadiri's study seems to support other studies that capital accumulation is much more important source of growth in developing countries than in developed countries.

b) Total factor productivity growth is also shown to be of less importance in developing countries than in developed countries. According to Nadiri, this is probably because a large part of investment expenditure is on infrastructure projects which do not yield productivity gains immediately.

The detailed results of Nadiri's survey are presented in Table 2.11.

Hagen and Hawrylyshyn (1969) study the sources of growth of developing countries for the period 1955-65.

They visualise their least square analysis not as an estimation of production-function but rather as something more akin to a factor analysis in which R^2 indicates the proportion of variance explained by the independent variables in the equations including only economic inputs (like land, labour, capital etc.).

Table 2.11 : The Contribution of Factor Inputs, Improvements in Quality of Labour and Resource Shifts to Economic Growth in a Section of Developing Countries

Country	Period	Rate of growth of income (%)	Cont. of total labour input	Cont. of labour input			Cont. of total capital input	Cont. of total factor prod. growth	Cont. of resource shifts to productivity growth
				Employment growth	Health and Nutri.	Education			
Argentina	1950-62	3.19	1.58	0.93	0.12	0.53	1.43	0.18	0.18
Brazil	1950-62	5.49	2.44	1.83	0.43	0.18	1.66	1.39	0.39
Chile	1950-62	4.20	1.05	0.65	0.20	0.20	0.32	2.83	0.11
Colombia	1950-62	4.79	2.35	1.66	0.49	0.20	1.04	1.40	0.33
Ecuador	1950-62	4.72	1.47	0.92	0.32	0.23	1.07	2.18	-0.35
Honduras	1950-62	4.52	2.17	1.06	0.82	0.29	0.95	1.40	1.38
Mexico	1950-62	5.97	2.41	1.43	0.93	0.05	2.82	0.74	0.44
Peru	1950-62	5.63	1.40	0.67	0.57	0.16	1.40	2.83	0.36
Venezuela	1950-62	7.74	2.59	2.19	0.21	0.19	2.04	3.11	0.56
Greece	1951-61	5.29	2.80	-	-	-	1.63	0.86	0.60
India	1950-60	4.47	1.86	-	-	-	1.55	1.06	-
Israel	1950-65	11.01	3.50	-	-	-	4.11	3.40	
Japan	1952-67	8.97	2.45	-	-	-	4.49	2.03	0.91
Phillipines	1947-65	5.75	2.24	-	-	-	1.01	2.50	-

They make use of three measures to estimate the contribution of education to growth. These are:

PRM = Growth rate in enrolment ratio at the primary level

SEC = Growth rate in enrolment ratio at secondary level

ED = Growth weighted index of education which is defined as

$$ED_j = a_i \ E_i \ (Y-5) \ / \ a_i \ E_i \ (0-5)$$

where

a_i = Weight ascribed to labour force members with level of education i

E_i = Enrolment ratio at educational level i

Y = The end year of growth period, (Y-5), lagged by 5 years

0 = The base year of growth period lagged 5 years (0-5)

ED_j = Index of educational improvement in the labour force at time j relative to base 0.

The results of Hagen and Hawrylyshyn (1969) are presented in Table 2.12.

It can be seen from Table 2.12 that in equations (1) to (8), the rate of educational improvement is of the wrong sign. The reason for the negative sign according to Hagen and Hawrylyshyn is because of too short a lag in the initial specification of education variable. The lag used here is thus 5 years. Thus in their subsequent effort they incorporate a longer lag of 10 years. The results of this exercise is presented in Table 2.13.

Table 2.12 : Education's Contribution to Growth

Eq.No.	Sample (N) size	Constant	Labour growth rate	Education index	Invest-ment rate	$\bar{R}^2$
Period; 1955-50						
1.	N=33	0.932 (0.7)	.395 (1.3)	-0.132 (1.0)	0.212 (3.1)	0.2926
2.	N=33	0.043 (0.02)	.342 (1.2)	-0.158 (1.2)	0.208 (2.4)	0.4951
3.	N=33	-0.416 (0.06)	.342 (1.2)	-0.155 (1.1)	0.203 (1.9)	0.4953
4.	N=33	-1.405 (0.2)	.344 (1.2)	-0.133 (0.9)	0.160 (1.4)	0.5373
Period : 1960-65						
5.	N=42	2.40 (1.7)	0.083 (0.3)	-0.50 (0.7)	0.190 (2.8)	0.2140
6.	N=42	.183 (0.1)	-0.004 (0.02)	-.098 (1.1)	0.251 (3.1)	0.3156
7.	N=42	3.387 (0.8)	-0.009 (0.03)	-0.072 (0.8)	0.277 (3.2)	0.3309
8.	N=42	3.448 (0.7)	-0.032 (0.1)	-.019 (0.2)	0.259 (2.8)	0.3742

Note: i) t values are given in brackets
ii) All variables used by Hagen and Hawrylyshyn are not presented, only results of variables relevant to our analysis are presented.

Soruce: Compiled from Hagen and Hawrylyshyn, 1969

Table 2.13: Lagged Effect of Education on Growth

Eq.	Constant	Labour growth rate	Education index	PRM	SEC	Investment rate	$\bar{R}^2$
1.	-0.611 (0.3)	-0.73 (0.3)	.073 (0.6)	-	-	0.258 (3.1)	0.2971
2.	-0.743 (0.4)	-0.073 (.03)	-	0.106 (1.1)	-	0.244 (3.0)	0.3142
3.	-0.931 (0.5)	-0.100 (0.4)	-	0.046 (0.4)	0.057 (1.2)	0.255 (3.1)	0.3450
4.	-0.191 (0.1)	-0.042 (0.2)	-	0.094 (1.3)	-	2.37 (2.9)	0.3509

Note: i) t values are given in brackets.
ii) All variables used are not included. Only variables relevant to our analysis are given.

Source: Compiled from Hagen and Hawrylyshyn, 1969

In equation 1-4 of the above Table, the effects of lagging educational variables by additional 5 years using growth of education in 1950-55 as explanatory factor for income growth in 1960-65 is seen to give positive coefficient values for the education variables, but still insignificant.

Equations 1-4 show that the composite index (ED) lagged for ten years becomes positive though not significant. Doing the same thing with primary and secondary separated, they find the coefficients turn positive and it is perhaps important that thè one for secondary enrolment is more significant. Thus they come to the conclusion that lags for education are more like ten and fifteen rather than anything lower, like five years.

The major conclusions reached by Hagen and Hawrlyshyn are:

a) Education quite clearly makes a very low contribution to growth of output.

b) It appears from their analysis that investments contribution to growth is more than labour's contribution to growth in developing countries.

c) Technical progress amounts for a greater proportion of growth in the developed countries than in case of developing countries.

d) With regard to inclusion of socio-political factors in' economic development, they note (i) the quantification of such factors are extremely elusive, (ii) the relationship between such factors and economic growth is much less one of determinate causation and much more one of mutual causation not subject to statistical separation.

After having undertaken a review of some of the major studies, which attempt to estimate the contribution of education to economic growth, we will not briefly review the literature on trade and growth especially in the context of production-function approach.

Trade as an Engine of Growth

The classical economists like Smith, Ricardo and Mill were convinced that free trade had a favourable effect on growth.

Recently, however authors like Prebisch and Singer have disagreed with the view of the classical economists, especially in the case of developing countries. They argue that since the income elasticity facing the exports of the developing countries, (usually primary products) is low, all that free trade results in, is the exporting away of productivity gains from developing countries to developed countries through falling terms of trade for the developing countries. Thus they argue that trade brings more harm than good to the developing countries.

Examining the emprical evidence available on trade and growth one finds that both exports and imports have made a significant and positive contribution to growth. This runs contrary to the view expressed by Prebisch and Singer and seems to confirm the alternative view that trade does in fact acts as an engine of growth.

We will now examine some of the emprical evidence available which look at trade and growth.

Trade and Growth

Balassa (1978) makes use of the production-function approach to examine the effect of export growth, on GDP growth rate (though he does not mention the explicit way in which export is included). Export is measured to enter the production-function as a contributor of total factor productivity.

Applying his framework to 10 developing countries for the period 1960-66 and 1966-73, the following results are derived as presented in Table 2.14.

Table 2.14 : Exports in Economic Growth

Eq.	Dependent variable	KP	KF	L	X	PPX	IXR	R^2
1.	Y	0.18 (3.23)	0.30 (2.42)	-	-	-	-	0.58
2.	Y	0.15 (3.33)	0.23 (2.40)	0.97 (3.57)	0.04 (3.57)	-	-	0.77
3.	Y	0.16 (3.59)	0.34 (2.44)	0.92 (1.82)	-	0.05 (3.34)	-	0.75
4.	Y	0.14 (2.32)	0.26 (2.32)	0.98 (1.66)	-	-	0.06 (1.86)	0.65

Notes: where

Y = Gross national product

KP = Average difference between gross fixed capital formation and current amount balance expressed as proportion of intial year GNP

KF = Average current account balance expressed as a proportion of intial year GNP

IXR = Incremental Export GNP ratio

L = Labour

X = Current dollar value exports

PPX=Purchasing power value of exports

Source: Balassa, 1978

Eq (1) amd (2) show that adding export variable in (2) raises R^{-2} from 0.58 to 0.77. We can see from Table (2.14) that a 1% increase in the rate of growth of exports is associated with a 0.04 of 1% increase in the rate of growth of GNP. Eq (3) and (4) show that the results are not substantially affected if the curent dollar value of exports (X) is replaced by the purchasing power of export (PPX) or by the incremental Export-GNP ratio (IRX).

The result of Michalopoulos and Jay (1973) are also similar to that of Balassa. For the period 1960-66 using data for 39 developing countries, Michalopoulos and Jay found that the inter country differences in domestic and foreign investment and in labour growth explained 53% of the inter country variation in GNP growth rates, while adding an export variable raised the coefficient of determination to 0.71.

Kruger (1975) found in a cross section regression analysis of ten countries that an increase in the rate of growth of exports of 1% tends to raise the rate of growth of GNP by 0.06 of 1%. But while Kruger's estimates reflect an adjustment for a time trend, no adjustments have been made for changes in labour and capital. At the same time Kruger has found that, on the average countries with liberalised trade regimes had a GNP growth rate 0.7% higher than others even after differences in export performance are taken into account.

Hwa (1983) makes use of a modified Cobb-Douglas production--function extended to include factors like agricultural growth, inflation rate and trade factors like export growth.

Thus, $Y = CK^{a}L^{b}\,e^{\log R}$ ...(2.41)

where

Y = Gross domestic product

C = A scale parameter

K = Capital stock

L = Labour force

$e^{\log R}$ = The rate of technical change over time, which is taken to be synonymous with productivity change.

Rewriting (1) in terms of the rate of change over time

$\dot{Y} = a\dot{K} + b\dot{L} + \dot{R}$ ...(2.42)

The productivity change ($\dot{R}$) is assumed to be positively influenced both by the rate of agricultural growth ($\dot{A}$) and export growth ($\dot{X}$) but is negatively related to the rate of inflation ($\dot{P}$).

$$\dot{R} = a + r\dot{A} + \theta\dot{X} + h\dot{p} + u \; \ldots . r, \theta > 0 \; h < 0 \qquad \ldots(2.43)$$

where a is a constant term and u is the residual assumed to be randomly distributed combing 2.42 and 2.43.

$$\dot{Y} = g + a\dot{K} + b\dot{L} + r\dot{A} + \theta\dot{X} + h\dot{p} + u \qquad \ldots .(2.44)$$

where

$\dot{Y}$ = The average annual rate of growth of GDP

$\dot{K}$ = The average annual growth rate of capital, proxied by the average investment rate

$\dot{L}$ = The average annual rate of growth of the labour force

$\dot{X}$ = The average annual growth of exports

$\dot{P}$ = The average annual rate of inflation

The emprical result of the application of the above model is given in equation below:

$$\underset{}{Y} = \underset{(0.1)}{-0.139} + \underset{(2.7)}{0.098}\,\dot{K} + \underset{(2.0)}{0.625}\,\dot{L} + \underset{(5.1)}{0.235}\,\dot{X} \underset{(2.6)}{-0.022}\,\dot{P} + \underset{(4.2)}{0.380}\,\dot{A}$$

$$R^{-2} = 0.61 \qquad \ldots(2.45)$$

t values are given in brackets.

From the estimated coefficients Hwa constructs an Average Sources of Economic Growth Table.

From the regression equation (2.45) and Table (2.15), it is clear that the contribution of export to growth is very high.

Table 2.15: Sources of Economic Growth (1970-79)

	Factor[a] contribution Growth Rate (%)	Share (%)	Average Growth Rate (%)
Factors of production	3.5	81	
of which			
Capital	2.1	48	21.6[b]
Labour	1.4	33	2.3
Productivity change	0.9	19	
of which			
Export	0.6	14	2.7
Inflation	-0.4	-9	19.1
Agriculture	0.8	17	2.0
Others[c]	-0.1	-3	
Total GDP	4.4	100	

Note: Calculation is based on equation (2.45).
a - The number in this column are obtained by multiplying the estimated elasticicities bythe average rates of growth of factors of production

b - Average investment rate

c - Reflecting the constant term

Source: Hwa, 1983.

The sources of growth decomposition tells us that 14% of output growth is due to growth in export.

Oyejide (1986) uses a model similar to that used by Hwa for the Nigerian economy, the only difference being that in Oyejide model, the rate of productivity change $\dot{R}$ is assumed to be influenced only by export growth.

Thus in Oyejide model

$$\dot{R} = C + c\dot{E} + u \qquad \text{...(2.46)}$$

where C is a constant u is a residual assumed to be randomly distributed.

The final estimating equation thus takes the form

$$\dot{Y} = C + a\dot{K} + b\dot{L} + c\dot{E} + u \qquad \text{...(2.47)}$$

where

$\dot{Y}$ = The average annual GDP growth rate

$\dot{K}$ = The average annual rate of growth of capital

$\dot{L}$ = The average annual rate of growth of the labour force

$\dot{E}$ = The average annual rate of growth of exports

Then exports are separated into two major components in the estimated regression equations. Agricultural export growth rate ($\dot{X}_A$) is used for the 1950-70 period, while oil exports growth rate ($\dot{X}_0$) is used in the 1970-84 period for the Nigerian economy.

The regression results are

<u>1950-70</u>

$$\dot{Y} = \underset{(4.7193)}{0.7638} + \underset{(2.0013)}{0.1476\dot{K}} + \underset{(2.1044)}{0.7050\dot{L}} + \underset{(2.7003)}{0.0744\dot{XA}}$$

$$\bar{R}^2 = 0.5214 \qquad DW = 1.1971 \qquad \text{...(2.48)}$$

1970-84

$$\dot{Y} = -0.1596 + 0.0711\,\dot{K} + 0.5513\,\dot{L} + 0.0342\,\dot{XO}$$
$$\quad (-3.9746) \quad (1.9986) \quad (2.3560) \quad (2.4881)$$

$$\bar{R}^2 = 0.5311 \qquad DW = 1.9173 \qquad \ldots(2.49)$$

Both regression results show that exports along with labour and capital contribute positively and significantly to the growth of GDP.

Table 2.16 : Sources of Economic Growth

	1950-70 Average growth(%)	Share (%)	Mean value	1970-84 Average growth(%)	Share (%)	Mean value
Factors of Production	3.94	74.34	-	3.18	83.68	-
Capital	2.32	43.77	15.7	1.64	43.16	23.1
Labour	1.62	30.57	2.3	1.54	40.52	2.8
Residual	1.36	25.66	-	0.62	16.32	-
Agri. Prod.	0.96	18.11	12.9	-	-	-
Oil exp.	-	-	-	0.78	20.53	22.7
Others	0.40	7.55	-	-4.21	-	-
GDP	5.30	100.0	-	3.80	100.0	-

Source: Oyejide, 1986.

Thus in the period 1950-70, agriculture export rate contributed 18.1% to growth and for the period 1970-84, oil exports contributed 20.53; which seemsto confirm Hwa's result of high positive contribution of export to growth.

Hicks (1980) while analysing trade factors in the growth process estimates the contribution of import growth rate to GDP growth rate. The reason for including import growth variable is justified by Hicks on the ground that imported inputs and capital goods into the developing countries are carriers of foreign technology and hence may be expected to make a positive contribution to growth. If it does make a positive contribution, then he argues that there is justification for embarking on a policy of import liberalization by the less developed countries.

Hicks does not work under a production-function framework. Rather he starts from the belief that GDP per capita (dependent variable) is related to three factors: the growth rate of imports, (IMP), the level of investment, (INVR) and the level of human resource (HR).

His regression equation estimated is as follows:

$$GRYPC_t = \text{constant} + a_1 INVR_t + a_2\ GRIMP_t + a_3\ HR$$

$$GRYPC_t = -1.02 + \underset{(6.2)}{0.2451}\ GRIMP_t + \underset{(1.8)}{0.0680}\ INVRI_t + \underset{(3.3)}{0.0223}\ LTI_{60}$$

$$R^2 = 0.59 \quad n = 55 \quad t = 1960\text{-}77 \qquad \ldots (2.50)$$

t values are given in brackets.

$GRYPC_t$ = Growth rate of per capita income

$GRIMP_t$ = Growth rate of imports

$INVRT_t$ = Level of investment

LIT_{60} = Literacy rate at 1960

From the regression results he concludes that imports has a high positive coefficient and is also found to be highly significant. This leads him to the policy prescription that a developing country will find it profitable to adopt a policy of import liberalisation.

The conclusion which emerges from a study of trade and growth literature is that both the trade factors namely export and import growth seems to make a high positive contribution to the growth of output. The positive contribution of export to growth is justified on such grounds as: (a) exports provide for economy of scale operation, (b) exports enlarge the level of composition of domestic industries. Similarly the positive contribution of import growth is justified on the grounds that imported inputs and capital goods are carriers of foreign technology which then make a positive contribution to growth.

But the weakness of the existing literature on trade and growth is that there has been no attempt to incorporate both the trade determinants,namely export and import variables into a consistent theoretical framework. Such an approach we feel will bring to light the relative importance of these two variables in the growth process. Our analysis will make some attempt to do this.

The major conclusions which emerge from an examination of growth literature in developing countries are as follows:

a) Capital appears to make a greater contribution to growth than labour. This result is in marked contrast to that of developed countries.

b) Total productivity appears to contribute less to growth than in case of developed countries.

c) Quality factors like education's contribution to growth is not very clear in the face of contradictory evidence. Thus while the works of Nadiri (1971), Hagen and Hawrylyshyn (1969) and Williamson (1969) seem to indicate a rather low contribution of education to growth, other studies like those of Selowsky (1968), Hicks (1980) etc., have found a very high contribution of education to growth.

d) Trade factors like export growth and import growth seem to also contribute highly and positively to economic growth.

e) Finally the shift of resources from agriculture to idnustry seems to make a high positive contribution to growth as seen in Robinson's analysis (1971).

variable and R_L and R_K as the independent variables. The coefficients a and b will be estimated in this fashion. Then one can multiply these coefficients with some average value of R_L and R_K to get at the relative quantitative importance of each factor in the growth process.

The production-function most commonly fitted to aggregate data has been the Cobb-Douglas one. This can be written as

$$Y = A_t L_t^a K_t^b u$$

Y = output, L_t = labour input, K_t = capital input, u = random disturbance, A_t = constant.

As one can see the relationship is non linear. But it can be transformed into a linear function by converting all variables to logarithms to give

$$\log Y_t = \log A_t + a \log L_t + b \log K_t + \log u$$

$$Y' = A' + aL' + bK' + u'$$

In terms of the primed variables we have a linear function. This function is convenient in international comparisons. Since a and b are elasticity coefficients, they are pure numbers and can be easily compared among different samples using varied units of measurement.

In a sense one is able to capture the flavour of essential non linearities of the production process and yet benefits from the simplifications of calculation from linear relationships by transforming to logarithms.

CHAPTER : 3

ANALYTICAL FRAMEWORK

After a detailed survey of the literature on sources of economic growth we now present the model used in our estimations. We had to make certain modifications to the theoretical model because of lack of data.

Starting from a simple general aggregate production-function

$$Y = Y\ (L,\ K) \qquad \ldots(3.1)$$

where Y is the output, L and K are labour and capital respectively. Differentiating w.r.t. time, we get

$$dY/dt = \partial Y/\partial K\ dK/dt + \partial Y/\partial L\ dL/dt$$

Dividing by Y

$$dY/dt\ 1/Y = \partial Y/\partial K\ dK/dt\ 1/Y + \partial Y/\partial L\ dL/dt\ 1/Y$$

$$dY/dt\ 1/Y = \partial Y/\partial K\ dK/dt\ K/Y\ 1/K + \partial Y/\partial L\ L/Y\ dL/dt$$

$$\text{or } R_Y = aR_L + bR_K \qquad \ldots(3.2)$$

where

$R_Y = dY/dt\ 1/Y$ = Rate of growth of output

$R_L = dL/dt\ 1/L$ = Growth rate of labour

$R_K = dK/dt\ 1/K$ = Growth rate of capital

$a = \partial Y/\partial L\ L/Y$ = Partial elasticity of output w.r.t. labour

$b = \partial Y/\partial K\ K/Y$ = Partial elasticity of ourput w.r.t. capital

Thus one can run a regression with R_Y as the dependent

The Cobb-Douglas function is economical in the use of degrees of freedom, or parameters and yet gives us non linearity.

The attraction to use a Cobb-Douglas production-function derives not only from its simplicity - it is easy to comphrehend and is economical to apply - but from the desirable neoclassical properties it possesses.

Thus starting from a Cobb-Douglas production-function of the form

$$Y_t = A_t L_t^a K_t^b \; u$$

The first neoclassical property that any production-function should meet is that an increase in each input should have a positive effect on output that is (1) the marginal products should be positive. In symbols

$$\partial Y/\partial L > 0 \quad \text{and} \quad \partial Y/\partial K > 0$$

A second requirement for a production-function is that (II) each marginal product should decrease when labour and capital increase. Sympolically $\partial^2 Y/\partial L < 0$ and $\partial^2 Y/\partial K < 0$. This is one of the sufficient conditions for an equilibrium which implies that constant product curves are convex to the origin.

In the Cobb-Douglas case for reasonable values of the partial elasticities of output the marginal products decrease as each factor changes

$$\partial^2 Y/\partial L^2 = \partial(\partial Y/\partial L)/\partial L = a(a-1)/L \quad Y/L$$

and

$$\partial^2 Y/\partial K^2 = \partial(\partial Y/\partial K)/\partial K = b(b-1)/K \quad Y/K$$

Since a and b are normally less than unity, these expressions are negative, hence Cobb-Douglas function satisfies criterian II.

A third criterian is that a production-function should not specify apriori the degree of economies or diseconomies of scale, that is the emprical situation should be left to stipulate the degree of economies of scale.

In the Cobb-Douglas case, since a and b are the partial elasticity of output w.r.t labour and capital respectively, the two coefficients taken together measure the total percentage change in output for a given percentage change in labour and capital. In short a+b is the degree of homogenity of the Cobb-Douglas production-function. Thus if

$a+b < 1$ Diseconomies of scale

$a+b = 1$ Constant returns to scale

$a+b > 1$ Economies of scale

Since the Cobb-Douglas function can characterize any degree of returns to scale, it clearly satisfies criterian (III).

Thus the use of the Cobb-Douglas production-function is considered appropriate precisely because it satisfies the three criteria set forth, that any well-behaved production-function has to satisfy in a neoclassical framework.

The next part of our analysis will deal with the various modifications which are introduced into the Cobb-Douglas function to take account of factors other than traditional economic inputs like labour and capital.

Converting the Cobb-Douglas function given before to represent annual rates of change of the variables. It can be written as

$$r_Y = r_A + ar_K + br_L$$

where

r_Y = Annual rate of growth of output

r_A = Annual rate of growth of total productivity

r_K = Annual rate of growth of capital

r_L = Annual rate of growth of labour

a and b are partial elasticities of output w.r.t to capital and labour.

With knowledge of r_Y, r_K, r_L and a and b it becomes possible to separate out the contribution of factor inputs to growth from increases in output per unit of input represented by r_T.

Thus technical change have been traditionally treated as residue, all growth not explained by conventional economic inputs (like labour, capital etc.) being attributable to technical progress.

Although r_T has thus be variously called technical progress, advance in knowledge, etc., definitionally it is that portion of the growth of output not attributable to increases in the factors of production, and includes effects not only of the multifarious factors which go to increase the productivity of labour and capital (like education, embodied technology in capital goods etc.) but also measurement errors in the captial and labour series. r_T is perhaps best described as a 'residual' or perhaps more appropriately still 'a coefficient of ignorance'.

To incorporate quality factors into the capital input series, Solow (1960), proposed the vintage production-function to allow for embodied technical change. Basically the approach consists of giving a separate valuation to each year's addition to the capital stock, with a higher weight being assigned to the most recent and presumably the more production additions.

Nelson (1964) produced a similar model incorporating the same features where the effective capital stock is given as a function of the gross capital stock, its average age and the rate of productivity improvement of new capital goods. Denoting the effective capital stock as Γ, the Cobb-Douglas function as modified for changes in the quality of capital may be written as

$$Y_t = A_t \, \Gamma_t^b \, L_t^a$$

where Γ is the quality weighted sum of capital goods and A_t is now an index of total productivity excluding the effect of technical progress embodied in new capital.

A model analagous to that embodying technical progress in capital can be developed which embodies quality improvements in labour, although it is not strictly essential for new additions to the labour force to be more productive than the average for the average quality to increase. The sorts of factors that increase the personal efficiency of labour productivity, operate in general, in a disembodied way.

If we denote the improved quality of labour as q_L where q stands for the improvement in the productive efficiency of labour, changes in the quality of labour are accommodated by writing the Cobb-Douglas function as

$$Y_t = A^*_t K^b_t (qL_t)^a$$

where A^*_t is even narrower concept than A_t by excluding from the residual, improvements in the quality of labour as well as capital.

Next we turn to the presentation of our model, which we have used in the estimation and statistical analysis of our data.

<u>The Model</u>

We have made use of a modified Cobb-Douglas production-function extended to include quality improvements in labour (education) and trade factors (like export growth and import growth). Even though quality improvements in the form of education to the labour force have been included in most of the studies, there are very few studies which have incorporated trade factors in a production-function framework, and none as far as we know of which analyse both the import and export factors in the growth process. It is here that we feel that our model is an improvement over the previous studies.

$$Y = Cq^{d} L^{a} K^{b} e^{\log R}$$

where

Y = Gross domestic product

C = A scale parameter

K = Capital stock

L = Labour force

q = Quality improvements in the labour force

$e^{\log R}$ = Rate of technical change over time, which is taken to be synonymous with productivity change

Rewriting the variables in terms of rate of change over time yields

$$\dot{Y} = a\dot{L} + d\dot{q} + b\dot{K} + \dot{R} \qquad \ldots(3.3)$$

It is now argued that the rate of productivity change $\dot{R}$ is influenced by the rates of export growth ($\dot{X}$) and import growth ($\dot{M}$). This is done in order to gauge the effect of trade factors on growth. The inclusion of the export growth variable is made because of the fact that most of the studies (like Oyejide, 1986; Hwa, 1983; Balassa, 1978) have found a high contribution of exports to economic growth, we want to verify how far our own data confirms or rejects such a notion. Exports are also supposed to (a) provide for economies of scale operations, (b) enhance level of competition in domestic economy and hence contribute to growth. Import growth variable is included because it is believed that imported goods would be carriers of foreign technology which then may make a contribution to growth. Its inclusion is also justified on the grounds that to get at the influence of trade on development both export and import factors have to be studied under a consistent framework, in order to get at the relative contribution of exports vs imports in the growth process.

Thus we define $\dot{R}$ as

$$\dot{R} = g + r\dot{X} + \theta\dot{M} + u \qquad \ldots(3.4)$$

where g is a constant and u is a residual assumed to be randomly distributed combining 3.3 and 3.4 have

$$\dot{Y} = g + a\dot{L} + b\dot{K} + d\dot{q} + r\dot{X} + \theta\dot{M} + u \qquad \ldots(3.5)$$

Where in other factors contributing to productivity not included in the model would be reflected in the constant term.

Details of how the variables are measured and the results of the application of the model to the data will be taken up in Chapter 4 and 5 of our study.

CHAPTER : 4

DEFINITION OF VARIABLES AND DATA SOURCES

Our study is a cross sectional regression analysis for a sample of 30 developing countries in Asia and Latin America for the period 1965-1979 The study makes use of a modified Cobb-Douglas production-function extended to include trade factors, as outlined in our previous chapter.

We define economic growth as the rate of growth of output, where output is taken to be GDP at constant prices. Growth rate is calculated by fitting an exponential time trend to the data.

Thus, if we assume

$y_t = ae^{bt}$, where

y_t = GDP at constant prices

a = A constant

t = Time period

Then, taking log on both sides

$$\log y = \log a + bt$$

Regressing logy on t, we estimate b, which we take as the average growth rate of output for the period.

The data source has been U.N.Year Book of National Account Statistics various issues.

In broad terms, one speaks of the inputs to a production function as labour and capital. These two are in theory and to a large extent in practice physically identifiable factors, and in the simplest models, they make up the sum total of inputs to the production-function. That these two factors do not suffice to explain output or its growth is well known, and the residual of output growth is then attributed to a fourth factor, technological change .

Technological change is by no means independent of changes in the quantities of the physical inputs, as is manifested in the concept of embodied technological change. Thus we have attempted to incorporate the effect of education on quality of labour.

Further one feels that trade factors have not been given much of an importance in most of the studies. Thus we have tried to include trade variables in our model as determinants of productivity or technological contributors to growth.

To summarise we have five categories on the input side of the production-function: labour, capital, education, export growth and import growth. We shall now discuss each of these in turn and consider the data available to express these concepts quantitatively.

Labour Input

We will first consider the quantity aspect of labour and then the effects of education, a quality variant. Differences in levels of efficiency among countries are not relevant as we are dealing with rates of change.

Ideally a measure of the change in quantity of labour input would require consideration of hours of work, vacation and sickness, unemployment figures, in addition to labour force data, and even this treatment would assume away the effects of changes in the mix of different types of labour within each country. If we do so, we can write out the formula for total labour input as:

$$L_i = H_i W_i (G_i P_i) (1 - U_i)$$

where

H_i = The average hours worked per week;

W_i = The average weeks worked per year substracting vacation, sickness, absentiesm

G_i = The labour participation rate

P_i = The population (hence $G_i P_i$ = labour force)

and U_i = The rates of unemployment

Unfortunately, most of the data about the above variables are not available, hence we were forced to use population growth rate as a proxy for labour grôwth rate. The population figures were obtained from the U.N. Demographic Year Book various issues. Growth rates were obtained as in the case of GDP growth rate.

The effects of quality improvement on labour have most often been ascribed to education, but there are ofcourse other relevant factors, for example, work experience, health, housing, and security conditions. We will not consider any factors other than education for the following reasons. Theoretically, the relationship between the other factors mentioned and work effort or efficiency is quite unclear, although it admittedly does exist. More important for our purpose many of these factors are effects rather than merely causes of higher-income growth rates.

Let us then consider the effects of education and the possible data and variables which may be used to represent such effects. First of all, we should make clear that although labour quantity and education are together regarded as reflecting effective labour input, the two measures will be separated for two reasons. First to combine them the percentage of workers whose quality was improved by education would need to be known. If for example over the period 1965-79 labour quantity grew 15 per cent and some measure of education showed an index of 110 clearly, it would be wrong to say that the index of effective labour input was 125.4, (110 x 115) because the improvement in education affects only a proportion of labour force. Another reason for separating the two variables in the quantitative analysis is that this enables the statistical results to differentiate the relative effects, at least in the sense of indicating whether or not, each of the variables separately have any explanatory value in the regression.

We have worked with various measures of education, which we will briefly outline below:

a) Primary School Enrolment Ratio: Numbers enrolled in primary school as percentage of age group (PRE).

b) Secondary School Enrollment Ratio: Numbers enrolled in secondary school as percentage of age group (SEE).

c) Total Enrolment Ratio: Numbers enrolled in both primary and secondary school as percentage of total age group (0-6 + 6-12).

d) Literacy rate: Adult literacy rate of people over 15, who are able to read and write, either at base period, or growth rate over some period.

e) Education Index

$$Q_j = a_i P_{ij} / a_i P_{i0}$$

Q_j = Index of educational improvement in the labour force at time j relative to 0

a_i = Weight ascribed to labour force members with level of educational attainment i, (weights for each level of schooling, the cummulative number of grades at each level, 8 for primary and 12 for secondary)

P_i = Proportion of labour force with education attainment i,

C , j = Time period

Use of Lags: Since effect of education will only be felt after a time interval, a suitable lag has to be incorporated, say 5 or 10 years.

The source of data for education has been UNESCO Year Book various issues and World Development Report various issues.

Capital Input: In a regression analysis explaining growth rates, the ideal variable one would use to account for the role of capital in production is the rate of growth of capital stock. This is not feasible for lack of estimates of the size of the capital stock. Thus, any quantitative analysis in a large cross-section must necessarily use investment data in some form, and the most common relationship is considered to be that between the ratio of investment to output and the growth rate of output.

The problem with using a ratio I/Y as Denison correctly points out, is that the relationship is in theory false because the ratio I/Y is not an estimator of the growth of capital stock dK/K, although the two are related by a well known economic variable

$$r_k = I/K = I/Y \;\; Y/K \;\; = I/Y \;\; 1/a$$

where a = average capital output ratio K/Y. For a given country, and for a fairly short time period, it would probably be safe to assume a constant. However, for a cross-section of diverse economics, such as we have, the assumption that the average capital output ratio is constant over the sample is untenable. Thus the relative sizes of I/Y do not correctly estimate the relative sizes of I/K. But the fact remains that capital stock data are simply not available, and hence one is left with no choice except to use I/Y and realise exactly in what way using this is inappropriate.

To get at the ratio I/Y, data on gross fixed capital formation was collected for each year (1965-79), then these were divided by GDP at constant prices for each year and for each country. Then, an average of this ratio was obtained for each country and taken to be an index of capital growth or investment.

The source of data has been the U.N. Year Book of National Account Statistics various issues.

Technological Change

Effects of technological change have usually been measured as residuals, all growth unexplained by conventional economic factors being attributed to technological change.

Here again two different procedures are followed in the literature. The first approach interprets the least squares analysis not as an estimation of the production-function but rather as something more akin to a factor analysis in which R^{-2} indicates the proportion of variance explained by the independent variables, then one could interpret the value of $(1-R^{-2})$ in the equations including only economic inputs as in some sense a measure of technical change. But here it should be noted that $(1-R^{-2})$ includes all the "errors of measurement" and "badness of fit" and cannot be termed as technological change.

If we had reliable estimates of K and L and if we assume rate of technical progress were same for all countries. Estimation of the coefficients would enable us to get a value of λ which in the case of Least Squares approach would be the constant in the regression.

We have in our analysis made use of a modified Cobb-Douglas production-function, where we have tried to introduce trade factors like export growth and import growth as determinants of productivity factor.

Finally we have in our analysis in Section I of Results and Analysis Chapter (5) made an attempt to test certain hypothesis. This Section I we have treated as a pilot survey and hence the conclusions reached here do not form part of our final model.

We wanted to test the hypothesis of whether export (XR) as a contributor of foreign exchange was more important than foreign capital inflow (BR) in the growth process.

Exports (XR): We have defined as Exports/GDP averaged over the period 1965-79. The data source has once again been U.N. Year Book of National Account Statistics various issues.

Foreign Capital Inflow (BR): This we defined as Imports (M)-Exports (X)/GDP averaged over the period 1965-79.

The source of this data was the U.N. Year Book of National Account Statistics various issues.

In the next chapter, we will outline the results obtained by the application of our model to the data for the period 1965-79. We will also undertake a comparative analysis of results of our study with those obtained from other studies in the field. The final chapter examines our major conclusions and areas of future research interest

CHAPTER : 5

RESULTS AND ANALYSIS

This chapter will be divided into three major sections - Section I will be used to test certain hypotheses, Section II will discuss our results in detail under the following heads: (a) Role of Education in the Growth Process, (b) Role of Trade Factors in the Development Processes and (c) Homogeneity of our Sample. Finally, in Section III , we will undertake a comparative study of our results with those obtained from other studies.

Section-I

In this section, we do not undertake the fitting of a production-function to the data on hand. It is intended primarily to present and test certain hypotheses. All we attempt to do here is to identify GDP growth rate (R Y) as our dependent variable and run a regression of this against certain independent variables relevant for our hypotheses.

The important hypothesis we wish to test is to see whether exports (XR) as a contributor of foreign exchange is more important in the growth process than net foreign capital inflow (BR).

The variables used have been already defined in our last chapter.

The results of our hypothesis testing is presented in Table 5.1 below.

Table 5.1 : Ordinary Least Squares Regression with RY as the Dependent Variable

$$RY = a_0 + a_1RK + a_2RL + a_3(XR) + a_4(BR) + u$$

Eq. No.	Constant	(RK)	RL	Exports/ GDR(XR)	M-X/GDP (BR)	$\bar{R}^2$ F
1	-0.3390 (-0.171)	0.2210 (2.127)	0.7046 (1.867)	0.0026 (0.110)	0.0695 (0.821)	0.18 (2.610)
2	-0.2863 (-0.145)	0.2331 (2.280)	0.6503 (1.761)	0.0008 (0.034)	-	0.19 (3.308)
3	-0.3249 (-0.167)	0.2166 (2.304)	0.7109 (1.943)	-	0.0678 (0.829)	0.21 (3.6252)
4	-0.2904 (-0.150)	0.2346 (2.578)	0.6479 (1.821)	-	-	0.22 (5.1534)
5		0.2618* (3.018)	0.6998* (2.089)	-	-	17.07** (121.27)

Note: t and F values are given in brackets.
* Coefficients after hetrosecdastic correction
** Denotes residual sum of squares (RSS) and not $\bar{R}^2$

In equation 1, we include four independent variables namely (a) labour growth rate (RL), (b) investment rate (INVR or RK) (c) exports/GDP (XR) (d) M-X/GDP (BR) (where M denotes imports, X - exports). The independent variable in this as well as other equations is the rate of growth of GDP (RY).

Equation 1 shows that both the labour and investment coefficients are significant at the 5% level. However, the variables (XR) and (BR) turn out to be quite insignificant at the 5% level. The regression explains very little (about 18%) of the variation, and F value also turns out to be quite insignificant.

It is felt that there might be some correlation problem (even though the simple correlation matrix showed no such correlation) between the (XR) and (BR) variables, and dropping one variable might improve the result.

In equation 2, the BR variable is dropped. Once again labour growth rate and investment rate were significant at 5% level, but the R^{-2} improved only marginally from 0.18 to 0.19, even though the F value turns out to be significant at the 5% level. The XR variable is once again insignificant.

Similarly equation 3 is run leaving out the XR variable but retaining the BR variable. Once again labour growth rate and investment rate were significant at the 5% level. R^{-2} improved to 0.21 from 0.18 in equation 1. But as the (XR) variable in equation 2, the BR value also turns out to be quite insignificant.

Thus we are lead to the conclusion that since both the XR and BR variables turn out to be insignificant in whatever form they are tried, not much could be said about their relative importance. But equation 1 seems to suggest that the BR variable has a higher coefficient and t value than the export (XR) variable, which can be taken to mean that foreign capital inflow may contribute more to growth (BR) than foreign exchange through exports (XR), though as already stated both XR and BR variables turn out to be insignificant and thus this conclusion has to be taken with a pinch of salt.

Equation 4, (Table 5.1), thus contains only labour growth rate and investment rate as the explanatory variables. Equation 4 tells us that both the labour growth coefficient and investment rate are significant at the 5% level. R^{-2} continues to explain very little of the variation, though it seems to have improved fromm 0.18 in equation 1 to 0.22 in equation 4. The F value was significant at 5% level and showed considerable improvement over equation 1.

Finally equation 5 presents results after heteroskedastic correction. In cross section analysis heteroskedasticity is likely to be a serious problem. It arises because significant explanatory variables may have been omitted. Thus we feel that since equation 4 contains only labour growth and investment rate as explanatory variables, heteroskedasticity may arise because some explanatory variables which may contain distinctive variances, are not included.

To test whether heteroskedasticity is present in the regression equation 4, Table 5.1, two tests were performed. One was a multiplicative test suggested by Judge et al. (1980) and Amemiya (1977) and the other is an additive test which we use as a variant of multiplicative test.

Thus if e is the least squares residual

$$e^2 = LAB^{a1}\ INV^{a2}$$

so that

$$\log e^2 = a_1 \log LAB + a_2 \log INV \qquad \ldots(5.1)$$

and an additive form

$$e^2 = a_0 + a_1\ LAB + a_2\ INV \qquad \ldots(5.2)$$

where

e = Least squares residual

LAB = Labour growth rate

INV = Investment rate

a_0 = Constant

a_1 and a_2 = Coefficient of labour growth rate and investment rate respectively

We find that both the independent variables (labour growth rate and investment rate) are insignificant in the multiplicative form.

In the additive formulation, however, we find investment coefficient to be significant. Thus the original equation is divided by $1/\sqrt{a_2\ INV}$. and the regression is run without a constant term. Thus equation 5 in our Table 5.1 contains no constant term.

In order to find our whether the heteroskedasticity correction was successful, the following criteria is generally followed: (a) The residual sum of squares (RSS) after heteroskedasticity correction should be less than RSS before it. Since $\bar{R}^2$ does not provide a measure of goodness of fit, in equation without a constant term, we report only the residual sum of squares in our Table 5.1, equation 5 with a double star (**) mark. (b) The magnitude and sign of the coefficients should not change a great deal. (c) The significance level (F and t values) should improve after the heteroskedastic correction.

Equation 5, Table 5.1 presents the results after heteroskedastic correction. The residual sum of squares is about 17.07, while before the correction it was 85.05, so that it is reduced to about 1/5th of the initial level.

The individual coefficients of the explanatory variables have not changed a great deal. Thus the labour growth coefficient increases slightly from 0.65 to 0.69, while investment coefficient has increased marginally from 0.23 to about 0.26. The t values have improved. Thus, the t value for labour growth coefficient increases from 1.829 to 2.089 and for the investment coefficient, it increases from 2.578 to 3.018.

Thus on all three counts we find our heteroskedastic correction was successful.

As stated at the outset this section was intended as a pilot survey. We are not arriving at any conclusions from this section. All we wish to do is to point out certain broad directions which this section seems to suggest to us. The following are some observations which we wish to make on this section.

(a) Both the investment and labour growth coefficient are quite stable and consistently significant at the 5% level. Thus the labour growth coefficient varies from 0.65 to 0.70 and the investment coefficient from 0.22 to 0.26 in equations (1)-(5) of Table 5.1. They are also close to anticipated levels obtained from factor shares data & tells us that in developing countries, labour growth coefficient varies from 0.6 to 0.7 and investment coefficient from 0.2 to 0.3.

(b) In this section, we have also tested for the relative importance of exports and foreign capital inflow as contributors to growth. Unfortunately, the coefficients of both these variables though positive were insignificant. Thus we feel not much could be said about their relative importance inspite of the fact that equation 1 seems to suggest that the foreign capital inflow (BR) has possibly a greater influence than export on growth.

Section -II

In this section, we will outline the results of the application of our model as set forth in our analytical framework chapter. For convenience, we will reproduce the final estimating equation here:

$$\dot{Y} = g + a\dot{L} + b\dot{K} + d\dot{q} + r\dot{X} + \theta\dot{M} + u$$

where

$\dot{Y}$ = The rate of growth of GDP over the period

$\dot{L}$ = The rate of growth of labour force

$\dot{K}$ = The rate of capital growth, proxied by investment rate

$\dot{q}t$ = An index of educational improvement in the labour force

$\dot{X}$ = The rate of growth of exports

$\dot{M}$ = The rate of growth of imports

g = A constant

a = A random disturbance term assumed to be normally disturbed

Role of Education

As mentioned in our definition of variables and data sources chapter, we will be working with various measures of education to capture the effect of education on growth. These measures are explained in detail in Chapter 4.

Table 5.2, equation 1, we try two measures of education. These are growth of primary education (PRE) and growth rate of secondary education (SEE). From equation 1, it is clear that both these measures turn out to be insignificant. In fact PRE seems to have a negative influence on growth. Thus, equation 2, Table 5.2 is run only with growth rate of secondary education (SEE). Again this measure of education turns out to be insignificant but positive.

Table 5.2 : Education and Economic Growth

$$\dot{Y} = g + a\dot{L} + b\dot{K} + d\dot{q} + r\dot{X} + \theta\dot{M} + t$$

Eq.No.	Constant	K	L	PRE	SEE	TOE	EDI	$\dot{X}$	$\dot{M}$	$\bar{R}^2$ F
1	-1.8235 (-1.160)	0.2392 (2.153)	0.2455 (0.645)	-0.0425 (0.145)	0.0871 (0.430)			0.0714 (0.888)	0.3622 (4.657)	0.72 (10.18)
2	-1.88 (-1.281)	0.2469 (2.609)	0.2202 (0.672)	-	0.0771 (0.418)			0.0733 (0.956)	0.3630 (4.829)	0.74 (13.00)
3	-1.88 (-1.251)	0.2596 (2.796)	0.2378 (0.693)	-	-	0.0499 (0.181)	-	0.0720 (0.927)	0.3640 (4.822)	0.74 (12.91)
4	-2.31 (-1.023)	0.2586 (2.815)	0.2278 (0.677)	-	-	-	0.0041 (0.283)	0.0732 (0.945)	0.3645 (4.807)	0.74 (12.91)

Note: t and F values are given in brackets.

In equation 3, Table 5.2, both PRE and SEE are added together and a new measure, growth rate of total education (TOE) is tried. Again the results show that the effect of education on growth is negligible but positive.

Finally, in equation 4, Table 5.2, we introduce another measure which we call Educational Index (defined in Chapter 4). The results once again remain unchanged and the EDI coefficient is positive but insignificant.

It is evident that the effect of education on growth is found to be negligible because of two reasons: (a) since all the measures used in the estimation of effect of education on growth in equation (1)-(5), Table 5.2, took into account only a part of population educated. Thus a better measure it is thought would be to use a broader measure, like the literacy rate. (b) Again, it is generally true that education's effect on growth is only felt after a lag. Hence, it is thought to incorporate a suitable lag period say 5 or 10 years to study its effects on growth.

In line with the conclusions reached from Table 5.2, two measures of literacy are introduced. In equation 1, Table 5.3, we are using literacy rate at the period 1960 (base period lagged by 5 years) and calling it ADL_{1960}. The use of this measure also seems to be in vain as once again, it turns out to be insignificant at 5% level, though positive.

Table 5.3 : Lagged Literacy and Literacy Rate at Base Period as a Measure of Education

$$Y = g + a\dot{L} + b\dot{K} + d\dot{q}_t + r\dot{X} + \theta\dot{M} + u$$

Eq.No.	Constant	$\dot{K}$	$\dot{L}$	ADL_{1960}	ADLG	$\dot{X}$	$\dot{M}$	$\bar{R}^2$ F
1	-1.209 (-0.617)	0.2457 (2.442)	0.1679 (0.426)	0.0051 (0.305)	-	0.0543 (0.675)	0.3609 (4.434)	0.72 (11.61)
2	-1.626 (-1.055)	0.2426 (2.487)	0.2708 (0.797)	-	0.1433 (0.620)	0.0690 (0.857)	0.3819 (4.671)	0.72 (11.88)

Note: t and F values are given in brackets.

In equation 2, Table 5.3, we made use of a measure of adult literacy growth rate for the period 1960-1974 as a proxy for the improvement in the labour force via education. The results did not change much. ADLG variable like the ADL_{1960} variable turns out to be insignificant but positive.

Finally, we had a feeling that the use of dummy variables to reflect the quality improvements in the labour force via education, may help in capturing the effect of education on growth.

Table 5.4 : Dummies to Capture Effect of Education on Growth
0 : For below average value, 1: For above average values

Eq.	Constant	$\dot{K}$	$\dot{L}$	ADL_{d1960}	$ADLG_d$	$\dot{X}$	$\dot{M}$	$\bar{R}^2$ / F
1	-1.89 (-1.298)	0.2352 (2.373)	0.3391 (0.804)	0.3355 (0.560)	-	0.0705 (0.930)	0.3704 (4.872)	0.74 (13.14)
2	-2.02 (1.378)	0.2708 (2.936)	0.1845 (1.567)	-	0.3702 (0.743)	0.0771 (1.015)	0.3624 (4.876)	0.75 (13.38)

Note: t and F values are given in brackets.

The use of dummies seems to have not changed the picture much. In equation 1, Table 5.4, dummies of 0, for below average literacy rate at 1960 and values of 1 for above average literary rates are given. ADL_d 1960 turns out to be however insignificant but positive.

In equation 2, Table 5.4, values of 1 were given to above average literacy growth rate for the period 1960-74 and 0 for below average growth rates. The $ADLG_d$ variable turns out to be insignificant at 5% level.

From our analysis in Table 5.2 to Table 5.4, we reach the following conclusions:

(a) Whatever be the measure of education tried, its effect on growth turns out to be continuously insignificant at the 5% level. We can think of two reasons why the effect of education on growth comes out to be insignificant. First we feel that the lag used, 5 years, may not have been sufficient. The implications are that lags are more likely to be ten and fifteen rather than five and ten years. But due to non availability of data as also lack of knowledge and basis for postulating a longer lag, we did not pursue the question much farther.

The second factor may be that since educational expenditure could be considered both as a consumption expenditure as well as investment in human capital formation, its ultimate effect on growth will depend on whether the benefit from educational expenditure in the form of skilled labour is greater than its cost as a consumption expenditure. Thus in our case, it might be possible that the benefits of education are offset by the rather high cost of education. Thus ultimately what we are left with is a small, insignificant contribution of education to growth. But we offer no conclusive proof that the offsetting effect is infact taking place. It is just mentioned as a possibility here.

(b) It can be seen that the growth rate of labour turns out to be insignificant in most of the equations from Table 5.2 to Table 5.4, except in equation 2 of Table 5.4, where it is close to 5% acceptance level. The reason may be that since we use population growth as a proxy for labour growth rate and since education measures we use have also an element of population growth in them, it might make the labour growth rate insignificant.

(c) The capital growth rate coefficient proxied by investment rate is continuously significant at the 5% level and its coefficient value is around 0. 23.

(d) The export growth rate ($\dot{X}$) turns out to be insignificant throughout while the import growth rate ($\dot{M}$) not only has a high positive coefficient but is also highly significant at the 5% level. The reasons for such a behaviour of these two variables will be taken up in dètail when we analyse the influence of trade factors on growth.

Since education seems to have a negligible influence on growth and its inclusion does not improve the overall explanatory power of the model (in fact, it is responsible for the labour growth rate turning insignificant), we drop it.

Trade Factors in the Growth Process

Once we leave out the education variable from our analysis, our specified equation becomes

$$Y = g + a\dot{L} + b\dot{K} + r\dot{X} + \theta\dot{M} + u$$

where variables are as defined before.

Table 5.5 : Trade and Growth

$$Y = g + a\dot{L} + b\dot{K} + r\dot{X} + \theta\dot{M} + u$$

Eq No	Constant	$\dot{K}$	$\dot{L}$	$\dot{X}$	$\dot{M}$	$\bar{R}^2$ F
1	-1.42 (-0.972)	0.1790 (2.235)	0.6416 (2.594)	0.0018 (0.027)	0.3157 (4.367)	0.70 (5.39)

Notes: t and F values are given in brackets.

From equation 4, Table 5.5, we find that export growth rate is insignificant at the 5% level. This is very surprising since most of the studies especially like those of Hwa (1983), Oyejide (1986), have found a very high positive contribution of export to economic growth. The reason may be because of the fact that exporting firms which obtain a license to import on the pretext that they are exporting, may either be selling imported input, at a premium in local markets, or it might think it profitable to sell in the domestic market, which is quite large and is also willing to accept lower quality standards than the international market, where competition generally tends to be rather severe.

Equation 1, Table 5.5 also tells us another interesting story. The effect of import growth rate is not only highly positive but also has a high t value. This result is unique because there are very few studies which have studied the contribution of import growth to GDP growth rate, and have generally expressed the opinion that its effect on growth is likely to be negative (though Hicks (1980) like us, also found a high positive contribution of import to growth). The likely explanation for the high and significant positive contribution of import growth to growth may be because, imported capital goods and raw materials may be carriers of foreign technology which may then make a positive contribution to growth.

Granting the fact that imported inputs and goods are carriers of foreign technology, we ask ourselves the question, whether we can disaggregate the effects and see the relative contribution of consumer goods imports, raw material imports and capital goods imports to growth.

Table 5.6 presents the results of the disaggregation. The results show that consumer goods import growth have a negative effect on growth and is also insignificant at the 5% level.

Table 5.6 : Disaggregating Imports

$$\dot{Y} = g + a\dot{L} + b\dot{K} + f_1\dot{C} + f_2\dot{R} + f_3\dot{CAP} + u$$

Eq.	Constant	L	K	Consum. goods	Raw mater.	Capit. goods	R^2_F
1	0.4976	0.6456 (1.839)	0.1168 (1.759)	-0.0353 (0.908)	0.0731 (1.720)	0.1705 (4.328)	0.72 (15.33)

Notes: t and F values are given in brackets.

But as expected we find both the raw material import growth as well as capital goods import growth making a rather high positive contribution to growth. Thus the raw material import growth variable has a coefficient of 0.07, while the Capital goods import growth rate variable has a component of 0.17, indicating that the relative effect of capital goods import on growth far exceeds that of raw material import rate.

The distinctive coefficients obtained for consumer goods import growth, capital goods import growth and raw materials import growth seems to suggest that the direction of causality is from import growth to GDP growth and not vice versa. This is

1965-72, which is the period before the oil shock is better than for the period 1972-79.

The regression explains 74% of variation before 1972, but it explains only 54% during the period 1972-79.

The magnitude as well as significance values of all the coefficients are higher before 1972 than after it. The only exception is the coefficient value of import growth variable which jumps from 0.16 in 1965-72 to about 0.32 in 1972-79. The reason might be that when oil price eroded the contribution of other factors to growth (like labour, capital, exports etc), then the developing countries instead of cutting down its imports may have tried to increase it in order to restore its growth, at least to some extent. Since the drop in $\bar{R}^2$ from 0.74 to 0.54 is not very high, we are possibly right in reasoning that increase in imports in the post-hike period helped developing countries to certain extent.

A Chow test is conducted to test for the stability of the model for the whole period 1965-79. The results of the Chow test indicate that the model is stable for the whole period, and the disturbance caused by the oil price hike of 1972 did not disturb the system significantly.

We then examine the possibility whether a more homogeneous grouping of the countries within our sample could improve our results.

important as it gives an indication of the absence of simultaneous equation bias. But it should be noted that though the distinctive coefficients are indicative of the direction of the causality they are not here offered as conclusive proof.

<u>Examination of Stability and Homogeneity of Sample</u>

In order to test whether the coefficients are stable throughout the period under study, as also to examine the effect of oil price hike of 1972, we divide the sample into two sub periods, namely 1965-72 and 1972-79. We also try to group our sample of developing countries into more homogeneous groupings to see whether that improves the results.

Table 5.7 : <u>Dividing the Sample into Two Sub Periods</u>

$$Y = g + a\dot{L} + b\dot{K} + r\dot{X} + \theta\dot{M} + u$$

Eq.No.	Constant	$\dot{K}$	$\dot{L}$	$\dot{X}$	$\dot{M}$	$\bar{R}_F^2$
1	-2.34	0.2619	0.7707	0.0619	0.1695	0.74
1965-72	(-1.474)	(3.865)	(2.449)	(1.119)	(2.693)	(17.01)
2	-0.46	0.1676	0.1599	0.0255	0.3277	0.54
1972-79	(-0.197)	(1.719)	(0.279)	(0.230)	(4.576)	(7.27)

Notes: t and F values are given in brackets.

As expected the results of the regression for the period

Thus the following criteria of classification is tried. We classified the countries on the basis of (a) Per capita income (b) Proportion of Exports to GDP - export oriented countries (c) Proportion of Imports to GDP - import biased (d) Region wise -Latin America and Asia and finally (e) According to growth rates, -fast growing vs slow growing countries. But our finding is that the results did not change by much.

Thus we conclude that our sample of 30 countries are homogeneous by themselves and further classification is not necessary.

<u>Source of Economic Growth Decomposition</u>

Finally we attempt what has come to be called in the literature as sources of economic growth decomposition.

Such a decomposition is undertaken in Table 5.8. This Table is based on equation 1, Table 5.5. The chief merit of undertaking such a decomposition is to see how much is the relative contribution of various factors in the growth process.

It is clear from the Table 5.8 that for the period 1965-79, the average rate of growth is 5.79%, the sources of growth decomposition indicates factors of production labour and capital jointly contribute 84% of growth in total output, with labour growth rate contributing 26% and the capital growth 58%.

Table 5.8 : Sources of Economic Growth Decomposition (1965-1979)

	Growth rate [a]	Share (%)	Average growth rate
Factors of Production	4.88	84	
of which			
a) Capital	3.35	58	18.72 [b]
b) Labour	1.53	26	2.39
Productivity Change	0.91	16	
of which			
a) Export	0.01	.02	6.01
b) Import	2.32	40	7.36
c) Others [c]	-1.42	-24	-
Total (GDP)	5.79	100	-

Notes: Calculation based on equation 1, Table 5.5.
a - The numbers of this column is obtained by multiplying the estimated elasticities by the average rate of growth of the factors concerned.

b - Average values of various variables (Mean values)

c - Denotes constant term

The remaining 16% is explained by productivity change, to which import growth contributes 40% and perhaps factors like underutilisation, import restriction, misguided subsidation, excessive inflation (since we have assumed that factors not included explicitly as productivity variables would be reflected in the constant term) may be responsible for the negative contribution of 24%, though this remains a proposition and we cannot offer conclusive proof that it infact does have a negative influence. Surprisingly export growth variable contributes very little to growth (about .02%).

The implications for policy which follows from our analysis can be summarised as below.

(a) Capital investment, comes out as the largest contributor to growth, and the developing countries must make every effort to increase capital investment. This conclusion is also supported by other studies, which we will discuss in Section III of our analysis.

(c) Import growth rate comes out to be the next important factor contributing to growth, with a contribution of 40% for the period 1965-79. This seems to indicate that the developing countries can reap higher productivity gains by embarking on a policy of import liberalisation. Such a policy we feel will enable the importing less developed countries to obtain foreign technology at a lesser cost than would be possible otherwise.

(d) Contrary to popular conclusion reached in other studies, export's contribution to growth is very negligible. This may be, we feel due to the fact that exporters prefer to sell in local markets, as also because the international market for exportables from developing countries is unfavourable. Hence, policy makers should try to induce exporting firms to produce in those lines in which international demand is high (like India is diversifying into engineering products and away from primary products like jute).

Section-III

In this final section of our results and analysis chapter, we undertake a comparative study between our study and some of the other studies undertaken for developing countries. While doing such a comparison, we will also bring out how far our coefficients estimated is close to those of other studies as well as to the anticipated magnitude obtained from factors shares data.

We have chosen five studies plus our own study to compare. These studies are those of (a) Hagen and Hawrylyshyn (1969), (b) Robinson (1971), (c) Hicks (1980), (d) Hwa (1983) (e) Oyejide (1986).

We will have a Table showing the estimated coefficient from the different studies including our own.

Table 5.9 : A Comparative Analysis

Name of the author	CON	INV	LAB	DKS	DLS	$NFBR_1$	$NFBR_2$	Oil export	Agri. expor.	Exports	Imports	Inflation	Agri. grow.	Literacy rate	$\overline{EDI}$	$\bar{R}^2$ F	Period of study
Hagen and Hawrylyshyn	.043 (0.02)	0.208 (2.4)	.342 (1.2)	-	-	-	-	-	-	-	-	-	-	-	-0.158 (1.2)	0.49 (7% level)	1955-60
Robinson	.067 (1.25)	0.092 (0.066)	.347 (0.300)	1.073 (0.565)	2.011 (0.777)	0.313 (0.100)	0.165 (0.074)	-	-	-	-	-	-	-	-	0.52 (5.8)	1958-66
Hicks	-1.02	0.0680 (1.8)	-	-	-	-	-	-	-	-	0.2451 (6.2)	-	-	0.0223 (3.3)	-	-	1960-77
Oyejide	0.7638 (4.7193)	0.1476 (2.0013)	0.7050 (2.10)	-	-	-	-	-	0.0744 (2.70)	-	-	-	-	-	-	0.5214	1950-70
Oyejide	-0.1596 (-3.97)	0.0711 (1.99)	0.5613 (2.35)	-	-	-	-	0.0342 (2.48)	-	-	-	-	-	-	-	0.5311	1970-84
Hwa	-0.139 (6.1)	0.098 (2.7)	0.625 (2.0)	-	-	-	-	-	-	0.235 (5.1)	-	-0.022 (2.6)	0.380 (4.2)	-	-	0.61	1970-79
Our study Eq.2, Table 5.3	-1.626 (-1.055)	0.2426 (2.487)	0.2708 (0.797)	-	-	-	-	-	-	0.0690 (0.675)	0.3609 (4.439)	-	-	0.1433 (0.620)	-	0.72 (11.88)	1965-79
Our study Eq.1, Table 5.5	-1.42 (-0.972)	0.1790 (2.335)	0.6416 (2.594)	-	-	-	-	-	-	0.0018 (0.027)	0.3157 (4.367)	-	-	-	-	0.70 (5.39)	1965-79

Notes: a) t and F values are given in brackets, except for Robinson's study where the values given in brackets are standard errors.

b) Dependent variable in most cases is GDP growth rate. However, in Robinson's study, the dependent variable in GNP growth rate for the concerned period and in Hicks analysis, it is growth of per capita income over the relevant period.

c) All variables are measured as growth rates.

Compiled from

Sources of Data

Hagen and Hawrylyshyn: "Analysis of World Income and Growth 1955-65". Equation 3, Table 12 B: Economic Development and Cultural Change, October 1969.

Robinson (1971) "Sources of Growth in Less Developed Countries: A Cross Section Study", Equation 3, Table II. Quarterly Journal of Economics, 1971.

Hicks (1980) "Human Resources and Economic Development", World Bank Staff Working Paper: 408.

Oyejide (1986) "Sector Proportions and Growth in the Development of the Nigerian Economy. International Economic Association, New Delhi 1986.

Hwa (1983) "The Contribution of Agriculture to Economic Growth: Some Emprical Evidence. World Bank Staff Working Paper No. 619, November 1983.

Definition of Variables Presented in Table 5.9

CON = Constant term

LAB = The rate of growth of labour force

INV = The investment rate, used as a proxy for capital growth rate over the period

DKS = The average annual absolute change in the share of the non agricultural sector in GDP intended to reflect effect of transfer of capital from less productive to more productive sector on growth.

DLS = The rate of transfer of labour measured by estimating the average annual absolute change in the percentage share of population living in cities, again intended to capture the effect of labour transfer from less productive to more productive sector on growth.

NFBR = The ratio of net foreign balances to gross national product, to gauge the effect of foreign exchange availability on growth.

$NFBR_1$= Dummy used to test for country size. Equals NFBR for large countries (population over ten millions) and zero otherwise.

$NFBR_2$= Equals NFBR for small countries, zero otherwise.

Oil Exports = The growth rate of oil exports for the period 1970-84

Agri. Exports = The growth rate of agricultural exports for the period 1950-70

Exports = The growth rate of total exports over the period

Imports = The growth rate of imports over the period

Inflation rate = The rate of increase in price over the period

Agri. Growth = The rate of growth of agriculture over the relevant period

Literacy rate = The literacy at some base period (say 1960 in Hicks equation) or over a period growth rate (like in our study)

EDI = Educational index showing improvement in labour force quality

Table 5.10 presents a comparative analysis of the sources of economic growth decomposition undertaken as we have attempted in our study.

The growth rates are obtained by multiplying the respective coefficients of the variables with some average growth rate of the variable concerned over the relevant period.

Based on Table 5.9 and Table 5.10, we will now undertake a comparative study.

In most of the studies, presented in Table 5.9 and 5.10, the dependent variable for the regression equations has been the rate of growth of GDP. To put it in other words economic growth is taken to mean the growth in GDP over the relevant period (though there are two exceptions to this general trend. Robinson uses GNP growth rate, while Hicks has used growth rate of per capita GDP).

Turning to the explanatory variables, the factors contributing to growth, we have the following variables:

Labour Growth Rate: In general population growth rate (like our study, Robinson's study (1971) and Oyejide's study (1986) or participation rate (Hagen and Hawrylyshyn (1969) have been used to reflect the effect of growth of labour force on output.

Table 5.10 : Sources of Economic Growth Decomposition

	Robinson's study, 1958-66	Hwa's study 1970-79	Oyejide's study 1950-70	Oyejide's study 1970-84	Our study 1965-79
Labour					
a) growth rate	0.95	1.4	1.62	1.54	1.53
b) share %	19	33	30.57	40.52	26
Capital					
a) growth rate	1.56	2.1	2.32	1.64	3.35
b) share %	32	48	43.77	43.16	58
DKS					
a) growth rate	0.22	-	-	-	-
b) share %					
DLS					
a) growth rate	0.68	-	-	-	-
b) share %					
NFBR					
a) growth rate	0.70	-	-	-	-
b) share %	14				
Export					
a) growth rate	-	0.6	0.96	0.78	0.01
b) share %	-	14	18.11	20.53	.02
Import					
a) growth rate	-	-	-	-	2.32
b) share %					40
Inflation					
a) growth rate	-	-0.4	-	-	-
b) share %		-9			
Agriculture					
a) growth rate	-	0.8	-	-	-
b) share %	-	17			
Others					
a) growth rate	0.84	-0.1	0.40	-4.21	-1.42
b) share %	17	3	7.55	-	-24
Total GDP					
a) growth rate	4.95	4.4	5.3	3.80	5.79
b) share %	100	100	100	100	100

Robinson (1971) and Hagen and Hawrylyshyn (1969) get a coefficient of around 0.3 for the growth rate of labour force. (Table 5.9) while other studies like those of Oyejide (1986), Hwa (1983) and our study (1987) get an estimate around 0.6 - 0.7.

The argument advanced by Robinson for such a low coefficient value for labour growth is that there exists imperfect competition in the labour markets of most developing countries and hence marginal productivity theory does not hold, and one could expect the coefficient value to be lesser than that obtained from factor share data.

In general most of the studies do not estimate these coefficients, (labour growth rate and investment rate) statistically (by use of regression analysis). Instead they assume that perfect competition prevails in the factor market (and hence marginal productivity theory holds) and use factor shares in the national income as a proxy for these coefficients. For developing countries, it is generally found, that from factor share data, labour's coefficient is about 0.6 - 0.7 and investment rate coefficient to be around 0.2 - 0.3.

But contrary to Robinson's view that coefficient of labour growth rate is less than that obtained from factor shares data, the studies like our's,(1987), Hwa's (1983) and Oyejide's (1986) seem to take the contrary view that it is infact close to the factor share estimates. Since we (as also Hwa's (1983) and Oyejide's (1986) have also used statistical tools (regression analysis) to arrive at our results, it casts doubt on Robinson's way of viewing things.

From the sources of economic growth decomposition analysis (Table 5.10), it is seen that in all studies labour's contribution to growth is lesser than the contribution of capital to growth. Labour's contribution to growth is thus 19% in Robinson's study, 33% in Hwa's study, 30.57% in Oyejide's estimate for 1950-70 and 40.52% in 1974-84 and about 26% in our study.

Capital Growth

As already mentioned while discussing our definition of variables chapter, it is often difficult to get a direct estimate of the growth of the capital stock. Hence, what most studies (including ours) have done is to use the investment rate as a proxy for capital growth. This is the reason why the reader will often find investment rate and capital growth rate used inter changeably in our analysis.

From Table 5.10, the investment coefficient is around 0.2 in our study, Hagen and Hawrylyshyn (1969) and Oyejide (1950-70). But the studies of Robinson (1971), Hicks (1980) and Oyejide (1970-84) get an estimate around 0.10.

As already mentioned this difference may arise because of the distortions prevalent in the factor market during the period of study.

But Table 5.10 tells us that all the studies examined find that capital contributes more to output growth than labour. Infact its contribution is around 50% in most cases. It is 32% in case of Robinson's study, 48% in Hwa's, 43.77% for Oyejide (1950-70), 43.16% for (1970-84) and 58% in our study.

Among productivity factors contributing to growth various studies have examined different factors. Like Robinson (1971) examines the contribution of (a) Transfer of labour (DLS) and capital (DKS) from less productive to more productive branches, (b) The effect of foreign exchange availability on growth (NFBR).

Thus for his period Robinson (1971) finds DKS and DLS together contribute 18% to total output and NFBR contributes about 14% to output.

Education and Growth

The factors enhancing the quality of factors, especially labour are considered important from the view point of growth. One of the important determinants of labour quality considered in most studies is education.

From Table 5.10, we have three studies which examine the role of education on growth. These are our own study, Hagen and Hawrylyshyn's study (1969) and the study of Hicks (1980).

Both ours (1987) as well as the study of Hagen and Hawrylyshyn

(1986) find that contribution of education to growth is negligible (Hagen and Hawrylyshyn infact get a negative estimate). Hicks (1980) however found that education's contribution to growth is positive and highly significant.

The reasons for our low estimate might have been as already mentioned, are the following.

a) The length of the lag used (5 years) may not have been sufficient.

b) Since education can be considered as a consumption expenditure as well as investment in human capital, we feel in our period the former effect may have offset to a large extent the beneficial effect of the latter.

Trade Factors in Growth

We feel that one of the major drawback of most studies undertaken till date have been the rather scant attention paid to trade factors in the growth process.

Inspite of the fact that some of the studies like those of Hwa (1983); Oyejide (1986) have analysed the contribution of exports to growth, while others like Hicks (1980) have analysed effect of imports on growth. There has been practically no study which examines both these factors under a consistent framework. Such an analysis is necessary in order to gauge the relative influence of exports vs imports on growth.

Exports and Growth

From Table 5.10, it is clear that most of the studies have found a rather high positive contribution of exports to growth. Hwa's study (1983) finds its contribution to be 14%, it is 18.11% for agricultural exports in Oyejide's (1986) study for 1950-70 and 20.53% for oil exports in the period 1970-84.

But the most surprising result comes from our (1987) own study. Exports as can be seen makes a meagre contribution of 0.02% in our case. The reason may be that exporting firms might have during our period of study obtained a license to import on the pretext that they are exporting. Then they might have either sold their imported quota at a premium in the local market, or might have sold the finished product in the domestic economy because of the reason that the international market is too competitive for them, as also the fact that domestic consumers may be willing to accept lower quality standards.

Imports and Growth

The effect of imports on growth is generally not considered at all in most studies. The reason being the fact that it is generally believed that the contribution of imports to growth will be negative, involving as it does a loss of precious foreign exchange.

But both the studies which have included imports in their analysis like our study (1987) and that of Hicks (1980) find its coefficient to be highly positive and significant.

From Table 5.9, Hicks (1980) gets a value of 0.24 for his import growth rate coefficient, while we get a value of 0.31, which works out to be 40% of total output in Table 5.10.

The reason for such a high contribution is perhaps due to the fact that imported inputs and capital goods are carriers of foreign technology which may then make a positive contribution to output in developing countries.

<u>Other Factors Contributing to Growth</u>

In general in most studies factors which have not been explicitly included in the analysis, because they are difficult to characterise, or because data are not available are often treated as residues or put under "others" category.

From Table 5.10, it is clear that "others" category contribute 17% in Robinson's (1971) analysis, 3% in Hwa's (1983), 7.55% in Oyejide's (1986) (1950-70) and a negative influence of -24% in our analysis.

The rather high negative influence obtained in our analysis suggests that the excluded factors have had a detrimental effect on growth (these may be inflation, import restriction, etc.). We however, could not characterise these factors due to non availability of data.

It should be mentioned that Hwa's(1983) study also examines the effect of inflation and agricultural growth on output. From Table 5.10, one can see that inflation contributed negatively to the tune of -9% and agricultural growth rate makes a positive contribution of 17% to output in Hwa's (1983) study.

CHAPTER : 6

CONCLUSIONS AND FUTURE RESEARCH

Our study is a cross sectional regression analysis for a sample of 30 developing countries in Asia and Latin America for the period 1965-1979.

The study makes use of a modified Cobb-Douglas production-function extended to include trade factors like export growth and import growth rate.

We arrive at the following conclusions from our study.

1) Capital growth seems to be a major contributor to economic growth, accounting for about 58% of the growth in output. This is not, however, very urprising as capital is a scarce factor limiting economic growth in most countries. The capital growth coefficient is also seen to be quite stable and its size varies between 0.2 - 0.3 , which is the expected level obtained from factor share data. The high contribution of capital to economic growth is also found in most of the studies attempted for developing countries (Maddisson, 1970; Williamson, 1969; Hwa, 1983; Oyejide, 1986). The implication for policy is that the developing countries ignore capital investment at their peril.

2) Labour growth contributes 26% to growth. Its coefficient like the capital growth coefficient continues to be quite close to the anticipated level obtained from factor share data (about 0.6 - 0.7).

3) Productivity contributes around 16% which is also consistent with other studies (Robinson,1971; Hwa,1983 etc.). It is generally seen that the contribution of productivity to growth is less than that of developed countries.

We have included trade factors in our model as determinants of productivity. This is done because we find that in the literature, there has been no attempt to include trade factors in a consistent framework of a production-function.

4) The significant result is that import growth makes a contribution of 40% to measured growth. Its coefficient also turns out to be quite stable. The high contribution of imports to growth is also found by Hicks (1980).

The implication for policy is that it pays the developing countries to embark on a policy of import liberalisation.

5) There seems to be a problem of underutilisation of resources, misguided subsidation, import restriction etc., (though we cannot offer conclusive proof) which have a negative influence on growth to the extent of 24%, thereby offsetting to a large extent the productivity gains from import growth.

Thus suitable policies have to be designed to remove these obstacles to growth, if the developing countries are to reap higher productivity gains.

6) Exports growth contribution to growth is a meagre 0.2%, which may be due to the fact that the exporting firms may prefer

to sell their products domestically rather than abroad.

7) Education quite clearly has, at the very least, a long gestation period and indeed it is not clear that its effect when finally matures is as great as is sometimes thought. In our model, we see that whatever way education is defined, it turned out to be insignificant. It was therefore, felt that the cost of education to a large extent outweighed the benefits of education. Thus we finally had to discard this variable from our model.

If it is not yet obvious from the previous discussion, it is worth reiterating that the aggregate model used, the cross section parameters estimates, are rough tools. The study, however, has indicated important forces at work and has provided estimates of their average effect.

The future research areas are as follows.
While cross section analysis seems to cover the common variables that determine the complex growth process underlying individual countries, it should nevertheless be supplemented by detailed country studies to examine country's specific factors.

It has been pointed out by Kelley and Williamson (1973) that the sources of growth methodology only provides a framework for examining expost data. It cannot reveal the future sources of growth since the technique provides no theory of endogenous factor growth. To put it in other words, demand factors should be explicitly included in the model.

Again, the assumption of a common production-function across countries may not be quite true.

Further the aggregate production-function, we have made use of may suffer from aggregation bias. Thus, it is felt that the analysis should be conducted at a more disaggregated level, like the sector level or industry level.

It is also felt that the sources of growth methodology does not allow for the effect of quality improvements in products via research and development expenditures.

Since socio-political factors play a crucial role in the growth process in developing countries, it has to be explicitly included in any model seeking to describe developing countries growth process.

Finally the data used is not very good, even though all attempts have been made to make them good. We were, however, forced to use proxy variables for certain factors like labour growth and capital growth.

We plan to take up some of these issues in our future research.

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