ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

HUMAN RESOURCES DEVELOPMENT AND ECONOMIC GROWTH IN ETHIOPIA

BY

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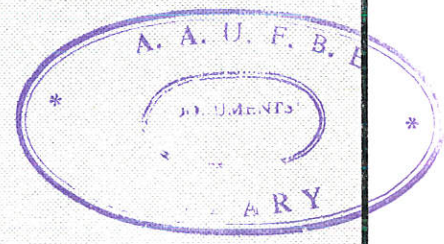

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HUMAN RESOURCES DEVELOPMENT AND ECONOMIC GROWTH IN ETHIOPIA

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BY

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Human Resource Development and Economic Growth in Ethiopia

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ACRONYMS AND INITIALS

ADLI	Agricultural - Development - Led Industrialization
CSA	Central Statistical Authority
DGP	Data Generating Process
ERP	Economic Reform Program
FDRE	Federal Democratic Republic of Ethiopia
GP	General Medical Practitioner
HDI	Human Development Index
HDR	Human Development Report
HRD	Human Resources Development
IMF	International Monetary Fund
Kcal	Kilo Calorie
MEDaC	Ministry of Economic Development and Cooperation
MEEC	Ministry of External Economic Cooperation
MOE	Ministry of Education
MOF	Ministry of Finance
MOH	Ministry of Health
NaTCAP	National Technical Cooperation Assistance Program
NBE	National Bank of Ethiopia
NEP	New Economic Policy
ONCCP	Office of the National Committee for Central Planning
PER	Public Expenditure Review
PFP	Policy Framework Paper
PHRD	Policy and Human Resources Development
PHRDP	Policy and Human Resources Development Project
PMGSE	Provisional Military Government of Socialist Ethiopia
SAFL	Structural Adjustment Facility Loan
SAL	Structural Adjustment Loan
SSA	Sub Saharan Africa
TGE	Transitional Government of Ethiopia
UNDP	United Nations Development Program
USD	US Dollar
WDR	World Development Report

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ABSTRACT

Human resources development has long been considered an important factor in economic growth. This study examines the contribution of human resources in Ethiopia's economic growth. This is accomplished by entering education and nutrition (as proxies for human resources development) apart from physical capital and labor in the growth equation by taking the 28 years time period from 1967/68 to 1994/95. A long run static and a short run dynamic (error correction) models are employed to observe the contribution of human resources. The results obtained indicate that in the period under reference education enters positively and significantly whereas nutrition enters positively but insignificantly in explaining the growth in output.

CHAPTER ONE

INTRODUCTION

1.1 Statement of the Problem

Economic growth has been one of the primary goals of economic policy in virtually every country of the world, whether developed or developing. In the last three decades some countries have succeeded to achieve a rapid economic growth, whereas most economies failed to do so. Studying economic growth is important to determine the reasons behind the difference in growth of economies.

At the forefront of economies that have registered rapid economic growth are the eight East Asian economies[1]. A World Bank study [1993a:5] unfolds that private domestic investment and rapidly growing human capital were the principal engines of growth for these economies. These countries have gained a lot from their human capital, which was attained by focusing initially on elementary education and then increasing the availability of secondary education. Other studies such as Hicks [1980], Wheeler [1980], and Barro and Lee [1993] have also shown that rapidly growing countries have well developed human resources.

Whereas, in Ethiopia both the growth experience and the development of human resources are very low. In fact Ethiopia is one of the least developed countries in the world with a very low level of per capita GDP of USD 100 in 1994 [WDR, 1996]. The level of human resources development is also very low even compared to Sub Saharan African and least developed countries.

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[1]These include: Japan; the 'Four Tigers' (Hong Kong, The Repuplic of Korea, Singapore, and Taiwan); and the 'Three Newly Industrialized Economies' (Indonisia, Malaysia, and Thailand).

According to the 1994 Human Development Report (HDR), out of the total population of Ethiopia, only 46 percent had access to health services during 1985-1991, only 28 percent had access to safe water during 1988-1991, life expectancy was 46.4 years in 1992, and primary and secondary enrollments were only 27 percent. Daily calorie supply per capita had been only 1700 Kcal in 1988 to 1990 period. This same report, using the Human Development Index (HDI) as a measure, put Ethiopia at a rank of 161 out of 173 countries.

Though exaggerated, Barro and Sala-i-Martin [1995:3] exclaimed that: "If Ethiopia were to grow at the long term US rate of 1.75 percent per year, then it will take 239 years to reach the 1990 level of US real per capita GDP. The required interval would still be 152 years, if Ethiopia were to grow at the long term Japanese rate of 2.7 percent per year".

These and other figures hence indicate how serious the problem is and the challenge ahead in human resources development of the country in particular, and economic growth in general.

1.2 Objectives of the Study

The objectives of the study are:

- To assess the level of human resources development of the country and evaluate human resources development policies implemented in the past; and
- To measure the contribution of human resources development to economic growth by taking a 28 years time period (1967/68 to 1994/95).

1.3 Justifications of the Study

Any study to measure the contribution of human resources development to economic growth has important implications for policy formulation irrespective of the nature and level of development of the economy under consideration.

Studies under taken in other countries, both developed and developing, have revealed that human resources development in the form of education and training, better health and nutrition has contributed to economic growth (see Hicks [1980], Wheeler [1980], Mankiw et. al. [1992], Benhabib and Spiegel [1994], and Islam [1995]). The existing few studies on human resources development in Ethiopia (for instance, Mesele [1994], Habtamu [1994], and PHRDP [1996a,b]) are, however, concerned with its single components. More importantly they do not deal with its relationship to economic growth. This study will fill a major gap in knowledge on the relationship of human resources development to economic growth in Ethiopia. Furthermore, the policy review will contribute to the debate on the role of policies in human resources development.

Most of the studies[2] in this area have focused attention on comparative analysis. They have used pooled cross country data. Cross country analysis, however, masks issues peculiar to an economy. This is because, the regression coefficients which are the basis of analysis represent an average country. Thus the results will be invalid unless the countries under consideration are of the same level of development. Cross country analysis assumes similar production function and the same level of technology for the countries under investigation, which are less realistic.

[2] These studies have been mentioned above, i.e, Hicks [1980], Wheeler [1980], Mankiw et. al. [1992], Benhabib and Spiegel [1994], and Islam [1995].

To avoid the problems of cross section analysis and clearly observe the growth experience peculiar to Ethiopia, this study has adopted time series analysis. Hence, the methodology used is another justification for this study.

1.4 Organization of the Study

The rest of the thesis is organized as follows. Chapter two gives an overview of the performance of the Ethiopian economy during the period 1967/68 to 1994/95, and assesses the development of human resources in this same period. Chapter three reviews the literature on economic growth and human resources development. Chapter four presents and discusses the empirical framework employed for estimation, and the estimation results. Finally, chapter five concludes by addressing the policy implications of the results.

CHAPTER TWO

AN OVERVIEW OF THE ETHIOPIAN ECONOMY AND HUMAN RESOURCES DEVELOPMENT

2.1 Introduction

Ethiopia is among the poorest nations in the world, with a very low level of per capita Gross Domestic Product (GDP) of USD 100 in 1994 [WDR, 1996] which is less than the 1984 level of USD 110. During the period 1980 to 1991, 43 percent of Ethiopian children (between 24 and 59 months) were classified as chronically malnourished, with an additional 19 percent classified as acutely malnourished [UNDP, 1993]. Such set of indicators as life expectancy, percentage of total population with access to health care and safe water, and school enrollment are also very low even compared to most Sub Saharan African (SSA) countries; whereas rates like infant mortality, maternal mortality, and total fertility are all very high (see Table 2.1).

Table 2.1

Basic Social Indicators

	Ethiopia	Kenya	Tanzania	Uganda	SSA
Life expectancy at birth, 1994	49	59	51	42	52
Infant mortality rate (per 1000 live births), 1994	120	59	84	122	92
Maternal mortality rate(per 100,000 live births),1989-95	1528	646	748	550	..
Total fertility rate, 1994	7.5	4.9	5.8	7.1	5.9
Percentage of population with access to health care, 1993	55	..	93	..	..
Percentage of population with access to safe water, 1993	18	..	52	..	..
Primary school enrollment, 1992	22	95	68	71	67

Source: World Development Report , 1995 and 1996

.. Data not available

These facts all testify that, Ethiopia is at a very low stage of development. The economy has been growing at a very slow pace. For instance, for the period 1966/67 to 94/95, average

economic growth (measured by the growth of GDP at 1980/81 constant factor cost) was only 2.4 percent, which was less than the parallel growth of the population of 2.9 percent (population has more than doubled in this same period).

This chapter highlights the economic growth performance of Ethiopia in the last three decades and assesses the various national human resources development (education, health, and nutrition) policies and strategies adopted and implemented. Towards this end different government documents are used as reference.

2.2 Economic Growth (1967/68 to 1994/95)

This study covers the 28 years period from 1967/68 to 1994/95, which falls in three regimes, i.e., 1967/68 to 1973/74 in the Imperial, 1974/75 to 90/91 in the 'Derg', and 1991/92 to 94/95 in The Federal Democratic Republic of Ethiopia (FDRE). The average annual economic growth measured by the growth rate of real GDP in these regimes have been 3.8, 1.9, and 2.5 percents respectively (see Table 2.2).

During the decade between 1963/64 to 1973/74 the economy has been growing on average at 3 to 5 percent annually and in per capita GDP terms at 1.5 to 2 percent. After the 1973/74 revolution the country followed a socialist path, and radical changes had been introduced into the economy including the widespread nationalization. The economy stagnated and growth declined from the prerevolution decades. Particularly during 1974/75 to 77/78, the growth of the economy in terms of real GDP was about 1 percent only. This was partly due to the war with Somalia. This was then followed by a period of recovery 1978/79 to 82/83, where real GDP grew at a rate of 4.3 percent on average. The campaign

which tried to mobilize resources to increase production contributed to the recovery. This trend was reversed in the years 1983/84 and 84/85 because of the drought and famine that hit the country and the economy registered 5.7 and 9.7 percent growth rates below zero respectively in real GDP.

Dissatisfied with the slow pace of growth, the then government formulated a Ten-Year Perspective plan for 1984/85 to 93/94 and set goals for all sectors, including health and nutrition, and education in line with the socialist principles. The primary goal of the Ten-Year Perspective plan was the achievement of an average annual growth rate of 6.5 percent in real GDP. Since the country's population, was supposed to grow at an estimated rate of 2.9 percent per year over the same period, real per capita GDP was expected to grow at the average annual rate of 3.5 percent.

To attain the above stated rate of economic growth, agricultural GDP was planned to increase at an average annual rate of 4.3 percent, industrial GDP at 10.8 percent and services GDP at 6.9 percent. The plan aimed at increasing the investment level over the period at average annual rate of 16.8 percent and gross domestic saving at a very high annual rate of 23.9 percent. It also envisaged a tremendous effort to increase export earnings so as to meet the rising import requirement. Exports of goods and non factor services were estimated to grow on average at about 8.8 percent per year in real terms, their share in GDP rising to about 13.2 percent in 1993/94 [PMGSE, 1984: 23-25]. All these were meant to bring a structural transformation of the economy (i.e. to industrialize the country). That is, the share of agriculture in GDP that was 48.3 in 1983/84 was planned to decline to 39.1 percent in 1993/94; while that of industry to rise from the 1983/84 figure of 16 to 23 percent in 1993/94.

Nonetheless, economic growth has remained slow, less than 2 percent on average, and there have been only a 0.2 percent increment in per capita food production from 1974/75 to

1990/91. Gross capital formation increased on average by only 6.8 percent and gross national saving by 7.6 percent which are all by far below the planned level. The economy had registered a growth of 9.6 and 13.8 percent in real GDP in 1985/86 and 1986/87,

Table 2.2

Average Growth Rates[3]

	Real GDP[a]	Inflation[b]	Gross Capital Formation[a]	Gross National Saving[a]	Budget Deficit[c]
1967/68 - 1973/74	3.2	2.9	1.5	10.6	-6.6
1974/75 - 1977/78	1.0	16.0	0.0	-8.1	56.7
1978/79 - 1982/83	4.3	7.7	10.5	6.1	61.4
1987/88 - 1990/91	-0.4	9.8	-0.5	-2.0	16.9
1974/75 - 1990/91	1.9	9.1	6.8	7.6	37.7
1991/92 - 1994/95	2.5	11.0	33.4	57.8	-192.7
1967/68 - 1994/95	2.5	8.1	9.6	16.1	-6.5

Sources:- a: MEDaC, National Accounts Team; b: CSA; c: MOF, Annual Government Revenue and Expenditure

respectively, following the timely and adequate rainfall. But, due to the increased civil unrest and the drought that hit the Northern part of the country in 1987/88, the trend had been reversed and economic growth had declined on average by 0.4 percent during 1987/88 - 90/91. The expected structural transformation was not achieved. Though the share of agriculture in GDP declined from 51 percent in 1983/84 to 48.5 percent in 1989/90, the share of the manufacturing sector remained almost constant.

In May 1991, Ethiopia has experienced a change of government. The government after having full control of the state apparatus issued a New Economic Policy (NEP) in Nov. 1991. The NEP has been operationalized through an Economic Reform Program (ERP)

[3] The whole period 1967/68 - 94/95 is divided into six sub periods, with this in mind: 1967/68 - 73/74 falls in the Imperial era, 1974/75 - 77/78 is the period of the Somalia war and a general social unrest, 1978/79 - 82/83 covers the campaign period, 1987/88 - 90/91 was the period in which the civil war in the country reached its maxim and economic activity was retarded as a result, 1974/75 - 90/91 was the 'Derg' period, and 1991/92 - 94/95 is the TGE & FDRE period.

with Structural Adjustment Facility Loan (SAFL) from the IMF, Structural Adjustment Loan (SAL) from the World Bank, and debt relief and loans from members of the Paris Club and other donors. Since the government first embarked on the Economic Reform Program in 1992/93, four Policy Framework Papers (PFPs)[4] have been issued and implemented.

The reform program, as cited in the first PFP, has been envisaged to be in three overlapping phases. The first focusing primarily on economic stabilization through tightening the fiscal policy, strengthening monetary control, and adjusting the exchange rate; the second on structural reform aiming at generating a supply response; and the third phase strengthening the initial structural reform measures by subsequent structural measures focusing primarily on the financial sector, public enterprises and civil service reform.[5]

The economic reform, as stated by Mekonnen [1994:15], is meant to stem and reverse the economic decline and put the economy on a sustained path of growth and development. Towards this end such reform measures as reducing budget deficits, relating prices to market levels, liberalizing trade, adjusting the exchange rate, and controlling the supply of money and credit have been taken. These measures are expected to bring macroeconomic balance in the short term, and economic growth and equity in the long term [Workneh, 1994: 120].

The government has also endorsed a long term development strategy - Agricultural - Development - Led Industrialization (ADLI) - which takes the agricultural sector as the basis for the development of other sectors. Given the size of the agricultural sector both in terms of its contribution to GDP and export, and the proportion of the population engaged in agricultural activities this strategy is defendable.

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[4] These are, the Policy Framework Papers: 1992/93 - 94/95, 1993/94 - 95/96, 1994/95 - 96/97 and 1996/97 - 98/99.

[5] Refer to the first PFP for detail discussions and further information.

When we look at the movement in real GDP, from 1990/91 on, the economy experienced a negative growth rate right after the change of government, basically due to the instability in most part of the country. The economy then witnessed a recovery in the growth of real GDP since 1992/93 primarily because of the good weather and the increased land under cultivation, except in 1993/94 where real GDP grew by 1.7 percent as a result of severe drought and pest damages on standing crops.

In the period 1967/68 to 1994/95 other macroeconomic indicators, other than GDP growth discussed above, such as price, and external sectors have not performed well either. Inflation[6] has been low in Ethiopia. At times there have been negative inflation which is hard to reconcile with the reality in the country. Overall, as is indicated in Table 2.2 in the three regimes under consideration, the rate of inflation has been on average 2.9, 9.1, and 11.0 percents for the Imperial, Derg, and TGE and FDRE respectively. These low inflation could be explained, as stated by Abebe [1996:14], partly by the tradition of tight monetary policy pursued by National Bank of Ethiopia and the structure of money demand in a situation of financial repression and low level of monetization.

The external sectors of the economy have witnessed increasing imbalances during the reference period. This imbalance have been manifested by the widening negative resource gap, i.e., export minus import. Of the total 28 years period covered in this study, the country enjoyed positive resource gap in two years only, i.e., in 1973/74 and 1974/75. The consistently widening negative resource gap has been due to the fast growth of imports in the face of sluggish growth in exports. Furthermore, Ethiopia's exports are not diversified, it is dominated by primary agricultural products whose demand in the world market has been falling over time.

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[6] The rate of inflation is computed from the Addis Ababa price index. The major drawbacks of this index are: first, it is based on the income and expenditure survey undertaken by CSA in 1963. Second, it does not cover such basic expenditure items as rent.

Therefore, in the period under investigation, Ethiopia has suffered from internal and external shocks. The external shocks have largely been explained by the instability of world primary commodity prices. But the internal shocks were due to political instability (resulting in frequent change in development policies), long and protracted civil war, and frequent drought and famine which have been very damaging. These all together have resulted in the very poor performance of the economy.

2.3 Human Resources Development (1967/68 to 94/95)[7]

This section assesses the level of human resources development of the country, and evaluates the various policies and strategies towards the same. This is accomplished by looking into the major social sectors (education and health - which is divided into health services and nutrition) that are instrumental in the development of human resources.

2.3.1 Education

Though education has a very long history[8] in Ethiopia, modern public education made a modest entry into the history of the country at the beginning of this century with the establishment of the Minilik school in 1908 [Tekeste, 1996:1]. In the initial days education was strongly associated with the Christianity faith. With the introduction of modern education, however, the goals of education has been changing depending on the pressing

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[7]This section relies on "Ethiopia Social Sector Studies" produced by the Policy and Human Resources Development Project (PHRDP), Addis Ababa, in Nov. 1996; and "Ethiopia Social Sector Review (PER II)" produced by the Center for the study of African Economies, Oxford University, July, 1996, as major references.

[8] There is a widespread agreement that, traditional education has begun with the introduction of christanity into the Aksumite Kingdom. Since then the religious institutions, particularly those in The Ethiopian Orthodox Twahdo Church were the basic source of skilled manpower both for the state and The Church. Clergies, judges, governors, and administrators were trained through The Churchs' institutions.

needs of governments. Consequently, during the era of Menilik II the major objective was to train people in foreign languages. Whereas during the initial Haile Selassie period beside the objective of producing students fluent in foreign languages the educational system was geared towards producing citizens who are loyal to the king and the country as well.

Furthermore, before the 20th century school curricula were not in any way related to development activities. It is only after Emperor Haile Selassie I took power that education was believed to contribute to economic growth and hence to development. As a result, budget allocated for this sector had begun to increase, rising on average by about 13.5 percent annually during 1967/68 to 73/74. Its share out of total government expenditure had increased from 10.8 percent in 1967/68 to 17.0 percent in 1973/74. The primary problem of the education policy in this era, however, was that it lacked coherence. The curricula and textbooks used were hardly related to the existing realities and pressing requirements of the country.

With the coming to power of the military regime in 1974 student enrollment expanded rapidly. It has more than doubled rising from 1,148,619 in 1975/76 to 3,532,476 in 1989/90 (see Table 2.3). Likewise the literacy rate increased from 7 percent in 1975 to a claimed high of 75 percent in 1983, due to the literacy campaign undertaken by subsequent rounds once a year, since 1979.

The rampant expansion in student enrollment, following the socialist principle of 'education to the masses' was at the cost of quality, which was not high at any point in time. In most urban schools, up to eighty children or more are squeezed into poorly-lit rooms designed for no more than forty pupils, and many children remained without chairs or desks in these classrooms. Teachers provided instruction with only a chalk board as the only educational aid [PHRDP, 1996a:65]. To alleviate this problem of class rooms the Ministry of Education (MOE) introduced a double shift system in 1971 and many schools have been operating this system since then.

The introduction of the double shift system has reduced the problem of classrooms to a certain extent, and saved on capital costs. But it could not be a lasting solution to the problem of shortage of space indefinitely. At the same time teaching time was reduced and access of students to library facilities was severely affected which are factors that adversely impacted on the quality of education. Perhaps the solution to the prevailing shortage of space in schools may have to be found beyond adopting a double shift system. The PHRD office has estimated that, the country currently needs 41,000 more schools to accommodate the potential student population [PHRDP, 1996a:66] without compromising on quality of education. Furthermore, the need for adequate financing of all schools is clear.

A manifestation of financial problems are the poor facilities of the schools. A 'facility level survey conducted by the PHRD office found out that, of the surveyed schools (295), only 24 percent have adequate laboratories; 17.4 percent have auditorium; and only 52 percent have a school library (irrespective of the available supply of books). Water and electricity are not provided to more than 30 percent of the schools, and around 20 percent do not have toilets. Only 35 percent of the schools have a staff lounge, and 75 percent have a sport field [PHRDP, 1996a:66].

Table 2.3

Student Enrollment, Teacher-Pupil Ratio and Schools

	Student Enrollment			Teacher - Pupil Ratio			No. of Schools		
	Primary	Secondary	Total*	Primary	Secondary	Total*	Primary	Secondary	Total*
1967/68	496,334	26,690	523,024	44	19	41	2,028	84	2,112
1975/76	1,084,406	64,213	1,148,619	44	25	42	3,673	125	3,798
1989/90	3,080,710	451,766	3,532,476	41	40	40	9,437	274	9,711
1994/95	3,098,409	370,916	3,469,325	33	33	33	10,403	329	10,732

Source: MOE, Annual Education Statistics

* Totals do not include tertiary level education.

When one turns attention to participation rate, it is easy to see that it is among the lowest in the world. At the primary level, in 1994/95, despite over 3.1 million students enrolled in

10,403 schools, the country's total gross[9] enrollment[10] account for a little over 20 percent of the relevant school age children. Still many of these children are over the age of 14 which is outside the official age bracket for primary education recommended by the Ministry of Education (i.e. between the ages of 7 and 14). Thus when we net out the over aged children, the net enrollment rate will obviously be less than 20 percent. This is by far less than the corresponding figures for other East African countries (see Table 2.1). Gross enrollment rates for senior secondary and tertiary education were 6.6 and less than 1 percents respectively.

Furthermore, there are wide differences in participation rates between rural and urban, and female and male. Primary enrollment ratio for urban area is more than 90 percent while it is less than 20 percent in rural areas. This gap widens further at the higher educational levels. Gross enrollment ratios which are 73 percent in junior secondary, 38 percent in senior secondary, and 2 percent in tertiary levels for the urban centers are 6 percent, 2 percent, and almost zero respectively for the rural areas [PHRDP, 1996a:12].

Among the reasons for the observed disparities between urban and rural areas, the most prominent one is the opportunity cost of students time in rural areas. The opportunity cost is very high, as boys are required to work mainly in farm activities and girls in other domestic activities. Confirming this fact 68.4 percent of the respondents in the rural household survey gave the importance of alternative time use compared to attending school as the first reason for not sending children to school [PHRDP, 1996a:28]. Other reasons mentioned include, lack of further educational opportunities, low potential for off farm employment, and perceived irrelevancy of schooling in rural life.

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[9] Gross enrolment ratio is derived as the ratio of the total number of children in school irrespective of age to the population of school age, by level of schooling. The net enrolment ratio, however, includes only school age children in the numerator.

[10] Enrolment rates are estimates, calculated based on the population estimates extrapolated from the 1984 population census. Thus they are indicative and not accurate.

According to a MOE recommendation the optimum teacher - student ratio for Ethiopia is 1:50 in primary grades (1-8), and 1:40 in the secondary. In 1994/95, the national average for all levels was 1:33, though there is a wide range of disparity among the regions [PHRDP, 1966a:82]. This is an indication of the existing under utilization of teachers and in effect the inefficient utilization of educational resources.

The government owns most of the existing schools that cater a large proportion of the students. In 1994/95, for instance, as documented by PHRDP [1996:79] of all schools in the country, 95 percent of the primary, 85 percent of the junior secondary, and 90 percent of the senior secondary were government owned and operated. Government schools cater for 92 percent of the enrolled children in primary, 86 percent of the enrollments in junior secondary, and 97 percent of the senior secondary schools enrollment. Almost 94 percent of primary school teachers, 89 percent of junior secondary, and 97 percent of senior secondary school teachers are in government schools. The government also provides subsidies to community schools by paying their teachers.

Non government schools,[11] particularly private schools, have not been significant in the past two decades in Ethiopia as these were nationalized in the 1970s. Recently, however, government has passed a legislation on private schools that allows the MOE and Regional Education Bureaux to issue licenses for private schools. The private schools are supposed to comply with the MOE standards and to follow MOE curriculum [FDRE:1995].

The structure of the formal education system comprised of six years of primary (1-6); two years of junior secondary (7 and 8); four years of senior secondary (9-12); a vocational training system grade 10 plus 3 years; and a higher education at diploma and degree levels ranging from 1 to 5 years. There were also specialized training aimed at meeting a specific manpower needs.

[11] Non government schools are not necessarily private schools, they include public (schools returned to their sponsors), orthodox church, mosque, community, mission, and very few private schools.

The new structure which is being introduced, has eight years of primary education divided into two cycles of basic education (grade 1-4) and general education (grade 5-8); general secondary education grades 9 and 10; senior secondary education grades 11 and 12; a technical and vocational stream grades 11 and 12; higher education of 1 to 2 years for diploma and 3 to 5 years for undergraduate study. Besides, there will be technical and vocational education side by side with the school education system and such programs as adult education, special education and distance learning will also be endeavored.

The government has also endorsed an education development program for the period 1997-2001 [FDRE:1996a]. It envisages to achieve the following broad objectives:

- expand access to education by raising primary enrollments from 3.1 to 7 million and achieve an average gross enrollment of 50 percent for primary education;
- improve quality by extending the new curricula to all levels of the system, increasing the number of certified primary teachers from 85 percent to 95 percent, and lower textbook ratio at the primary level from 5:1 to 1:1;
- increase efficiency by the more effective utilization of teacher ratio and raising from 60 percent to 80 percent the education system coefficient of efficiency reflecting a reduction of the number of drop-outs and repeaters;
- improve quality by achieving a gross enrollment ratio of primary education of at least 25 percent in under served regions, raise female participation share in primary schools from 38 percent to 45 percent, and increase the number of female teacher from 25 to 35 percents.
- increasing financing for education by raising public expenditure on education to 4.6 percent of GDP and achieve a target rate of 5 percent of, new school construction owned by non government institutions, and introduce cost sharing at the tertiary level.

In summary it can be said that the existing extraordinarily low level of school participation and demand for schooling are reflections of the existing socio - economic problems. Educational policies designed and implemented in the past failed to attain their target mainly because they were not designed on the basis of the underlying realities and the curricula were more academic than technical. They also did not take into account the absorptive capacity of the economy, though these may be partly explained by the low quality of the education the students received. Ethiopia remains among the countries with the lowest developed system of formal education in the world despite the new development policies and strategies, whose outcomes are to be judged in the future.

2.3.2 Health and Nutrition

Health

In the last four decades the health status of the population in many countries has shown marked improvements because of advance in public health and medical technologies, improvement in nutrition and food hygiene, and female education. Over 17 percent of all Ethiopian children die before their fifth birthday [PHRDP, 1996b:1]. Such mortality rates were the result of various factors including poor nutrition and limited access to health care services. Nutrient supplies in Ethiopia are exceptionally low (average daily calorie supply was 1667 calories in 1989),[12] which is less than the recommended food intake for an average person.[13] Health care service in Ethiopia has remained poor. Only 55 percent of the population had access to health care services in 1993 [WDR, 1996].

[12] 1989 was a 'normal' year in that there was no major drought in the country.
[13] The Ethiopian Medical Association recommended a minimum 2100 Kcal average calorie per day, for an average individual [ONCCP, 1987].

At present Ethiopia faces an increasingly serious health threat from a revitalized malaria[14], acute respiratory infection, maternal and prenatal mortality, nutritional deficiency, diarrhea, and HIV/AIDS. As clearly stated in a PHRDP document [1996b:3] these and many other health problems place a severe burden on development in general and health resources in particular. The effect on the economy could be through; first, the effect of these diseases on household income and survival as a result of premature death and disability; second, the effects of the diseases on resources caring for the sick; and third, the effect of the loss of the productive population on the country's economy and the support needed for the dependents of the dead.

The health sector in Ethiopia is characterized by shortage of skilled manpower, maldistribution of available resources (both human and physical facilities), poor quality of services, mismanagement in the public system, and high attrition rate. Thus the following pages attempt to assess the health care services by looking into these peculiar characteristics of the health sector.

Many studies (such as: Office of the Prime Minister [1994], PHRDP [1996b]) have concluded that the existing health manpower is quite inadequate to provide adequate services to the country's population. Table 2.4 compares the number of health professionals to population, taking two years (1978 and 1994). As can be seen from the table, in the sixteen years period, the absolute number of health professionals has increased. The number of GPs and Health Officers, Nurses, and Health Assistants had more than doubled. The improvement relative to population growth (ratio) is, however, modest, i.e., in 1978 one health professional was to 3,286 people on average and after sixteen years one health professional is to 2,644 people.

[14] It is now more difficult to prevent and to treate because of the increasing resistance of the transmitting mosquito and the malaria parasite to the insecticides and drugs that are affordable and commonly in use.

Table 2.4

Number and Ratio of Health Professionals to Population

Type of Health Personnel	1994 Population = 52,298,178		1978 Population = 30,000,000	
	Number	Ratio	Number	Ratio
Medical Doctors	1,484	1:35,054	785	1:38,200
Medical Doctor Specialists	330	1:157,036	241	1:124,500
GPs and Health Officers	1,154	1:45,078	495	1:60,000
Nurses	3,723	1:13,973	1,470	1:20,400
Health Assistants	11,220	1:4,624	5,329	1:5,400
Pharmacist	473	1:109,979	107	1:280,000
Sanitarians	574	1:90,627	324	1:92,600
Medical Technicians (Lab. & X-Ray)	823	1:63,208	378	1:79,400
Total	19,781	1:2,644	9,129	1:3,286

Source: Adopted from PHRDP, 1996b:49.

When one looks at the figures for urban and rural areas separately, it is possible to see the urban bias in the distribution of services. The rural population (which constitutes 85 percent of the total) lives 30 km or more from a paved road, and most people live at least three days away on foot from rural health units [Hodes and Kloos, 1988:921].

The maldistribution between urban and rural can be seen by comparing the 1981 and 1990 health manpower in Addis Ababa to the total available in the country. Table 2.5 shows that the distribution has favored Addis Ababa for all types of health manpower

Table 2.5

Urban-Rural Disparity in the Distribution of Health Professionals

	Ethiopia		Addis Ababa		Percentage Share of A.A.	
Type of Health Personnel	1981	1990	1981	1990	1981	1990
Medical Doctors	504	1,658	258	1,020	51	62
Health Officers	233	94	89	79	38	84
Nurses	1,680	3,575	660	1,646	39	46
Health Assistants	6,778	10,045	1,285	3,460	19	35
Pharmacist	161	377	50	276	31	73
Sanitarian	261	389	82	196	31	50
Medical Technician(Phar, Lab, & X-Ray)	643	1,114	250	602	39	54
Total	10,260	17,252	2,674	7,279	26	42

Source: Adopted from Office of the Prime Minister, 1994:3.

This inequitable distribution between urban and rural areas is also observed in the different regions [see: PHRDP, 1996b:54-57].

There are only 89 hospitals, 191 health centers, 2,515 health stations and 1,175 health posts [PHRDP, 1996b:35]. Their distribution among regions and between rural and urban areas is uneven [see: Office of the Prime Minister, 1994:4; and PHRDP, 1996b:37-39]. In addition to the limited number of facilities, the condition in which these facilities are in is also a cause for concern. An assessment by PHRD office of public health facilities in 1995 found out that, over 50 percent of the facilities reported leaking roofs, and electrical, plumbing and sanitary problems. Overall assessment of the condition of the buildings showed that 15.1 percent were in excellent condition, 41.1 percent required minor repairs, 28.8 percent needed major repair, and 15.1 percent had to be replaced [PHRDP, 1996b:36].

Another manifestation of the problems of the public health care system is the inappropriate mix of human resources (see Table 2.4). The ratio between nurses and health assistants is 1 to 3 whereas the ratio between doctors and nurses is 1 to 2. This means that on average there are 2 nurses to 1 doctor and 3 health assistants to 1 nurse. Though the health assistants to nurse ratio is relatively acceptable, the nurse to doctor ratio should have been wider.

According to the report by the Office of the Prime Minister the quality of public health service in Ethiopia is low. Among the reasons propagated are: first, the training curriculum is mostly irrelevant, much theory less practice, curative oriented, and hospital based. Second, health workers have very little chance of being promoted, upgraded, refreshed or get trained on the job. Third, the Ministry of Health (MOH) has no inbuilt performance assessment of health workers [Office of the Prime Minister, 1994:7]. These had led the

public to lose confidence in the profession and resort to the traditional medicine, and the health workers to low morale and high attrition.

The Ethiopian modern health sector can be broadly categorized into public and private. Of these, the public sector is huge. Currently 91 percent of the hospitals, 93.2 percent of the health centers, and 76.2 percent of the health stations are owned and run by The Federal and Regional Governments. The share of the private and non governmental sector in health care facilities amounted to 8.9 percent of the hospitals, 6.8 percent of the health centers, 23.8 percent of the health stations, 95 percents of the pharmacies, all of the drug shops, rural drug vendors and private clinics [PHRDP, 1996b:35]. The traditional sector which includes traditional healer, self medication by collecting herbs, and the use of religious facilities for medical purposes plays a major role in the country's health care services. It is a common practice in rural areas, particularly where modern health care is not available.

The discussion so far sheds light on the current situation of Ethiopia's health sector and the status of the health care delivery. Another fact not touched yet is the various health policies and strategies in the sector. A brief review of these policies and strategies is given below.

The socialist government, with a motto of 'Health to the Masses', promised to emphasize primary health care, rural health care, and the control of common diseases. Accordingly the Ten-Year health plan (1984/85 to 93/94) set goals of expanding health care services and immunization for the majority of the population and creating a healthy environment. The ambitious goals of the plan included immunization of all pregnant women and children under two, an increase in the proportion of the population with access to health care services from 43 percent in 1984 to 80 percent a decade later, and an increase in per capita visits to modern health care services from 0.5 to 2.5 per year. The plan aimed to decrease infant mortality (from 145 to 95 per 1,000), and child mortality (from 92 to 65 per 1,000); and increase life expectancy (from 42 to 55 years). By 1994, all health institutions were to provide maternal and child health care services, immunization and family planning programs

[Hodes and Kloos, 1988:919]. The achievements of this plan were generally not satisfactory.

In line with the government's policy on primary health care, rural health services had developed more rapidly than hospitals in the last regime. The number of community health agents and traditional birth attendants or midwives, each trained for several weeks increased from none in 1974 to approximately 1,500 a decade later. Each community health service was expected to serve a minimum of 1,000 people in both rural and urban areas. Some of these workers were paid by the peasant associations and kebeles. However, this system did not last long, it collapsed because of low community participation. The number of health stations and health centers had increased from 650 to 1,949, and from 93 to 141 between 1974 and 1984, respectively. The number of hospitals had increased by only one, but the total number of hospital beds have increased from 8,415 to 11,296 between 1974 and 1988. Most health institutions had operated below the recommended staffing due to shortage of funds. Overall, the proportion of the population with access to health service has increased from an estimated 15 to 20 percent in 1974 to 43 percent in 1984 [Hodes and Kloos, 1988:921].

The health service delivery system was a six level pyramid, where at the base are community health services followed by health stations, health centers, and then three levels of hospital services namely rural, regional, and central hospitals. This is summarized, in PMGSE [1984] and MacKinnon and Collard [1996], as follows:

- At the base of the pyramid are health posts, their village health agents and their traditional midwives. Some 12,000 health posts have been established, though only few are operational. The community health agents are neither paid nor supervised.
- The second tier is for the health stations, which are the most peripheral of the health structures. Some 2,200 health stations should exist in the country, or in average one

health station for every 25,000 inhabitants. The staff of such a health station usually includes 1 to 3 health assistants.

- The third tier of the system is for health centers. Some 190 such centers operate in the country, or one for every 300,000 inhabitants. Their staff includes 1 to 5 doctors (non specialists), nurses, and health assistants. The health centers also employ health agents, laboratory and pharmacy technicians, administrative and maintenance personnel.
- At the fourth tier are rural hospitals which for all practical purposes are similar to that of a health center, sometimes reinforced by a pharmacist, a laboratory or radiology technician, etc. It is supposed to serve some 500,000 inhabitants.
- The fifth tier is for regional reference hospitals. It is bigger and its staff includes several specialists.
- At the top of the tier are national reference hospitals - either general or specialized - which theoretically have a larger capacity for specialized care.

The number of hospitals (rural, regional, and reference) were 85 in all (of which 77 belong to the government). These include a total of 9,675 beds, that is less than 0.2 beds per 1,000 inhabitants (whereas in SSA the ratio is 1.4 beds per 1,000 inhabitants).

The high number of levels is now believed to have complicated the distribution of responsibilities and of tasks attributed to the different health care structures. As a result there is overlapping of activities at the different levels. Besides, the health system has been centralized during the last regime. The MOH was involved in every activities including those at lower level. The long bureaucratic chain has resulted in inefficient, ineffective, and unresponsive health system. With the intention of overcoming these problems in the health system the government has introduced new health policy and health sector strategy.

Assurance of accessibility of health care for all segments of the population, decentralization of the health service delivery system and development of the preventive components of

health care are some of the fundamental principles incorporated in the new policy [PHRDP, 1996b:30].

The new health system will have a four tier pyramid. The first will be health centers followed by district and regional hospitals, and national reference hospitals as second, third and fourth tiers in the pyramid respectively.

- The health center that will include five satellite community health posts, will provide a package of essential health promotion, preventive and curative services to a population of about 25,000 inhabitants. It will also have 10 beds for emergencies. It will be directed by a health officer and have a staff of 25 employees of which 13 will be technical staff and 12 supportive personnel. Three remunerated community agents will staff each community health posts.
- There will be one district hospital for every 250,000 habitants. It will have 50 beds and the staff will include 30 health workers and 20 support staff.
- There will be one regional hospital with 100 beds providing services for every 1 million people. It will have 60 health workers.
- The national reference hospital with 250 beds will cover the needs of 5 million inhabitants. It will employ 120 health agents. We need 9 more such hospitals between now and 2015.

The health sector investment program also stipulated to achieve a life expectancy at birth of 50 - 55 by the year 2002 from its present level of 47 - 54, infant mortality rate of 90 from its present rate of 105 - 128, health care coverage of 70 percent from its present rate of 35 - 45

percent, maternal mortality rate of 450 - 500 from its present rate of 500 - 700 per 100,000 live births [Abebe, 1996].

The management line comprises the central MHO, the Regional Health Bureaux, Zonal and Wereda/District Health Departments. The responsibility of planning, and executing health development activities have been devolved to the lower levels. The responsibility of the central MOH will be to prepare operational guidelines set standards of facilities, staffing, drugs and supplies and providing technical support including manpower that cannot be produced at regional level [PHRDP, 1996b:30].

It is evident that constraint in the financing of health care services is major factor for the existing poor performance. Ethiopia's health care system is financed from such sources as, government, private, external assistance and loan, private health insurance, and NGO's. To have a rough image of the contribution of these sources, let's have a look at estimates of health care spending in 1995/96 done by PHRD office.

Table 2.6

Sources of Financing the Health System in 1995/96 (in Millions of Birr)

	Budget			Percentage Share out of		
	Recurrent	Capital	Total	Recurrent	Capital	Total
Private Expenditure	388.4		388.4	51.8		35.9
Government Expenditure	281.6	238.0	519.6	37.5	71.3	47.9
Donors and Loans	75.2	96.0	171.2	10.0	28.7	15.8
Insurance Scheme	5.0		5.0	0.7		0.5
Total	750.2	334.0	1,084.2	69.2	30.8	100.0

Source: Adopted from PHRDP, 1996b:60.

The table indicates that more than half of the recurrent cost is attributable to household spending. The government share is high particularly in capital spending. Overall, the recurrent budget is more than double that of the capital budget. The government health budget (both recurrent and capital) has increased markedly. In 1967/68, the government's health expenditure was 239 Million Birr, and by 1994/95 it had reached to 498.4 Million Birr (see Appendix E). Although the government's health expenditure increased by 1985 percent over 28 years, the general price index increased by 661.8 percent. Thus the increase in real terms was much lower. Furthermore, the proportion of government expenditure allocated to the health sector ranged between 3 to 6 percent of the total. Whereas, for almost all the period between 1967/68 to 1994/95, the proportion of health expenditure has been below one percent of GDP.

The discussion so far has described the low level of development and the poor performance of the health sector, which has implications for the capacity of the country to reduce poverty and has sustainable development. Development requires physically able and healthy work force. The challenge, however, is that, because the country is poor it cannot devote adequate resources for the health sector, making things even worse, the cost of health services is increasing from time to time.

The country has, therefore, to face these challenges and do something before things get even worse. Thus in the short run, available resources need to be transferred from less to more cost effective services, and the government should intervene by defining a package of minimum clinical services, by targeting the poor, and by implementing a package of public health interventions. Besides as cited in [PHRDP, 1996b:3] the government should

encourage the private sector to participate in the promotion of health care services. In the long run, however, the government need to take measures that can bring about sustainable change, such as increasing female participation in education, and implementation of economic growth policies that will benefit the poor.

Nutrition

Endowed with considerable agricultural potential, Ethiopia had been self sufficient in staple food and was classified as a net exporter of food grains till the late 1950s. However, since early 1960s, domestic food supply failed to meet the food requirements of the people [Tesfaye and Debebe, 1995:20][15].

Domestic food production has exhibited cyclical movement in the period between 1967/68 to 1994/95. For instance during 1978/79 to 82/83 domestic food production on average increased by 12.7 percent annually, whereas during 1987/88 to 90/91 it declined on average by 1 percent. This fluctuation in production is highly related to the weather condition.

Table 2.7

Average Growth Rates

	Domestic Production	Total Available	Per capita calorie/day
1967/68 - 1973/74	-0.028	-0.028	-0.047
1974 /75 - 1977/78	0.010	0.010	-0.014
1978/79 - 1982/83	0.127	0.137	0.097
1987/88 - 1990/91	-0.010	-0.023	-0.040
1974/75 - 1990/91	0.031	0.031	0.002
1991/92 - 1994/95	0.052	0.053	0.020
1967/68 - 1994/95	0.020	0.020	-0.008

[15]Appendix E presents the food supply situation of the country from 1967/68 to 1994/95, which is summarized in Table 2.7.

Food production per person has fallen below nutritional requirements. For Ethiopia the recommended minimum average calorie requirement per day for an average individual is 2100 kcal as recommended by the Ethiopian Medical Association [ONCCP, 1987]. The annual deficit in the last decade was estimated at 0.6 to 4.0 million tones of food grain equivalents [Tesfaye and Debebe, 1995:21]. This shortfall in food production, coupled with high levels of post harvest losses has led to rapidly increasing dependence on food aid and commercial imports. As a result, the per capita food import rose from 5 kg in the early 1980s to 24 kg during the famine period of the mid 1980s and 19 kg in the early 1990s [Tesfaye and Debebe, 1995:21].

Nutritional status is commonly measured by anthropometeric measures that relate weight and height to the age of the person. There are three basic indicators for assessing the nutritional status of children aged below five. These are: stunting (height-for-age) measures chronic malnutrition and is a long term nutritional deprivation; wasting (weigh-for-height) measures acute malnutrition and is a recent nutritional situation; and under weight (weight-for-age) is an indicator of general malnutrition and measures past and/or present nutritional status (see: PHRDP [1996b:8] and Tesfay and Debebe [1995:24]).

In 1995/96 the CSA has conducted a survey using anthropometric measurements on a nationally representative sample of children living in more than 12,000 households. The survey results show that 64.9 percent of children aged 3 - 59 months were chronically malnourished (68.7 for rural and 56.3 percent for urban children)[16]. Among these, 49.3

[16] For detailed discussion on the variation of nutritional status between regions, urban and rural, and female and male refer to Tesfaye and Debebe [1996:24-26], and PHRDP [1996b:8-12].

percent of the rural and 36.2 percent of the urban children respectively were below 3 standard deviations of the reference population indicating severe malnutrition. Similarly about 10.8 percent were in a state of wasting (indicating acute malnutrition), while 45.9 percent were underweight (low weight for age) malnutrition [PHRDP, 1996b:8].

The nutritional status of both children and adults (see: PHRDP [1996b:9-11]) have been very low, as is discussed above. This obviously is one of the reasons for the observed low productivity in the agricultural sector.

Human resources development is concerned with developing human capabilities. It is a process of enlarging the range of choices people have, i.e., increasing their opportunities for education, health care, etc [HDR, 1991]. However, our discussion in section 2.3 above has revealed that, Ethiopia has one of the lowest school enrollment, very poor health care services, and people with poor nutritional status. These are the results of limited access to education, better health care, and balanced nutrition. Consequently, development of human resources in Ethiopia could be said at a very low level.

The dismal state of the economy is mainly the result of both natural and manmade factors. A major factor is the low level of the country's human resources development. This has been reflected by the extraordinarily low level of school participation and access to health care, and the small amount of per head calorie intake. Another factor has been change of government coupled with changes in political and economic policies. A major problem associated with such changes has often been the dramatic turn witnessed resulting in the reorientation of political and economic objectives causing discontinuity to unfolding development endeavors. It is a painful experience of the public to note that every government that came to power condemned what its predecessor had done, despite achievements, and tried to start everything all over again in the direction of his political and

economic policies, leading to discontinuity in the development process and results in wastage of resources. It is also important to note that the main sectors of the economy are characterized by low productivity, structural rigidity and capacity under utilization. Agriculture which is the mainstay of the economy contributing about 50 percent of GDP and more than 90 percent of export in 1994/95, is characterized by low productivity, fragmented and family based (most of the time unable to meet own consumption need), and largely rain dependent peasant farms. The industrial sector which is in third place in terms of its contribution to GDP was dominated by inefficiently managed public enterprises dependent on imported raw materials and spare parts, and high level of capacity under utilization. The other sectors are also not well developed. Lastly, the recurrent drought that hit the country and the long and protracted civil war which claimed the lives of many and caused destruction of economic and social infrastructures also has been a major contributing factor to the state of the economy.

CHAPTER THREE

LITERATURE REVIEW

This chapter sets forth the background for analyzing the relationship between human resources development (HRD) and economic growth. First, a brief summary of the major theoretical views on the concepts of economic growth and human resources development is presented. This is followed by, empirical evidences on the sources of economic growth, with particular emphasis on the contribution of human resources development.

3.1 CONCEPTS

In what follows, the major views on how economic growth occurs? and the concept of human resources development, which is the main concern of the study are discussed briefly.

3.1.1 Economic Growth

The theory of economic growth dates back to the late 18th and early 19th century of classical economists Adam Smith, David Ricardo, and Thomas Malthus. The 1928 classic article by Frank Ramsey, however, marks the starting point for modern growth theory. This was then followed by the works of Harrod and Domar in the late 1930s and mid 1940s, respectively, who attempted to integrate Keynesian analysis with elements of economic growth. Then followed the important contributions of Robert Solow and Trevor Swan in the mid 1950s that laid the base for neoclassical growth theory. Since the mid 1980s, with the work of Paul Romer and Robert Lucas a new growth theory called Endogenous Growth Models were added to the growth literature (for a more detailed discussion on the history of modern economic growth theory, see Barro and Sala-i-Martin [1995:9-13]).

Long run growth in per capita gross domestic product (GDP)[17] is usually used as a measure of a country's economic performance, hence economic growth. At present there are different views on the way economic growth occurs. The major perceptions can be categorized into three: neoclassical, structuralist, and 'new growth' theory.

In the neoclassical tradition, economic growth is the long term effects of capital accumulation, labor force expansion and technological change [Chenery, 1986]. Underlying this perception are several systematic assumptions. The overall economy is assumed to be characterized by competitive equilibrium. Both consumers and producers are assumed to have perfect foresight and in all markets continuous equilibria prevail. Resources are assumed to be efficiently allocated (in the Pareto sense). An important implication of these assumptions is that at any given point in time, it is not possible to increase aggregate output by shifting labor and capital from one sector to another, for factor returns are with equal marginal productivity in all uses.

Unlike the neoclassicals, structuralists view economic growth as one aspect of the transformation of the structure of production that is required to meet changing demands and to make more productive use of technology [Chenery, 1986]. Economies of scale, learning by doing, and reduction of internal and external bottlenecks are possible sources of growth besides the neoclassical sources of growth mentioned above. This perception is based on the assumptions of imperfect foresight and limits to factor mobility. These assumptions explain the essential features of developing countries, thus this perception is likely to be more important for these economies than the neoclassical view. The implication is that, economic growth can be accelerated by shifting labor and capital from less productive to more productive sectors.

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[17]GDP is more specifically a measure of the productive capacity of an economy hence it is in no sense a comprehensive measure of well being. UNDP (United Nations Development Program), since its first Human Development Report in 1990, has designed a new measure for well being: the Human Development Index (HDI). The HDI integrated life expectancy, adult literacy and income in an innovative way to produce a yardstick more comprehensive than GDP alone for measuring the progress of a country.

The new paradigm of economic growth has been introduced by Romer, and Lucas in the late 1980s motivated by the dissatisfaction with exogenously driven explanation of long run productivity growth. They introduced the roles of increasing returns, R&D activity, human capital, and the diffusion of technology. The new growth theory views growth as an endogenous outcome of the economic forces at work within a decentralized market system rather than the product of exogenous technological innovations on which the market has no control [Ehrlich, 1990], hence the designation endogenous growth model.

In pursuing this approach Becker, Murphy and Tamura [1990]; Rosenzweing [1990]; Romer [1990]; Barro [1990]; King and Rebelo [1990]; and Jorgenson and Yun [1990] have relaxed the more limiting assumptions of the neoclassical model. These studies established the possibility that an economy can achieve perpetual growth equilibria through internal forces, and they emphasize even more than the earlier literature the micro foundations of the growth process by identifying in some detail the engine of growth and its mechanics, as well as the motivating forces that affect the needed accumulation [Ehrlich, 1990].

In doing this Becker, Murphy and Tamura, as well as Rosenzweing treated both population growth and human capital formation, i.e., the economy's effective human resources, as individual choice variables. Romer interpreted and analyzed the specific role of disembodied technological change as the outcome of entrepreneurial decisions motivated by market forces rather than the consequence of autonomous scientific discoveries; and Barro, King and Rebelo, as well as and Jorgenson and Yun examined the role of the government in the growth process, possibly as an independent catalyst of growth, but also as an initiator of policies that can exert salutary or deleterious effects on the economy's growth rate, and not just its level [Ehrlich, 1990].

3.1.2 Human Resources Development

Human resources development is concerned with developing human capabilities and with using them productively. For a long time it has been meant the preparation and supply of middle and high level manpower in sufficient quantity and quality for the modern and formal occupations. Presently it is being perceived as the empowerment of the masses of the population so that every one will be enabled to contribute to overall development. Thus, human resources development encompasses education and training, better health and nutrition, reduction of fertility, sanitation and water supply. UNDP, Human Development Report [1991], defined human resources development as:

> *The process of enlarging the range of peoples choices - increasing their opportunities for education, health care, income and employment and covering the full range of human choices from sound physical environment to economic and political freedoms.*

A working definition of human resources can be adopted from ECA [1990]. That is,

> *human resources is the totality of skills and knowledge available to any given society as well as the prevailing attitudes and resourcefulness of members of that society to manipulate natural and physical resources towards the production of socially and economically valuable goods and services. Human resources development denotes all actions taken to provide skills and knowledge to, and nurture attitudes in members of a society so that they are better placed to contribute to improvements in the standards of living in society.*

Based on this concept, ECA [1990] classified human resources development as follows: (a). Education: basic education for all, i.e., basic literacy, numeracy, etc; formal education improvement, i.e., primary, secondary, and tertiary; non-formal education improvement; special education programs. (b). Training: skills improvement or upgrading for better performance on the job; formal training improvement e.g. the strengthening of programs in existing training institutions; special training programs e.g. provision of new training programs within or outside existing institutions. (c). Health and Nutrition: primary health

care programs particularly for disadvantaged communities; child survival programs; environmental programs particularly to improve the quality of social services such as health, housing and transportation. (d). Employment Promotion: employment information, institutions, etc; employment programs for special groups (youth, women, the disabled, etc); promotion of efficiency - increased productivity of labor.

Human resources development thus recognizes that people are both the means and the ultimate goal of development. Accordingly human development involves not only meeting the basic needs of people through the provision of basic services such as education, health, sanitation and nutrition but also creating the conditions necessary for the utilization of capabilities such as access to appropriate technology, better employment and human freedoms and opportunities [Mesele, 1994].

3.2 The Contribution of Human Resources to Economic Growth

Human resources development (i.e. investing in people) is good for economic growth could seem to be intuitively obvious. It receives apparent empirical support from both individual and aggregate data, and has become a fundamental tenet of development strategy. In the early days human resources development has been treated in its narrower sense as investment in human capital, particularly education. It is in the 1980s that the other human resources development indicators, i.e., health and nutrition are considered as possible sources of growth (Hicks, 1980 and Wheeler, 1980). There are ample empirical work on the contribution of investment in human capital (more specifically education) to economic growth both at the micro and macro levels, as well as both for developing and developed countries. Thus most of this section is devoted to reviewing this empirical work on the relationship between human capital and economic growth.

3.2.1 Theoretical Background

The concept that investment in human capital promotes economic growth actually dates back to Adam Smith and the early classical economists, who emphasized the importance of investing in human skills [Psacharopoulos and Woodhall, 1985].

Conventional economic growth theories tried to explain economic growth with the help of factors like labor and capital. However, this approach was unable to explain more than half of economic growth with the help of labor and capital. Put another way if economic growth was due to entirely to increases in physical capital and labor, then it should have been possible to disaggrerate the rate of growth of output into its capital and labor components.

Researchers, then attempted to discover how much of the 'residual' was related to the effect of education on the quality of the labor force, and how much to other factors such as improvements in the quality of physical capital, and economies of scale. In the beginning, the unexplained proportion of economic growth, i.e., the 'residual' was attributed to 'technical progress' [Solow, 1957]. Later works Denison [1962], and Grliches and Jorgenson [1966], however, clearly established that a significant proportion of this residual is attributable to human capital, particularly education. These and other findings then led to the rediscovery of the role of human capital in economic growth in the 1950s.

Consequently two approaches have been widely employed by researchers to measure the contribution of education to economic growth: the first is 'growth accounting' approach introduced and used by E.F. Denison and others in 1962; the second is 'human capital' approach introduced and used by T.W. Schultz and others. Growth accounting is based on the concept of an aggregate production function, which links output to the inputs of physical capital and labor, education entering as an input. Human capital approach, on the other hand, tries to measure the economic benefit of education by estimating its effect on the life time earnings of individual workers [Psachropoulos and Woodhall, 1985].

Education, therefore, is not merely a consumption activity, rather it is an investment that leads to the formation of human capital. Education transforms the raw human beings into productive 'human capital' by inculcating the skills required by both the traditional sector and the modern sector of the economy, and makes the individuals more productive [Pritchett, 1996].

Lau, et.al. [1991] outlined the following possible channels through which education affects economic growth, productivity and development in general. First, education enhances the ability of an individual to perform standard tasks and to learn to perform new tasks. Second, education enhances the ability of an individual to receive and process new information. Third, education enhances the ability of individuals to communicate and therefore to coordinate activities with one another. Fourth, education enhances the ability of an individual to evaluate and adjust to changed circumstances. Fifth, education helps to reduce subjective uncertainty and unnecessary anxiety as well as fatalistic acceptance of the status quo and thereby enhances the probability of adoption of new technologies or practices by an individual. Finally, at higher levels, education also helps to bring about innovations in the production technology.

Besides, as mentioned by Weale [1992:3], there are other effects. The most important of these is the effect of education on fertility, with educated populations growing more slowly. And a higher level of education is associated with a higher standard of health. These effects may then feed back into productivity, i.e., a more healthy work force is more productive. And lower fertility is likely to lead to more healthy children who may learn more at school and be more healthy and more productive as adults. This thus clearly reveals the link between the different components of human resources development.

3.2.2 Empirical Evidences

Denison in his 1962 pioneering work, using a growth accounting framework, estimated that 23 percent of the growth rate in per capita income between 1909 to 1929 in the United States could be due to education, and the corresponding figure was as high as 42 percent during 1929 to 1957. According to his later works, Denison [1974], it was found that 21 percent of the growth during 1948-73 was due to increased levels of education of the labor force [Tilak, 1989]. Similar calculation by Denison found the contribution of education in other advanced countries varied considerably, from 2 percent in Germany, to 12 percent in the United Kingdom, 14 percent in Belgium, and 25 percent in Canada. When the same approach was applied to the growth rates of some developing countries [Nadiri, 1972], the results were mixed. Here, education appeared to account 16 percent of the increase in output in Argentina, but less than 1 percent in Mexico and only 2 to 3 percent in Brazil and Venezuela [Psacharopoulos and Woodhall, 1985].

There have also been numerous studies undertaken by adopting the 'human capital' approach, pioneered by Schultz [1961]. Psacharopoulos [1985] has summarized the many rate of return to education studies around the world. He found that the estimated rates of return to education are typically above, and sometimes considerably above, 10 percent per annum in real terms, which is generally considered a very respectable rate of return. The rates of return are higher for lower levels of education, i.e., they are the highest for primary education, followed in descending order, by respectively secondary and higher education. They are also higher in countries where educated manpower is more scarce [Lau, et. al., 1991:2].

World Development Report [1991:159], presented a regression which explains growth in output by means of growth in inputs and by the initial level of education of the work force, and the increase in educational attainment of the work force in the period under study for 68 economies. The coefficients for education were positive, though statistically insignificant.

Barro [1991:429] run regression for 98 countries to explain the growth in GDP per capita by a number of variables describing education and political and social stability. His result suggested that an increase of 10 percent points in the fraction of school age population attending secondary school raised the per capita growth rate of GDP by 0.2 percent per annum. A similar increase in the growth rate was achieved by a 10 percent points increase in the fraction of the school age population attending primary school. Thus a 10 percent point increase in the fraction of the age group processed by both school systems would add 0.4 percent per annum to the per capita growth rates.

Mankiw et. al. [1992] taking 75 developing countries found that about 75 percent of the cross country variation in per capita income were explained by the average investment ratio and average fraction of working age population at secondary school. The school variable had a positive coefficient and was significant.

From the foregoing discussion it seems clear that, increased education of the labor force appears to explain a substantial part of the growth of output in both developed and developing countries since about 1950. However, two recently created data sets on the educational attainment of the labor force show that the growth of educational capital per worker has had no (or even perhaps a mildly negative) impact on the rate of growth of output per worker [Pritchett, 1996].

Benhabib and Spiegel [1994], and Spiegel [1994], using data on changes in the stock of education, apply a standard growth accounting framework and find the growth of years of schooling enters negatively (although it is statistically insignificant). The results were tested to be robust to the choice of sample and the inclusion of a wide variety of ancillary variables (i.e. dummies for regions, political instability, share of machinery investment, etc).

Benhabib and Spiegele [1994] argued that the negative (but insignificant) human capital coefficient could be the result of misspecification due to the incorporation of human capital

as an ordinary input in the production function. As an alternative they introduced a model that allows human capital levels to directly affect aggregate factor productivity through two channels, i.e., directly influencing productivity by determining the capacity of nations to innovate new technologies suited to domestic production, and affecting the speed of technological catch-up and diffusion [Benhabib and Spiegel, 1994: 144-145]. With this model their result confirm that the growth rate of total factor productivity depends on a nations human capital stock and human capital contributes positively to per capita income growth.

Lau et. al. [1991] estimated different effects of education by level (primary Vs secondary) and five regions and found that primary education had an estimated negative effect in Africa, insignificant effects in South Asia and Latin America and only positive and significant in East Asia.

To reconcile these results Pritchett [1996] forwarded three arguments: first, schooling may not actually raise cognitive skills or productivity but schooling may nevertheless raise the private wage because it serves as a signal to employers of some positive characteristic like ambition or innate ability; second, expanding the supply of educated labor in the presence of stagnant demand for educated labor causes the rate of return of education to fall rapidly; third, education does raise productivity, and that there is demand for this more productive educated labor, but that demand for educated labor comes from individually remunerative but socially wasteful or counter-productive activities so that while individual wages go up with education, aggregate output stagnates or even fall.

Extending these works to other components of human resources development Hicks [1980] examined the relationship between economic growth and human resources development (measured by literacy and life expectancy) in eighty-three developing countries during the period 1960-77 and found that the twelve developing countries with the fastest growth rate had well above the average levels of literacy and life expectancy. Three variables were

found to explain about 60 percent of the variation in per capita growth rates in developing countries between 1960 and 1977: the rate of investment, the growth rate of imports and the level of human resources development in 1960. Of course correlation does not prove causation.

To allow for the fact that education, and other indicators of human resources development, are both a result of and a cause of economic development, Wheeler [1980] devised a simultaneous model, which he applied to data for eighty-eight developing countries. The simultaneous model takes into account the interactions, overtime, between growth and human resources development, and tries to separate cause and effect. Tests with this model suggest that education, health and nutrition contribute to growth of output not only directly, but also indirectly, by increasing the rate of investment and by lowering the birth rate. The relationship is strong for education than for life expectancy, however, which shows a stronger relationship with economic growth in the 1960's, but not in the 1970's.

Economic growth and human resources development reinforce one another. The two need, therefore, to be treated simultaneously. It is necessary to stimulate economic growth through sound policies that promote sustainable, equitable development; and at the same time to invest heavily in human resources through improvement in education, health, nutrition and other social services. Economic growth is needed to generate more opportunities for people to earn their way to a better life; human resources must be developed so that people will have the skills and abilities they need to take advantage of those opportunities offered by economic growth.

CHAPTER FOUR

MODEL SPECIFICATION AND ESTIMATION

The empirical literature on economic growth is growing rapidly. However, much of it deals with cross country growth, i.e., cross-section analysis see Chenery [1986], Barro[1991], Mankiw et. al. [1992], Cohen et. al. [1994], Benhabib and Spiegel [1994], and Islam [1995]. One reason for this could be the difficulty of getting time series data for macroeconomic variables that will enable good analysis. Another, perhaps more important reason is related to the issue of convergence[18]. That is regions or countries with lower starting values of the capital/labor ratios have higher per capita growth rates and tend thereby to catch up or converge to those with higher capital/labor ratios [Barro and Sala-i-Martin].

Most of cross country growth analyses try to test the hypothesis of convergence among countries, following the seminal work of Solow [1956], which assumes diminishing marginal returns to capital; so that "the growth process within an economy eventually reaches the steady state[19] where per capita output, capital stock, and consumption grow at a common constant rate equating the exogeneously given rate of technological progress" [Islam, 1995:1129]. However, time series treatment of economic growth is very scant. One exception is the time series work of Jones [1995], but he does not employ the recent development in time series econometrics.

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[18] Convergence can be understood in two different ways Islam [1995]. The first is in terms of level of income and the second in terms of growth rates: a. if countries are similar in terms of preferences and technology, then the steady state income levels for them will be the same, and with time they will all tend to reach that level of per capita income; b. since in the Solow model the steady state growth rate is determined by the exogenous rate of technological progress, then provided that technology is a public good to be equally shared, all countries will eventually attain the same steady state growth rate.

[19] Countries are said to be in their steady state, when the correlation between initial levels of income and subsequent growth rates is found to be negative.

This study attempts to adopt the emerging time series analysis in applied econometrics to formulate a growth equation. More specifically a general-to-specific modeling is attempted. The conceptual framework starts with a brief discussion of the neoclassical growth models. This will give an insight on the growth models employed so far, and will be of help in our endeavor into time series growth modeling. Then, the second section of this chapter presents and discusses the estimation results obtained from the time series specifications.

4.1 Conceptual Framework

4.1.1 General Background

A country's economic growth can be represented by a well behaved neoclassical aggregate production relationship of the following form as postulated by Solow [1957].

$$Y_t = F(K_t, L_t, t) \qquad [4.1]$$

where Y denotes a measure of aggregate output, K and L refer to capital and labor input used in the production process, respectively, all at time t, while t represents time and is supposed to capture technical progress.

As a background to our analysis we review the theoretical properties of a neoclassical production relationship, and the various forms of technological progress that are found in the literature.

Barro and Sala-i-Martin [1995:16-17] showed that, ignoring technological progress, the production function in [4.1], $Y_t = F(K_t, L_t)$, is said to be a neoclassical production function when the following three conditions are fulfilled.

- For all K > 0 and L > 0, $F(K_t, L_t)$ exhibits positive and diminishing marginal products with respect to each input, so that

$$\frac{\partial F}{\partial K} > 0, \qquad \frac{\partial^2 F}{\partial K^2} < 0 \text{ ; and}$$

$$\frac{\partial F}{\partial L} > 0, \qquad \frac{\partial^2 F}{\partial L^2} < 0$$

- $F(K_t, L_t)$ exhibits constant returns to scale. That is

$$F(\lambda K_t, \lambda L_t) = \lambda F(K_t, L_t) \text{ for all } \lambda > 0$$

- The marginal product of capital (or labor) approaches infinity as capital (or labor) goes to zero and approaches zero as capital (or labor) goes to infinity;

$$\lim_{K \to 0}(F_{Kt}) = \lim_{L \to 0}(F_{Lt}) = \infty$$
$$\lim_{K \to \infty}(F_{Kt}) = \lim_{L \to \infty}(F_{Lt}) = 0$$

The condition of constant returns to scale implies that output can be written as

$$Y_t = F(K_t, L_t) = L_t F\left(\frac{K_t}{L_t}, 1\right) = L_t f(k_t)$$

where $k_t = K_t / L_t$ is the capital labor ratio, and the function $f(k_t)$ is defined to equal $f(k,1)$. This result means that the production function can be expressed in intensive form as

$$y_t = f(k_t)$$

where $y_t = Y_t / L_t$ is per capita output.

The exogenous technological progress term, t, in the growth model of [4.1] has been treated in various ways. It may be capital saving, labor saving, or neutral (or unbiased). A technological progress (invention) is capital saving when producers generate the same amount of output with less capital input, labor saving when producers generate the same

amount of output with less labor input, and neutral when the invention does not save more of capital or labor. There are three commonly used definitions of neutral technological progress.

(i). Hicks neutral:- if the ratio of marginal products remains unchanged for a given capital/labor ratio. The production function in [4.1] can then be written as:

$$Y = T_{(t)}F(K, L)$$

where $T_{(t)}$ is an index of the state of the technology, and $\dot{T}_{(t)} \geq 0$.

(ii). Harrod neutral:- if the relative input shares, KF_K/LF_L, remain unchanged for a given capital/output ratio. The production function takes the form:

$$Y = F(K, L \cdot A_t)$$

where $A_{(t)}$ is an index of the technology, and $\dot{A}_{(t)} \geq 0$. This type of technological progress is called labor augmenting technological progress because it raises output in the same way as an increase in the stock of labor.

(iii). Solow neutral:- if the relative input shares, LF_L/KF_K, remain unchanged for a given labor/output ratio. The production function takes the form:

$$Y = F(K \cdot B_t, L)$$

where $B_{(t)}$ is an index of the technology, and $\dot{B}_{(t)} \geq 0$. A production function of this form is called capital augmenting because a technological improvement increases production in the same way as an increase in the stock of capital.

In the neoclassical growth model, only labor augmenting technological progress turns out to be consistent with the existence of a steady state (i.e., with constant growth rates of the various quantities in the long run) [Barro and Sala-i-Martin, 1995:33].

4.1.2 Neoclassical Growth Models

Since Solow's 1956 seminal work, there have been different neoclassical growth models. The difference among these models arises mainly from the underlying assumption about the nature of technological progress. For instance, Solow's model which assumes Harrod neutral technological progress has been used by Mankiw et. al. [1992]. Chenery [1986] on the other hand, used Hicks neutral technological progress to decompose the three sources of output growth (i.e., capital, labor, and TFP).

In this study the Mankiw, Romer and Weil [1992], (hereafter MRW), extended Solow model will be used with some adjustment to the emerging time series econometrics. Hence in the following pages the Solow growth model and the extended Solow model (extended to include human capital by MRW) are presented.

Solow Growth Model

The traditional Solow model, featuring a Cobb-Douglas production function with labor augmenting technical progress, is represented by

$$Y_t = K_t^{\alpha}\left(A_t L_t\right)^{1-\alpha} \qquad [4.2]$$

where Y is output, K is capital and L is labor, A is level of technology, and $0<\alpha<1$. L and A are assumed to grow exogenously at rates n and g, respectively. That is

$$L_t = L_0 e^{nt}$$
$$A_t = A_0 e^{gt} \qquad [4.3]$$

Capital follows the law of motion

$$\frac{dK_t}{dt} = I_t - \delta K_t \qquad [4.4]$$

where I_t and δ are investment in physical capital and the rate of depreciation of physical capital, respectively. Given the constant fraction of output that is saved and invested, s, we can write

$$I_t = sY_t - \delta K_t \qquad [4.5]$$

Finally defining output and the stock of capital per unit of effective labor as y = Y/AL and k = K/AL, respectively, the dynamic equation for k_t can be written as:

$$\begin{aligned} \dot{k}_t &= sy_t - (n+g+\delta)k_t \\ &= sk_t^{\alpha} - (n+g+\delta)k_t \end{aligned} \qquad [4.6]$$

where δ is the constant rate of depreciation. The term $n+g+\delta$ is now the effective depreciation rate for k_t. If the saving rate, s, was zero, then k_t would decline partly due to depreciation of k_t at the rate δ and partly due to growth of effective labor at the rate $n+g$.

Since the steady state growth rate of k_t is zero, the steady state value k_t^* satisfies

$$k^* = \left(\frac{s}{n+g+\delta}\right)^{1/(1-\alpha)} \qquad [4.7]$$

The steady state capital labor ratio is related positively to the rate of saving and negatively to the rate of population growth and the rate of depreciation.

Substituting equation [4.7] into [4.2] and taking logs, we find the steady state income per capita.

$$\ln\left[\frac{Y_t}{L_t}\right] = \ln A_0 + gt + \frac{\alpha}{1-\alpha}\ln s - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad [4.8]$$

Equation [4.8] contains $\ln A_0 + gt$ in addition to the saving and population growth variables. Now g (exogenous rate of technological progress) is assumed to be the same for all countries and t is a fixed number in cross section regression analysis. Hence, gt in the equation is a constant. But A_0 reflects resource endowments, climate, institutions, and so on, in addition to technology [Mankiw et.al., 1992:411]. Therefore, A_0 differs across countries and can be represented as

$$\ln A_0 = a + \varepsilon \qquad [4.9]$$

where a is a constant and ε is the country specific shift or shock term.

By substituting [4.9] into [4.8] and adding gt to the constant term, a, we get:

$$\ln\left[\frac{Y_t}{L_t}\right] = a + gt + \frac{\alpha}{1-\alpha}\ln s - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon \qquad [4.10]$$

where ε is assumed to be independent of s and n.

Equation [4.10] becomes an empirical model that can be used to explain differences in the current per capita income across countries due to differences in the saving and labor force growth rates. Mankiw et. al. [1992], before testing for 'conditional convergence' (i.e.,

including human capital and initial income), employed this model for 98 countries. They found the model to be quite successful in explaining a large fraction of the cross country variations in income, but the estimates of the elasticities of output with respect to capital, α, were found to be unusually high. The reason was that the capital term in [4.10] includes human capital besides physical capital. Hence, MRW explicitly included human capital as another input of the production function and hence as a variable in the regression equation. This then led to the extended Solow model which we present below.

Extended Solow Model

MRW assumed a Cobb-Douglas aggregate production function which includes human capital, and which displays constant returns to scale.

$$Y_t = K_t^{\alpha} H_t^{\beta} \left(A_t L_t\right)^{1-\alpha-\beta} \qquad [4.11]$$

where Y_t is aggregate output, K_t and H_t are physical and human capital, L_t is raw labor input (labor force), A_t is the exogeneously determined level of aggregate productivity, all at time t, and $\alpha + \beta < 1$.

Labor and technology are expected to grow at rates n and g, respectively, with

$$L_t = L_0 e^{nt}$$

and [4.12]

$$A_t = A_0 e^{gt}$$

Physical and human capital accumulation are assumed to follow the laws of motion.

$$\frac{dK_t}{dt} = I_t - \delta K_t$$
$$and \qquad [4.13]$$
$$\frac{dH_t}{dt} = Z_t - \delta H_t$$

where I_t and Z_t denote investment in physical and human capital, respectively, and δ is the rate of depreciation (assumed common to physical and human capital)[20]. Given the saving rates s_k and s_h for physical and human capital, we can write

$$I_t = s_k Y_t$$
$$and \qquad [4.14]$$
$$Z_t = s_h Y_t$$

The differential equations describing the economy can then be rewritten as:

$$\dot{k}_t = s_k y_t - (n + g + \delta)k_t$$
$$and \qquad [4.15]$$
$$\dot{h}_t = s_h y_t - (n + g + \delta)h_t$$

where y = Y/AL, k = K/AL, h = H/AL are quantities per unit of labor, and (n + g + δ) are the effective depreciation rates of physical and human capital as is discussed in [4.6] above.

Since the steady state growth rate of k and h are zero, from equation [4.15] the economy converges to the steady state values k* and h* defined by:

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n + g + \delta} \right)^{\frac{1}{1-\alpha-\beta}}$$
$$and \qquad [4.16]$$
$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n + g + \delta} \right)^{\frac{1}{1-\alpha-\beta}}$$

[20] By assuming the same depreciation rate for human and physical capital MRW assumed that the same production function applies to human capital and physical. That is one unit of consumption can be transferred costlessly into either one unit of physical or human capital Mankiw et. al. [1992:416].

Plugging [4.16] into the production function given by [4.11] and taking logs gives the following equation of income per capita.

$$\ln\left[\frac{Y_t}{L_t}\right] = \ln A_0 + gt - \left(\frac{\alpha+\beta}{1-\alpha-\beta}\right)\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln s_k + \frac{\beta}{1-\alpha-\beta}\ln s_h \qquad [4.17]$$

Following the same reasoning as in equation [4.8], equation [4.17] can be transformed into an empirically estimable equation of the form

$$\ln\left[\frac{Y_t}{L_t}\right] = a - \left(\frac{\alpha+\beta}{1-\alpha-\beta}\right)\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln s_k + \frac{\beta}{1-\alpha-\beta}\ln s_h + \varepsilon_t \qquad [4.18]$$

Equation [4.18], therefore, depicts how income per capita depends on population growth and accumulation of physical and human capital. By adding human capital to the Solow model in this way, MRW found a better performance. The high coefficient on physical capital in the traditional Solow model is reduced to a theoretically reasonable estimate.

This extended Solow model of MRW was developed in response to the recent finding of some researchers, using a large sample of countries, that the correlation between initial income levels and subsequent growth rates could either be zero or even positive. This in effect questioned the whole issue of convergence, which lead to the development of the endogenous growth theory. However, MRW's result proved that, controlling for differences in the initial level of income and some other important variables, the correlation between the initial level of income and subsequent growth rate is negative even in the wider sample countries. Hence, the concept of convergence holds once we control for the initial state of development of countries.

4.1.3 Time Series Model Specification

In this study, a labor augmenting aggregate Cobb-Douglas production function of the form shown in [4.19] is specified to estimate the contributions of education and nutrition to aggregate output in addition to those of capital and labor.

$$Y_t = K_t^{\alpha} E_t^{\beta} N_t^{\gamma} \left(A_t L_t\right)^{1-\alpha-\beta-\gamma} \qquad [4.19]$$

where Y_t is aggregate real output measured by expenditure on GDP at 1980/81 constant price, K_t is capital measured by gross capital formation at 1980/81 constant price, E_t is education measured by enrollment ratios at different levels, N_t is nutrition measured by average daily per capita calorie supply, L_t is labor measured by the size of the working force (population aged 15-64), A_t is exogenous technological progress, and $\alpha + \beta + \gamma < 1$.

Equation [4.19] is transformed into an empirically estimable model, following MRW's approach, so that

$$\ln Y_t = a + \theta_1 \ln K_t + \theta_2 \ln L_t + \theta_3 \ln E_t + \theta_4 \ln N_t + \varepsilon_t \qquad [4.20]$$

The emerging time series econometrics introduce the general-to-specific modeling instead of estimating [4.20] as it is. This is done by specifying a very general (over parameterized) model of the form:

$$\ln Y_t = a + \sum_{i=1}^{m} \theta_{0i} \ln Y_{t-i} + \sum_{i=0}^{m} \theta_{1i} \ln K_{t-i} + \sum_{i=0}^{m} \theta_{2i} \ln L_{t-i} + \sum_{i=0}^{m} \theta_{3i} \ln E_{t-i} + \sum_{i=0}^{m} \theta_{4i} \ln N_{t-i} + \varepsilon_{ot} \qquad [4.21]$$

where $\{\varepsilon_{ot}\}$ is a residual term with a white noise process[21]. In effect equation [4.21] is an autoregressive distributed lag (ADL) model, for y_t is autoregressive and x_{it} is a distributed lag. It expresses the level of real output as a function of its own past values and current and past values of real capital, working force, population, education, and nutrition. One major advantage of such an over parameterized model is that, it will reveal the structure and correlation of the variables in the model.

It is possible to derive about ten economically sensible specific models from the general ADL model in [4.21] by imposing restrictions on the parameters (for detailed discussion see Charemza and Deadman [1992:80-86], Adam [1993:20-23], and Doornik and Hendry [1994:211-220]). In this study two specific models: the static regression and error correction mechanism are used.

Long Run Static Model

The long run static model is given by equation [4.20] which is reproduced here for convenience.

$$\ln Y_t = a + \theta_1 \ln K_t + \theta_2 \ln L_t + \theta_3 \ln E_t + \theta_4 \ln N_t + \varepsilon_t \qquad [4.20]$$

This is arrived at by setting the coefficients of every lag variable in [4.21] to zero. This yields the model that has been used by most researchers. The model does not allow dynamic adjustments, thus represents a static long run structural equation.

In equation [4.20] all variables enter in levels, unlike the usual practice which use growth rates. The reasons are: first; this study deals with a time series analysis for a single country. Thus, the movement over time of the variables under use in levels are capable of revealing

[21] A serially uncorrelated error that is normally and independently distributed with mean zero and constant variance.

the economic reality. Second; as cited by Wheeler [1980:77], the use of growth rates in a production function incorporates the assumption of constant utilization of the available services, which is obviously wrong.

There are also studies that argue in favor of using variables in levels. For instance, Wheeler [1980] in his cross country analysis of the relationships between economic growth and human resources development (i.e. improvements in education, health, and nutrition), said the following when shifting from levels to growth rates in specifying the model:

> *" ... it [specifying the models with variables in levels] would be appropriate for estimation if time series for a single country were being considered [Wheeler, 1980:80-81]"*[22].

This statement clearly sets why growth rates are widely used in the literature and justify the use of variable in levels in our study.

Error Correction Model

The error correction (ECM) formulation starts with the recognition that the variables in [4.20] - the long run model - are non stationary (integrated of order one) but move together in the long run, such that there exists a stationary linear combination of these variables (integrated of order zero) preventing the errors in the long run from becoming larger and larger. If such a linear combination exists, then the variables are said to be cointegrated, and can have an error correction representation.

Once these conditions are fulfilled an error correction model is formulated by appropriately adding and subtracting terms, and rearranging them. To avoid mathematical complication

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[22] *Wheeler continues by saying "In this case, however, only two primary observation (for 1970 and the mid - '70's) are available for each country in the sample, along with one additional set of past observations (for 1960). The model must therefore be specified to reflect the consequences of single period changes across countries. The time derivative of [the equation in levels] is used as the production equation".*

we will expose the derivation of the error correction mechanism with a simple model with one explanatory variable and a one year lag. That is:

$$Y_t = \alpha_1 Y_{t-1} + \beta_o X_t + \beta_1 X_{t-1} + \varepsilon_t \qquad [4.22]$$

By subtracting y_{t-1} on both sides and adding and subtracting $\beta_o x_{t-1}$ on the right hand side of equation [4.22] we get:

$$\begin{aligned} \Delta Y_t &= (\alpha_1 - 1) Y_{t-1} + \beta_o \Delta X_t + (\beta_1 + \beta_o) X_{t-1} + \varepsilon_t \\ &= \beta_o \Delta X_t + (\alpha_1 - 1)(Y - KX)_{t-1} + \varepsilon_t \end{aligned} \qquad [4.23]$$

where $K = (\beta_o + \beta_1)/(1-\alpha_1)$.

The term $(Y - KX)_{t-1}$ is called an error correction mechanism (ECM), since it reflects the deviation from the long run equilibrium outcome, with agents removing $(1-\alpha_1)$ of the resulting disequilibrium each period.

Equation [4.23] combines both short and long run phenomenon. The short run impact effect of X is captured through β_o, the long run or equilibrium effect through K, and a feed back or error correction effect through $(1-\alpha_1)$ [Doornik and Hendry, 1994]. Therefore, the ECM relates the short run change in X to the short run change in Y (the impact effect), but ties the change to the long run proportionality between X and Y (the long run effect), through a feed back mechanism. Because of these and other advantages, the ECM has become popular in recent applied econometrics.

By imposing the restriction $\alpha_1 + \beta_o + \beta_1 = 1$ (i.e., K=1) all long run proportionality's are reproduced in static equilibrium by an appropriate ECM. This restriction yields:

$$\Delta Y_t = \gamma_o \Delta X_t + \gamma_1 (Y - X)_{t-1} + \omega_t \qquad [4.24]$$

Beyond being more interpretable, the parameterization in [4.24] has the major advantage that the regressors ΔX_t and $(Y - X)_{t-1}$ will not be highly correlated, being a current change and a lagged disequilibrium.

Following this simulation the error correction specification for our particular model will be:

$$\Delta \ln Y_t = c_o + \sum_{i=1}^{m} \theta_{0i} \Delta \ln Y_{t-i} + \sum_{i=0}^{m} \theta_{1i} \ln K_{t-i} + \sum_{i=0}^{m} \theta_{2i} \Delta \ln L_{t-i} + \sum_{i=0}^{m} \theta_{3i} \Delta \ln E_{t-i} + \sum_{i=0}^{m} \theta_{4i} \ln \Delta N_{t-i} + \theta_5 ECM_{t-1} + \varepsilon_{1t} \quad [4.25]$$

where ECM_{t-1} is the error correction mechanism lagged one period, and is the difference between the actual and fitted value of Y_t.

As the field is yet developing, there is no hard and fast rule as to how many lags to use. But as a general rule of thumb, Adam [1993:8], advocates the use of 4 to 6 lags for annual, 6 to 8 for quarterly, and at least 13 for monthly data. In this study, to avoid eating all the degrees of freedom, 4 lags are used for the general models.

After estimating the general ADL model in [4.25], we need to simplify it. The purpose of simplification, as pointed by Adam [1993:8], is to reduce the over parameterized ADL to a parsimonious simplification of the general representation, so as to render the model more easily interpretable and efficient parameters without losing any significant amount of information. The most obvious form of simplification is the deletion of unwanted regressors, i.e. setting the parameters to zero, guided by measures of statistical significance. This will be done over and again until we get a congruent model[23].

[23] A congruent model is one which is: a. interpretable in terms of the structure parameters of interest; b. data coherent (i.e. the error terms are white noise); and c. parameter stable [Adam, 1993:8].

4.2 Data and Estimation Results

4.2.1 Data

The data used in this study are from published and unpublished documents of government ministries and institutions (such as; MEDaC, MOF, MOE, MOH, NBE, and CSA). The study covered a 28 years period from 1967/68 to 1994/95.

Because of data constraints, the use of directly observable variables as proxy for the relevant variables to growth accounting has become a common practice. Consequently, educational capital has been proxied by enrollment ratios see: Tilak [1989], Lau et.al. [1991], Mankiw et. al. [1992], and World Bank [1993a], and sometimes by literacy rates see: Wheeler [1980]; physical capital stocks by gross investment rate; and health and nutrition by per capita daily calorie supply see: Wheeler [1980], and so on.

Complying to these facts in this study aggregate real output, the dependent variable of the production function, is measured by expenditure on GDP at 1980/81 constant price. The independent variables consists of the gross capital formation at 1980/81 constant price, the number of the working force population, student enrollment ratios at different levels, and average daily per capita calorie supply as proxies for physical capital, labor, educational capital, and nutrition. We have also included a dummy variable to catch years of war, drought and famine, and change of government (political instability) which all have a negative impact on aggregate output.

In most cases, however, the data employed for estimation can only be defended as the best available. The measure of education by enrollment rates is a fair representation. The measure of nutritional status by per capita calorie availability is a reasonable approximation. Domestic cereal production and wheat import are converted into calorie equivalent. In the existing paucity of data, this is a better approximation, since about 80 percent of the

country's food consumption is covered by cereals. The measures of capital and labor are poor, however. Firstly, we do not have a reliable figure on capital stock. Secondly, there is no information on capacity utilization. Similarly, the working force population is taken as it is to measure labor because of difficulty in getting time series data on unemployment rate.

Two points related to the type and coverage of the data, however, need some explanation. First, at present there are two series of national accounts data for Ethiopia, conventionally called the 'old' and the 'new' series. These names are given following the methods applied for computing the data. The former applied the 1968 United Nations System of National Accounts (UNSNA), while the latter applied the 1993. The difference between the two series, in effect, is one of quality. That is, the new series applied a more advanced methodology and at the same time tried to capture activities not included in the 'old' one. Thus the 'new' series is by all reasons better and more representative than the 'old' series. For these reasons the 'new' series of national accounts data are chosen to be used in this study. However, there is one big problem. That is, the 'new' series starts from 1980/81, whereas the 'old' series is available from 1960/61 to 1991/92. Thus the 'new' series is available for the last 16 years only, which is relatively small for a time series analysis. To circumvent this problem a simple but some what safe method is used to have more years back of the 'new' series. This is done by extrapolating backward from 1980/81 to 1966/67 using the respective growth rates of the 'old' series[24].

Second, all the data used in this study includes Eriteria in periods prior to 1990/91 and exclude thereafter as a result of the difficulty to get a time series data for all the variables needed that exclude Eriteria. Besides Eriteria was part of Ethiopia for the periods prior to 1990/91 hence there is no reason to exclude her from the analysis, at least for those periods.

[24] The National Accounts Team at MEDaC provides the actual data for the 'old' and 'new' series and is not accountable for any error in extrapolation.

4.2.2 Estimation Results[25]

The standard estimation and hypothesis testing in econometric theory assumes that all variables in a particular regression are stationary. However, most macroeconomic variables are non stationary over time. That is, the mean and variance are time dependent. Estimating a model with non stationary variables with standard estimation methodology (which assumes stationarity) will lead to spurious and inconsistent regression. Moreover, the residuals from such a regression will have variance increasing overtime, violating the property of least squares estimators. Because of these facts, in time series analysis testing the order of integration of variables in the regression is vital. It is the first stage in the analysis.

Therefore, in this section before moving to the estimation of the models specified in sub section 4.1.3 the test for the order of integration of each variables is made first. This is conducted using the ADF statistics for testing unit root (see Appendix A). The results from this test show that all the variables under consideration are integrated of order one. Then the long run (static) model specified in equation [4.20] is estimated using OLS, for our variables are all I(1). Following the static regression a test for cointegration is made. This done using the Engle - Granger two stage approach for cointegration. That is testing the stationarity of the residuals of the long run (static) regression using ADF statistics. The result proved cointegration, hence it is possible to have a more efficient estimate of the relationship between the variables through an error correction model. This is attempted in the last section by estimating equation [4.25].

[25] The computer package PcGive (Version 8) is used for all the computations in this chapter. PcGive is an interactive menu driven econometric modeling program designed for modeling time series data in particular.

Test for Order of Integration

Table 4.1 below displays the summary of the test results for the order of integration. It is done for three alternative specifications. That is, for DGP without constant and trend, with constant, and with constant and trend (see Appendix A for detailed discussion).

Table 4.1

Summary of the Test Results for the Order of Integration

	Variables in their natural log			Variables in first difference of their log		
	with out constant & trend	with constant	with constant & trend	with out constant & trend	with constant	with constant & trend
Y	2.090 (-1.955)	-0.674 (-2.985)	-3.420 (-3.603)	-4.071** (-2.665)	-5.755** (-3.734)	-5.618** (-4.394)
K	0.444 (-1.955)	-1.776 (-3.603)	-2.546 (-3.603)	-3.459** (-2.665)	-3.439* (-2.991)	-3.414 (-3.612)
L	4.240 (-1.955)	0.343 (-2.985)	-1.471 (-3.603)	-1.417 (-1.956)	-3.582* (-2.991)	-3.563 (-3.612)
N	-0.010 (-1.955)	-1.950 (-2.985)	-3.200 (-3.603)	-4.542** (-2.665)	-4.730** (-3.734)	-4.623** (-4.394)
Ep	-0.153 (-1.955)	-2.306 (-2.985)	-2.693 (-3.603)	-3.571** (-2.665)	-3.595* (-2.991)	-4.025* (-3.612)
Es	-0.341 (-1.955)	-1.666 (-2.985)	-1.900 (-3.603)	-2.933** (-2.665)	-2.962 (-2.991)	-3.221 (-3.612)
Eu	-0.625 (-1.956)	-1.600 (-2.991)	-1863 (-3.612)	-4.680** (-2.670)	-4.589** (-3.750)	-4.534** (-4.417)
Eps	-0.221 (-1.955)	-2.223 (-2.985)	-2.597 (-3.603)	-3.402** (-2.665)	-3.421* (-2.991)	-3.796* (-3.612)
Et	-0.119 (-1.956)	-1.658 (-2.991)	-1.063 (-3.612)	-3.064** (-2.670)	-3.017* (-2.997)	-3.272 (-3.622)

Notes: a. Numbers in parentheses are the ADF critical values.

b. Y = expenditure on real GDP at 1980/81 constant price, K = gross capital formation at 1980/81 constant price, L = number of working force population (15 - 64), N = daily per capita calorie supply, Ep = student enrollment ratio at the primary school level (7 - 14), Es = student enrollment ratios at the secondary school level (15 - 19), Eu = student enrollment at the tertiary - higher education- level (20 -24), Eps = student enrollment at the primary and secondary school level together (7 - 19), and Et = student enrollment at all school levels (7 - 24). * significant at 5 percent confidence level, and **significant at 1 percent confidence level.

From the table it is clear that, all the variables are non stationary. Because, the unit root test on the natural log of each variable fail to reject the null (unit root) hypothesis. This leads us to test unit root on the first difference of the logged variables. The result rejects unit root, and we accept the alternative, i.e, not unit root. This is true for all the variables at 1 percent level of significance under the specification without constant and trend except for labor

which is significant at the 5 percent confidence level with constant. This implies that, all the variables became stationary after first differencing. Therefore our variables are all integrated of order one.

Long Run Model - Static Regression

Equation [4.20] is estimated by OLS in levels to establish the long run relationship between real aggregate output and capital, labor, nutrition, and education. This is done for six alternative equations by using five alternative measurement for the education variable. That is enrollment ratios at the primary; secondary; tertiary; general (primary + secondary) education; and total (primary + secondary + tertiary) education are used alternatively. Table 4.2 reports parameter estimates for these alternative specifications.

The following general inferences can be suggested looking the results in Table 4.2. First, from the F values and R^2s we can say that the model performed in quite satisfactory manner. All the estimated coefficients are significantly different from zero (at 1 percent confidence level) in all the alternative specifications. The coefficient of determinations R^2s, (which are greater than 0.96 for the five specifications), show that a substantial portion of the variation in aggregate output is explained by the independent variables in the model. The DW test also approve, for specification one, three, five and six, the absence of serial correlation.

Second, in the first five specifications, labor (working force population), primary education, secondary education, general education, and total education enrollments are all significant at the 1 percent confidence level in specification one and three. The dummy variable is significant only at 10 percent confidence level, but calorie supply is not significant even at 10 percent confidence level in all of the alternative specifications.

Table 4.2
Long Run Regression Results for Six Alternative Specifications
Dependent variable lnY is GDP

	I	II	III	IV	V	VI
a	6.206 (8.152)**	6.345 (7.844)**	6.307 (8.188)**	5.151 (5.329)**	5.491 (6.964)**	6.463 (8.114)**
lnK	0.070 (1.660)	0.071 (1.621)	0.068 (1.618)	0.043 (0.707)	0.074 (1.610)	0.090 (1.837)+
lnL	0.829 (6.874)**	0.775 (5.767)**	0.816 (6.677)**	1.102 (7.970)**	0.949 (7.853)**	0.737 (5.138)**
lnN	-0.044 (-0.571)	-0.009 (-0.119)	-0.044 (-0.573)	0.066 (0.671)	0.018 (0.227)	-0.048 (-0.612)
lnEp	0.129 (4.542)**					0.070 (1.206)
lnEs		0.099 (4.178)**				0.068 (1.244)
lnEps			0.124 (4.533)**			
lnEu				0.106 (1.257)		-0.071 (-0.814)
lnEt					0.102 (3.712)**	
D1	-0.036 (-1.825)+	-0.031 (-1.477)	-0.036 (-1.802)+	-0.035 (-1.275)	-0.020 (-0.907)	-0.030 (-1.443)
R^2	0.965	0.962	0.965	0.937	0.959	0.968
DW	2.09	1.55	2.02	1.23	2.02	2.06
F	122.25**	112.84**	122.02**	65.66**	101.9**	85.75**
σ	0.042	0.044	0.042	0.057	0.046	0.043
SC	-5.86	-5.78	-5.86	-5.46	-5.69	-5.74
AR1 - 1F(1, 21)	0.06 (0.81)	0.94 (0.34)	0.01 (0.92)	2.78 (0.11)	0.01 (0.93)	0.07 (0.79)
ARCH 1F(1, 20)	0.01 (0.94)	0.08 (0.96)	0.05 (0.83)	0.42 (0.52)	0.41 (0.53)	0.75 (0.40)
Normality $Chi^2(2)$	0.18 (0.91)	0.08 (0.96	0.31 (0.86)	0.10 (0.95)	0.50 (0.78)	0.77 (0.68)
T(Obs)	28	28	28	28	28	28

Notes: a = Constant term; D1 = dummy for years of war, drought & famine; and change of government; lnx refers to natural log in variable x; t-values are in parentheses; SC = Schwarz Criterion; * significant at 5 percent; confidence level; ** significant at 1 percent confidence level; +significant at 10 percent confidence level.

Third, physical capital, labor, education, and the dummy variables are of the anticipated signs in all the alternative specifications. Calorie supply is not of the expected sign except in specification four and five.

Fourth, primary education, general education, and total education contribute strongly and positively to the growth of output in Ethiopia. This result is similar to some results obtained by Lau et. al [1991], Barro [1991], and Mankiw et. al. [1992] in their cross country study. The implication is that, education contributes to economic growth in many ways. Thus investment in education can be a key contributor to the country's aggregate output. The result suggests that, primary education is more important, relatively.

Specification five above is chosen because it incorporates the education variable in its totality (i.e., pooled for the three levels) and it may be important to look at the results of this specification more closely. The result reveals that, all the parameters are of the anticipated signs. Capital, labor, nutrition, and education positively influence aggregate output, while the dummy for war, drought and famine, and change of government (political instability) influencing negatively. However, only labor and education are significant (at 1 percent confidence level).

The contribution of labor is very large compared to physical capital and human resources (education plus nutrition).This result is unusual compared to the findings of Baffes and Shah [1993:10] and Lau et. al. [1991] who found a lower contribution of labor than physical capital. The explanation for this result could be the fact that Ethiopia is an agrarian economy which use labor as the primary input in production and the taking of GDP as the measure of output (before netting out for aid)[26]. Therefore, it is with this limitation that the result of this work should be interpreted.

Human resources development is the second largest contributor to output growth. The coefficient is very small compared to low income countries which have an average output elasticity of 58, Baffes and Shah [1993:7]. This very low output elasticity of human resources clearly shows the state of development of the country's human resources. As is

[26] Taking the Net National Income (NNI) as the output is an area of research that is outstanding. This study could not have used NNI as the data is not available.

discussed in chapter two Ethiopia registered one of the lowest school enrollment ratios, under nutrition, and poor health care services.

Physical capital turns out to be the least contributor to aggregate output. Like the others, it is very small compared to other countries. Considering the existing capacity under utilization, its share out of GDP (which has been only 11 to 19 percent during the period under reference), and the status of physical capital this finding is not very disappointing.

Since the major theme of this study is to detect the contribution of human resources development to economic growth, let's look into education in a disaggregated manner. The simple exercise in specification six (in Table 4.2) incorporates education as three variables corresponding to the three levels. The result shows 7 percent, 6.8 percent and - 7.1 percent output elasticites for primary, secondary, and tertiary education. Suggesting primary education should be given priority. The negative elasticities for tertiary education implies that, at this stage of development, a highly skilled manpower is not crucial. This is not a bad result observing the state of technology in the country, which is backward.

Test for Cointegration

From the test for the order of integration we have realized that all the variables are I(1). Here we want to test for the stationarity of the linear combination of these variables. This is done by testing the set of residuals from the long run model (static regression) for unit root. Consequently, for the six static regressions run above the residuals are found to be stationary, i.e., I(0), (see Table 4.3 below). The variables are cointegrated, therefore, it is possible to have an error correction representation of the static regressions.

Table 4.3

Test Results for cointegration

	RES_1	RES_2	RES_3	RES_4	RES_5	RES_6
t - adf	-5.683**	-4.17**	-5.512**	-3.174**	-5.56**	-5.879**
critical value	-4.374	-4.347	-4.374	-2.66	-4.374	-4.374

Note: RES_i , i = 1...6, represent the set of residuals for the six alternative specification of the long run model estimated in 4.2.2.3 below. ** significant at the 1 percent level of significance, * significant at the 5 percent level of significance.

Error Correction Model - Dynamic Regression

Following the discussion in sub section 4.1.3, equation [4.25] is estimated using OLS. This general to specific modeling is started with six lags for education, four lags for capital formation, and one year lag for GDP, working force, and calorie supply and then went on to simplify the overparametrized error correction model. In every step of the reduction process the general F - statistics and Schwarz Criterion (SC) information were checked to determine whether the previous reductions were valid. The results of the general model for the five specifications are put into Appendix B.

The results of the preferred models which are the basis for our analysis are presented in Table 4.4 below for the six alternative specifications. These models are preferred, for they are with smaller standard errors and SC compared to the general models (put in Appendix B).

The results show that the rate of growth of output is explained by the rate of growth of capital, labor, education, nutrition, and the error correction mechanism. Growth rates of labor and nutrition are found to be insignificant in explaining the growth rate of output in the short run. Furthermore, the growth rate of labor enters with negative in all the specifications. This implies that, since land is fixed in the short run, the marginal productivity of labour is declining.

Table 4.4
Short Run (Error Correction) Regression Results for Six Alternative Specifications
Dependent variable lnY is GDP in first difference

	I	II	III	IV	V	VI
a	0.027 (2.63)*	0.018 (1.23)	0.025 (2.29)*	0.038 (3.19)**	0.032 (3.01)**	0.028 (1.9)+
ΔlnK	0.095 (3.13)**	0.098 (3.02)**	0.093 (3.03)**	0.104 (3.19)**	0.097 (3.03)**	0.099 (3.18)**
ΔlnL	-0.29 (-0.84)	0.067 (0.14)	-0.22 (-0.61)	-0.468 (-1.1)	-0.33 (-0.91)	-0.42 (-0.78)
ΔlnN	0.002 (0.05)	0.05 (1.15)	0.003 (0.06)	0.06 (1.22)	0.034 (0.82)	-0.013 (-0.24)
ΔlnEp	0.136 (2.17)*					0.137 (1.67)+
ΔlnEs		0.124 (2.21)*				0.031 (0.47)
ΔlnEps			0.149 (2.33)*			
ΔlnEu				0.063 (0.92)		-0.072 (-0.97)
ΔlnEt					0.06 (1.75)+	
ECM_{t-1}	-0.776 (-4.32)**	-0.663 (-3.73)**	-0.765 (-4.25)**	-0.512 (-3.62)**	-0.759 (-4.21)**	-0.857 (-4.0**
R^2	0.75	0.71	0.75	0.70	0.72	0.72
s.e	0.03	0.03	0.03	0.04	0.03	0.03
SC	-6.41	-6.27	-6.39	-6.21	-6.29	-6.29
AR1 - 2F(2, 19) ♣	0.39 (0.68)	0.21 (0.81)	0.58 (0.57)	0.23 (0.80)	0.77 (0.48)	0.55 (0.59)
ARCH 1 F(1, 19)♣	0.13 (0.73)	0.17 (0.68)	0.04 (0.84)	0.66 (0.43)	0.00 (0.98)	0.08 (0.78)
Normality $Chi^2(2)$	0.73 (0.69)	0.28 (0.87)	0.68 (0.71)	5.45 (0.07)	1.08 (0.58)	1.29 (0.52)
T(Obs)	27	27	27	27	27	27

Notes: Δ = first difference; ♣ AR 1 - 2F(2, 17) and AR ARCH 1 F(1, 17) for specification VI; where s.e = standard errors; SC = Shwarz Criterion; and numbers in parentheses are t-values.

Education enters with the expected sign in most of the specifications and significant at 5 percent confidence level in the three specifications. Similar to the results from the long run model, primary education appears to be relatively large in its contribution to output growth (economic growth) compared to secondary and tertiary levels education.

The error correction term is negative and significant at 1 percent confidence level, in all the specifications. It represents the adjustment from disequilibrium position.

Diagnostic tests are also reported including the AR test for autocorrelations, the ARCH test for autoregressive heteroscedasticity and the normality test for the distribution of the residuals. These tests proved that there is absence of residual autocerrelation as indicated by AR test, absence of heteroscedasticiety as indicated by the ARCH test. The normality test shows that the residuals could still be approximated by a normal distribution.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

Human resources development has long been considered an important factor in economic growth. In Ethiopia both economic growth and the level of human resources development have been at low levels.

As is discussed in the course of this paper, in the 28 years time period from 1967/68 to 1994/95 under reference the Ethiopian economy has registered an average annual growth rate of 2.5 percent which is less than the parallel growth of the population 2.9 percent. Human resources development indicators (such as school participation, access to health care services, and calorie supplies) have all been at low levels even compared to most Sub Saharan African countries.

This study has tried to look into the relationship between human resources development and economic growth in Ethiopia. In doing this, education and nutrition (proxies for human resources development) are entered apart from physical capital and labor in the growth equation.

The study has applied a time series econometrics for estimating the contribution of human resources in Ethiopia's economic growth. Consequently two groups of regressions - long run static and short run dynamic (error correction) - are run taking six alternative specifications.

The results from the long run static regression uncover that:

i. Education enters positively and significantly in explaining aggregate output. The contribution of primary education is found to be relatively large compared to secondary and tertiary education.

ii. Nutrition enters negatively but insignificantly in explaining output in four out of the six specifications.

The results from the short run dynamic regression indicate that:

i. The growth of education enters positively and significantly in explaining the growth of output (i.e. economic growth). The contribution of primary education is again relatively large compared to secondary and tertiary level education.

ii. The growth of nutrition (calorie supply) enters positively but insignificantly in explaining output growth.

The findings of this study are in line with some other studies that confirm the importance of human resources development, and especially primary education for growth. Education contributes to economic growth both through the increased individual productivity brought about by the acquisition of skills and attitudes and through the accumulation of knowledge. Primary education is a corner stone of social development and a principal means of improving the welfare of individuals. It improves cognitive skills through literacy, numeracy, and problem solving ability.

The conclusion of this study is that human resources development is one potential area that could have positive impact for the country's economic growth. Therefore, government should invest towards developing the country's human resources, particularly in schooling.

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APPENDIX A

A. Brief Note on Integration and Cointegration Tests

Consider the following data generating process (DGP):

$$y_t = \alpha + \mu t + \beta y_{t-1} + \varepsilon_t \qquad [A.1]$$

Equation [A.1] can be defined to be stationary[27] or non stationary series depending on the values of the parameters. It is stationary if $\mu = 0$ and $|\beta| < 1$, and non stationary if $|\beta| \geq 1$.

The nonstationary series is further classified into trend stationary and difference stationary. Hence, y_t is said to be trend stationary if $\mu \neq 0$ and $|\beta| < 1$, and the autoregressive component (y_{t-1}) imply a short run deviation which in the end return to the trend. On the other hand, y_t is said to be difference stationary if $\mu = 0$ and $|\beta| = 1$, and don't display a tendency to return to the trend. This also known as random walk with out drift ($\alpha = 0$), and random walk with drift when ($\alpha \neq 0$).

In a growing economy the level of most macroeconomic variables grow over time. The levels of output, consumption, investment, prices, etc. are higher today, than they were decades or centuries ago. These types of series are called nonstationary. Unlike stationary series which has constant mean and variance, nonstationary series have no finite variance. This makes many of the standard asymptotic analysis based on the stationarity assumption invalid. That is estimation and hypotheses testing, using the least squares method is not justified. For these reasons we need to first test for stationarity of the series before proceeding to the regression.

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[27] A time series is stationary if its mean, variance and autocovariances are independent of time, and non stationary if these don't hold.

A.1 Test for Order of Integration

The most commonly used method of testing the order of integration are the Dickey and Fuller test (DF test), and Augmented Dickey Fuller test (ADF test).

Consider the following DGP:

$$y_t = \beta y_{t-1} + \varepsilon_t \qquad [A.2]$$

where ε_t is independently and identically distributed.

The DF test aims at testing the null hypothesis H_o: $\beta = 1$ in [A.2] against the alternative H_a: $\beta < 1$. Under the null hypothesis y_t is non stationary being a random walk without drift. Under the alternative y_t is a stationary process.

An equivalent regression of the form,

$$\begin{aligned} &\Delta y_t = \delta y_{t-1} + \varepsilon_t \\ &or \\ &y_t = (1+\delta) y_{t-1} + \varepsilon_t \end{aligned} \qquad [A.3]$$

is specified to test for unit root.

The equations in [A.2] and [A.3] are the same with $\beta = (1+\delta)$. Thus if δ is negative in [A.3], then in [A.2] β becomes smaller than one.

Therefore, the DF test for unit root, is a test for the negativity of δ in the OLS of [A.3]. Rejection of the null hypothesis $\delta = 0$ in favor of the alternative $\delta < 0$ implies that $\beta < 1$ and that y_t is stationary (integrated of order zero). But if the null $\delta = 0$ cannot be rejected, then the process is not stationary and one needs to test for higher order of integration. So to test

for first order integration, the above procedure should be applied on the first difference, that is

$$\Delta\Delta y_t = \delta\Delta y_{t-1} + \varepsilon_t \qquad [A.4]$$

Again the hypothesis tests for the negativity of δ. If the null $\delta = 0$ is rejected, then the alternative $\delta < 0$ can be accepted. The series Δy_t is stationary and $y_t \approx I(1)$ - integrated of order one. But, if the null cannot be rejected, we have to test for second order integration, and so on.

The procedure is the same when the DGP in [A.3] has a constant

$$y_t = \alpha + (1+\delta)y_{t-1} + \varepsilon_t \qquad [A.5]$$

or a constant and a trend

$$y_t = \alpha + \mu t + (1+\delta)y_{t-1} + \varepsilon_t \qquad [A.6]$$

The difference lies in the critical values to be used and the interpretation of the result. In practice, however, since the values of μ and β are not known, it is preferable to pursue sequential testing starting from [A.6] to [A.3], (for detailed discussion see Holden et. al., 1994:57-590. The test statistics (critical values) used for decision are the one derived by Dickey and Fuller for the three DGP given in [A.3], [A.5], and [A.6].

One major weakness of the standard DF test is that, it doesn't take account of possible autocorrelation in the error term ε_t. In other words the disturbance term ε_t is assumed to be independently and identically distributed. If this assumption is incorrect then the limiting distributions and critical values obtained by Dickey and Fuller cannot hold. The Augmented Dickey Fuller (ADF) test take care of this problem by including lagged left hand side

variables as additional explanatory variables to approximate the autocorrelation. The ADF test is identical to the standard DF test but it is constructed with in a regression model of the form

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-1} + \varepsilon_t \qquad [A.7]$$

The number of lags is determined based on the sample size. In practice it is usual to include as many terms in the lagged dependent variable as is necessary to achieve white noise residuals. Lagrange Multiplier tests can be used to test for serial correlation and thus to check whether the chosen lag is adequate [Holden et. al., 1994:62]. The procedure is the same as the DF test.

Generally a series is said to be integrated of order d if it becomes stationary after differencing d times but not d-1 times.

A.2 Test for Cointegration

In principle the test for Cointegration is similar to testing for the order of integration in a single data series. The only difference is that, here the test is applied to the residual of cointegrating regression. That is, we are testing the null hypothesis that assumes the residual series has a unit root against an alternative that the series is stationary. Thus the null hypothesis is non cointegration and the alternative is cointegration. DF, ADF, or Durbin Watson (DW) tests can be employed to know whether the linear combination of two (or more) variables is stationary (i.e., I(0)). The ADF test is preferable [Holden et. al. 1994:80].

This is done by two steps following Engle and Granger. In the first step, we test for the order of integration of the variables as discussed above. Here the variables need to be of the same order of integration, if they are two. But for variables more than two, the order of integration of the dependent variable should not be higher than the order of integration of any of the explanatory variables. Moreover, there must be either none or at least two explanatory variables integrated to an identical order higher than the order of integration of the dependent variable [Charemza and Deadman, 1992:149]. In the second step test for the stationarity of the estimated residuals from the long run relationship. That is:

$$\Delta\hat{v}_t = \delta\hat{v}_{t-1} + \xi_t \qquad [A.8]$$

for the DF, and

$$\Delta\hat{v}_t = \delta\hat{v}_{t-1} + \sum_{i-1}^{k} \delta_i \Delta\hat{v}_{t-i} + \xi_t \qquad [A.9]$$

for the ADF.

where $\hat{v}_t$ are the OLS residuals and can be interpreted as the deviation of the dependent variable from its long run path.

Thus, if the estimated residuals are stationary (i.e., integrated of order zero), then the variables are cointegrated.

Appendix B

General Model Results

Table B-1: Results for Specification I (Dependent Variable lnY is in First Difference)

Lags	0	1	2	3	4	5	6
ΔlnY		0.52 (2.37)					
ΔlnK	0.11 (2.98)+	-0.176 (-3.17)+	-0.05 (-0.95)	0.031 (0.52)	-0.033 (-0.55)		
ΔlnL	-0.82 (-1.63)	0.22 (0.45)					
ΔlnEp	0.092 (0.78)	0.151 (0.87)	-0.331 (-1.38)	0.487 (1.93)	-0.716 (-2.31)	0.312 (0.95)	-0.123 (-0.46)
ΔlnN	-0.055 (-0.9)	0.086 (1.37)					
ECM_{t-1}		-0.718 (-1.45)					
Const.	0.036 (2.59)						
R^2	0.99						
SC	-7.59						
T	21						
AR 1 - 2F(2, 4)							
ARCH 1 F(1, 4)							
Normality $Chi^2(2)$	0.22 (0.89)						

Note: Where numbers in parentheses are t-values, SC is Schwarz Criterion.
* significant at 1 percent, and + significant at 10 percent confidence levels.

Table B-2: Results for Specification II (Dependent Variable lnY is in First Difference)

Lags	0	1	2	3	4
ΔlnY		0.575 (2.48)*			
ΔlnK	0.11 (2.85)*	-0.09 (-2.10)+	-0.014 (-0.42)	0.001 (0.03)	-0.071 (-1.84)
ΔlnL	-0.51 (-0.84)	1.37 (2.30)+			
ΔlnEs	0.068 (0.93)	0.131 (1.77)	-0.136 (-2.22)+	0.106 (1.84)	-0.014 (-0.35)
ΔlnN	0.057 (1.32)	-0.007 (-0.13)			
ECM_{t-1}		-0.682 (-2.65)*			
Const.	-0.013 (-0.59				
R^2	0.95				
SC	-7.02				
T	23				
AR 1 - 2F(2, 4)	2.09 (0.24)				
ARCH 1 F(1, 4)	0.00 (0.99)				
Normality $Chi^2(2)$	1.16 (0.56)				

Note: Where numbers in parentheses are t-values, SC is Schwarz Criterion.
* significant at 1 percent, and + significant at 10 percent confidence levels.

Table B-3: Results for Specification III (Dependent Variable lnY is in First Difference)

Lags	0	1	2	3	4	5	6
ΔlnY		0.31 (0.94)					
ΔlnK	0.103 (1.61)	-0.094 (-0.94)	-0.10 (-0.98)	0.021 (0.20)	0.026 (0.23)		
ΔlnL	-0.09 (-0.07)	0.08 (0.07)					
ΔlnEps	0.212 (0.68)	-0.125 (-0.29)	0.062 (0.10)	0.127 (0.26)	-0.249 (-0.43)	-0.354 (-0.61)	0.296 (0.60)
ΔlnN	-0.052 (-0.58)	0.051 (0.30)					
ECM_{t-1}		-0.449 (-0.44)					
Const.	0.023 (0.85)						
R^2	0.97						
SC	-7.22						
T	21						
AR 1 - 2F(2, 4)							
ARCH 1 F(1, 4)							
Normality $Chi^2(2)$	0.81 (0.67)						

Note: Where numbers in parentheses are t-values, SC is Schwarz Criterion.

Table B-4: Results for Specification IV (Dependent Variable lnY is in First Difference)

Lags	0	1	2	3	4
ΔlnY		0.372 (1.05)			
ΔlnK	0.104 (1.97)+	-0.003 (-0.04)	-0.015 (-0.37)	0.104 (1.78)	0.01 (0.16)
ΔlnL	-0.192 (-0.32)	-1.28 (-2.02)+			
ΔlnEu	0.115 (1.08)	-0.175 (-1.57)	-0.141 (-1.35)	-0.107 (-0.8)	0.047 (0.69)
ΔlnN	0.111 (1.63)	-0.068 (-0.88)			
ECM_{t-1}		-0.70 (-2.95)*			
Const.	0.061 (2.85)*				
R^2	0.94				
SC	-6.07				
T	23				
AR 1 - 2F(2, 4)	3.49 (0.13)				
ARCH 1 F(1, 4)	0.01 (0.91)				
Normality $Chi^2(2)$	0.02 (0.99)				

Note: Where numbers in parentheses are t-values, SC is Schwarz Criterion.
* significant at 1 percent, and + significant at 10 percent confidence levels.

Table B-5: Results for Specification V (Dependent Variable lnY is in First Difference)

Lags	0	1	2	3	4	5	6
ΔlnY		0.29 (2.16)					
ΔlnK	0.034 (1.32)	-0.108 (-2.98)+	-0.145 (-4.30)*	-0.048 (-0.65)	-0.024 (-0.41)		
ΔlnL	0.033 (0.12)	-0.86 (-3.47)+					
ΔlnEt	0.021 (0.45)	-0.01 (-0.16)	0.103 (3.72)+	0.048 (0.92)	-0.018 (-0.25)	-0.127 (-2.08)	-0.043 (-0.51)
ΔlnN	0.054 (1.22)	0.006 (0.17)					
ECM_{t-1}		-1.209 (-5.38)*					
Const.	0.047 (4.38)*						
R^2	0.99						
SC	-7.99						
T	21						
AR 1 - 2F(2, 4)							
ARCH 1 F(1, 4)							
Normality $Chi^2(2)$	0.33 (0.85)						

Note: Where numbers in parentheses are t-values, SC is Schwarz Criterion.
* significant at 1 percent, and + significant at 10 percent confidence levels.

Appendix C

Education Expenditure Compared to Total Government Expenditure and GDP

In Millions of Birr

Year	GDP[a] at Market Price	Government Expenditure[b]			Education Expenditure[b]			% Share of Education Exp.	
		Recurrent	Capital	Total	Recurrent	Capital	Total	GDP	G. Exp
1967/68	4,551.2	442.2	81.0	523.1	50.5	6.1	56.5	1.242	10.801
1968/69	4,843.0	454.5	75.9	530.4	42.6	16.6	59.3	1.223	11.171
1969/70	5,128.5	478.9	106.1	585.0	55.3	11.1	66.5	1.296	11.366
1970/71	5,627.3	507.1	124.3	631.4	62.5	7.7	70.2	1.248	11.126
1971/72	5,941.8	521.5	150.0	671.6	85.2	13.6	98.8	1.663	14.713
1972/73	5,985.5	563.1	153.1	716.3	96.7	24.1	120.8	2.018	16.861
1973/74	6,314.8	599.3	178.5	777.7	107.5	24.3	131.8	2.088	16.951
1974/75	7,001.3	811.3	237.6	1,048.9	138.2	23.3	161.5	2.307	15.400
1975/76	6,968.3	917.6	282.8	1,200.4	133.0	20.9	153.9	2.208	12.820
1976/77	7,526.6	1,019.8	324.7	1,344.5	134.6	19.3	153.9	2.045	11.447
1977/78	8,604.6	1,367.3	329.4	1,696.7	138.1	10.5	148.6	1.727	8.758
1978/79	9,104.7	1,477.3	368.8	1,846.1	156.1	27.3	183.3	2.014	9.930
1979/80	10,132.1	1,694.7	443.3	2,137.9	179.6	21.1	200.6	1.980	9.384
1980/81	10,721.3	1,791.4	505.1	2,296.5	205.5	22.8	228.3	2.129	9.939
1981/82	11,280.9	1,934.6	715.0	2,649.7	238.2	43.9	282.1	2.500	10.645
1982/83	12,540.0	2,562.5	1,245.3	3,807.8	269.4	42.9	312.4	2.491	8.204
1983/84	11,849.3	2,265.1	933.0	3,198.1	296.7	37.1	333.8	2.817	10.437
1984/85	13,876.2	2,737.6	1,187.0	3,924.6	328.6	41.2	369.8	2.665	9.422
1985/86	14,493.3	2,659.3	1,471.8	4,131.1	346.4	39.7	386.1	2.664	9.346
1986/87	15,501.2	2,754.1	1,383.1	4,137.1	379.4	39.6	419.0	2.703	10.128
1987/88	15,996.9	3,598.8	1,459.2	5,058.1	405.9	41.9	447.8	2.799	8.852
1988/89	16,873.4	3,972.6	1,939.7	5,912.3	425.6	59.1	484.7	2.872	8.197
1989/90	17,871.7	3,929.1	1,440.1	5,369.2	456.2	39.4	495.6	2.773	9.231
1990/91	19,815.6	3,698.9	1,214.1	4,913.0	447.1	42.6	489.7	2.471	9.967
1991/92	20,792.0	3,305.1	951.8	4,256.9	490.3	38.2	528.5	2.542	12.414
1992/93	26,689.9	3,520.7	1,784.9	5,305.6	604.0	88.4	692.4	2.594	13.050
1993/94*	28,355.4	4,600.0	3,418.2	8,018.2	686.7	316.9	1003.6	1.117	3.952
1994/95*	34,063.4	5,369.9	3,061.9	8,431.8	733.6	411.6	1145.2	1.208	4.881

Source:- a: MEDaC, National Accounts Team; b: MOF

* Preliminary actuals.

Appendix D

Health Expenditure Compared to Total Government Expenditure and GDP

In Millions of Birr

Year	GDP[a] at Market Price	Government Expenditure[b]			Health Expenditure[b]			% Share of Health Exp.	
		Recurrent	Capital	Total	Recurrent	Capital	Total	GDP	G.Exp.
1967/68	4,551.2	442.2	81.0	523.1	19.8	4.1	23.9	0.524	4.562
1968/69	4,843.0	454.5	75.9	530.4	18.9	8.9	27.7	0.573	5.231
1969/70	5,128.5	478.9	106.1	585.0	20.6	16.2	36.8	0.717	6.283
1970/71	5,627.3	507.1	124.3	631.4	23.4	9.8	33.2	0.591	5.265
1971/72	5,941.8	521.5	150.0	671.6	24.8	12.2	37.1	0.624	5.521
1972/73	5,985.5	563.1	153.1	716.3	29.9	8.8	38.7	0.647	5.409
1973/74	6,314.8	599.3	178.5	777.7	31.9	8.7	40.5	0.642	5.212
1974/75	7,001.3	811.3	237.6	1,048.9	33.8	12.5	46.4	0.662	4.420
1975/76	6,968.3	917.6	282.8	1,200.4	43.2	11.5	54.6	0.784	4.550
1976/77	7,526.6	1,019.8	324.7	1,344.5	49.7	16.5	66.2	0.879	4.923
1977/78	8,604.6	1,367.3	329.4	1,696.7	51.8	18.6	70.3	0.818	4.146
1978/79	9,104.7	1,477.3	368.8	1,846.1	59.7	11.9	71.6	0.786	3.879
1979/80	10,132.1	1,694.7	443.3	2,137.9	65.4	9.1	74.5	0.735	3.484
1980/81	10,721.3	1,791.4	505.1	2,296.5	77.1	19.5	96.6	0.901	4.208
1981/82	11,280.9	1,934.6	715.0	2,649.7	75.8	33.7	109.5	0.970	4.132
1982/83	12,540.0	2,562.5	1,245.3	3,807.8	83.5	21.7	105.2	0.839	2.764
1983/84	11,849.3	2,265.1	933.0	3,198.1	85.4	25.2	110.6	0.933	3.457
1984/85	13,876.2	2,737.6	1,187.0	3,924.6	101.2	20.5	121.7	0.877	3.102
1985/86	14,493.3	2,659.3	1,471.8	4,131.1	101.7	24.0	125.7	0.867	3.042
1986/87	15,501.2	2,754.1	1,383.1	4,137.1	111.2	36.0	147.2	0.950	3.558
1987/88	15,996.9	3,598.8	1,459.2	5,058.1	117.6	37.0	154.7	0.967	3.058
1988/89	16,873.4	3,972.6	1,939.7	5,912.3	125.9	43.7	169.7	1.005	2.870
1989/90	17,871.7	3,929.1	1,440.1	5,369.2	132.6	41.8	174.4	0.976	3.248
1990/91	19,815.6	3,698.9	1,214.1	4,913.0	128.4	32.1	160.5	0.810	3.266
1991/92	20,792.0	3,305.1	951.8	4,256.9	151.5	37.4	188.9	0.909	4.437
1992/93	26,689.9	3,520.7	1,784.9	5,305.6	189.2	66.6	255.8	0.958	4.821
1993/94*	28,355.4	4,600.0	3,418.2	8,018.2	300.9	201.0	501.9	1.770	6.260
1994/95*	34,063.4	5,369.9	3,061.9	8,431.8	345.8	152.6	498.4	1.463	5.911

Source:- a: MEDaC, National Accounts Team; b: MOF

* Preliminary actuals.

Appendix E

Percapita Food Production and Availability

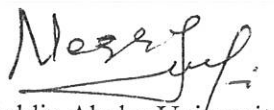
In '000 Metric Tonnes

Year	Domestic Production	Wheat Import	Total Availability	Population (in millions)	Percapita	
					Production	Availability
1967/68	5,486.80	1.61	5,488.41	28.31	193.81	193.87
1968/69	5,608.00	22.10	5,630.10	28.96	193.65	194.41
1969/70	5,751.90	0.59	5,752.49	29.62	194.19	194.21
1970/71	5,736.80	0.00	5,736.80	30.36	188.96	188.96
1971/72	5,895.10	5.11	5,900.21	31.12	189.43	189.60
1972/73	4,363.00	11.86	4,374.86	31.90	136.77	137.14
1973/74	4,337.30	1.05	4,338.35	32.70	132.64	132.67
1974/75	4,419.50	0.01	4,419.51	33.51	131.89	131.89
1975/76	5,857.80	15.33	5,873.13	34.35	170.53	170.98
1976/77	4,359.80	8.76	4,368.56	35.21	123.82	124.07
1977/78	4,150.40	0.31	4,150.71	36.09	115.00	115.01
1978/79	4,080.50	64.31	4,144.81	36.99	110.31	112.05
1979/80	6,396.55	126.53	6,523.08	37.92	168.69	172.02
1980/81	5,610.42	119.97	5,730.39	39.02	143.78	146.86
1981/82	5,393.50	159.33	5,552.83	40.15	134.33	138.30
1982/83	6,718.28	300.01	7,018.29	41.31	162.63	169.89
1983/84	5,526.82	223.56	5,750.38	42.80	129.13	134.35
1984/85	4,239.85	587.58	4,827.42	44.30	95.71	108.97
1985/86	4,819.99	586.17	5,406.15	45.70	105.47	118.30
1986/87	5,636.43	408.86	6,045.29	47.20	119.42	128.08
1987/88	6,136.97	487.77	6,624.74	48.60	126.28	136.31
1988/89	5,733.57	186.13	5,919.70	50.20	114.21	117.92
1989/90	6,137.53	317.74	6,455.27	51.70	118.71	124.86
1990/91	5,320.17	26.44	5,346.61	53.40	99.63	100.12
1991/92	4,567.14	253.58	4,820.72	55.10	82.89	87.49
1992/93	5,185.02	278.84	5,463.86	56.90	91.13	96.03
1993/94	4,740.40	154.01	4,894.41	58.70	80.76	83.38
1994/95	6,154.20	109.72	6,263.92	60.60	101.55	103.37

Source: MEDaC, Food and Nutrition Unit

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other University. All sources of materials used for the thesis have been duly acknowledged.

Name	Netsanet Walelign Workie
Signature	
Place	Addis Ababa University
Date	19th June 1997