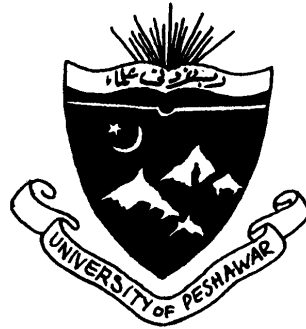


**THE ROLE OF HUMAN CAPITAL IN ECONOMIC GROWTH
OF PAKISTAN (1971-2008)**



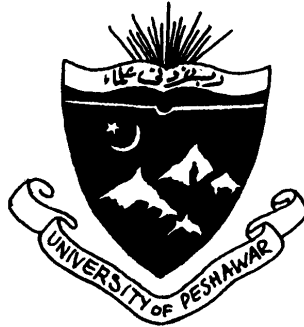
By

JANGRAIZ KHAN

Ph. D Research Scholar

**DEPARTMENT OF ECONOMICS
UNIVERSITY OF PESHAWAR
KHYBER PAKHTUNKHWA, PAKISTAN
2012**

**THE ROLE OF HUMAN CAPITAL IN ECONOMIC GROWTH
OF PAKISTAN (1971-2008)**



Submitted By

JANGRAIZ KHAN
Ph. D Research Scholar

A Dissertation Submitted to the Department of Economics, University of Peshawar in Partial Fulfillment of the Requirements for the Award of Degree of DOCTOR OF PHILOSOPHY in Economics

DEPARTMENT OF ECONOMICS
UNIVERSITY OF PESHAWAR
2012

ACKNOWLEDGEMENTS

All glory be to Allah Almighty, the Most Merciful and the Omnipotent; Whose limitless grace govern the entire universe, conferred upon me the blessing to proceed with my thesis and accomplish the strenuous research task successfully in given time limit. I pay my humble gratitude to the Holy Prophet Mohammad (S.A.W), Whose strict practice on available knowledge convinced me to work closely and honestly on my research thesis.

It gives me a great pleasure to pay special gratitude to my research Supervisor Professor Dr. Naeem Ur Rehman Khatak, Dean, Faculty of Social Sciences, University of Peshawar, who, besides his busy schedule, provided the arduous task of adept supervision to my thesis; editing different drafts several times assiduously and without whose unending sincere efforts, this work of research would not have been possible at all.

I would not hesitate to mention the names of Professor Dr. Ijaz Majid, Chairman, Department of Economics, Dr. Zilakat Khan and Prof. Dr. Muhammad Naeem, whose guidance and help enabled me to work passionately on my topic. In addition, I would like to thank all teachers and staff of department for their good wishes and cooperation.

I also express my heartfelt gratitude to my friend Iftikhar Ahmad, Staff Economist, Pakistan Institute of Development Economics, Islamabad, who helped me at each and every complex stage to solve my research problems by providing me with the relevant precious books and up-to-date research journals. It will be injustice to hesitate in expressing special gratitude to my best university friend, younger brother and Ph.D fellow Muhammad Tariq whose support and help served as a stepping stone to cross the ocean of complicated problems during my thesis. We faced all good and worse times together and he always stood by me in critical times during my Ph.D. I would like to pay special thanks to Dr. Qamaruzzaman, Associate Professor, Department of Statistics, University of Peshawar, Qazi Mujeebullah, Iqbal Khan and Javed Akhtar, Principal (Rtd), Education Department for their guidance, encouragement and moral support during my Ph. D. I am extremely grateful of Higher Education Commission of Pakistan for financing my Ph.D Programme and providing all possible facilities for research.

Finally, I am extremely grateful of my father Haji Misal Khan, my mother, my wife, my brothers and sisters, and other family members who served as a source of constant inspiration;

encouraging me to go ahead with my research task without caring for the least attention I gave them during the course of my study. I am extremely thankful of my elder brother Eng.Nisar Ahmad for his continuous moral and financial support during my Ph.D. The highly cooperative attitude of my younger brother Israr Ahmad (PMS Officer) for language correction of this dissertation is worth mentioning. At the end, I would convey my heartiest feelings to my loving kids Hira Khan, Swera Khan and little Abdullah for bearing my little strict behavior and sacrificing their time that resultantly the research dissertation took which should have been spent with them otherwise.

May Allah Almighty bless all those who contributed both directly and indirectly in the accomplishment of my research thesis and whose genuine and assiduous efforts would I never forget during the course of my entire life.

JANGRAIZ KHAN

ABSTRACT

Positive economic growth has always been the core objective of economic policies across the world. The economists and policy makers have always been engaged in digging out the determinants of economic growth. In 1960's, the concepts of health, consumption and education were introduced in economic growth studies, which led to addition of the term, "human capital" in determinants of economic growth. In 1980's, human capital was formally introduced in economic growth literature and since then, it became an integral component of economic growth.

The present study aims at finding-out the role of human capital in economic growth of Pakistan during the period 1971-2008. Education, health, and Research and Development (R&D) have been used as measures for human capital. An attempt has also been made in this study to find the impact of institutions on human capital and thus, its indirect contribution to economic growth. The study in hand, also strived to explore the impact of human capital on physical capital accumulation and labour force participation. Likewise, the contribution of Total Factor Productivity (TFP) has also been calculated in presence of education, health and R&D separately. The calculations of TFP have been revised by taking different shares of factors inputs and time intervals. The contribution of TFP in Pakistan has been compared with seven South Asian countries.

The study has used secondary data for analysis, which has been taken from different national and international organization. Growth Accounting Method (GAM) has been used to calculate TFP. The econometric techniques used for analysis are Ordinary Least Squares (OLS), Two Stage Least Squares, Cointegration and Granger Causality test. The results of the study show that TFP contribute 38.47 % to GDP per capita, when education is used as a measure for human capital. This contribution increases to 47.74%, when education is replaced by health and fell to 18.27% with R&D as measure of human capital in TFP model. The contribution of TFP increases irrespective of measure of human capital, when minimum share of capital is used. It increases to 46.72%, 57.08% and 24.14% in case of education, health and R&D respectively. The results of economic growth model, obtained through the Ordinary Least Squares (OLS) show that education, health and R&D positively affected economic growth of Pakistan during the study period. Health and R&D remained statistically significant while education remained insignificant. The results of simultaneous equations model show that Education, health, R&D

and labour are significant determinants of economic growth in Pakistan. The quality as well as quantity of educational institutions and Real GDP per capita appeared as significant determinants of education in Pakistan. The results further show that education and quality of health institutions are significant factors for health in Pakistan. Similarly, educational institutions and Real GDP per capita appeared as major and significant determinants of R&D during the study period. In the same way, R&D, health and education positively affected physical capital in Pakistan.

The Cointegration test results show that education, health and R&D affected economic growth in long run in Pakistan during 1971-2008. The equations for education and health also showed the existence of cointegrating equation, which indicates the existence of longrun relationship among the variables. Real GDP per capita, education, quality and quantity of educational institutions affect R&D, while human capital, labour force and economic growth affect physical capital in the long run. Similarly, human capital in form of education, health and R&D emerged as a macro determinant of labour force participation. The Granger Causality Test shows some important uni-directional relationships among the variables of the study.

The findings of the study suggest TFP to be an important determinant of economic growth in Pakistan, hence, the determinants of TFP needs to be explored. Education should be kept on top priority and resource allocation to education should be increased. It is strongly recommended to enhance investment in health and R&D to put the economy on path of sustained growth. Labour in Pakistan positively affect economic growth, therefore to increase the productivity of labour, it should be equipped with appropriate skills.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	List of Tables	ix
	List of Figures	xii
	Abbreviations	xiii
CHAPTER 1	INTRODUCTION	1-6
1.1	Introduction	1
1.2	Objectives of the study	4
1.3	Hypothesis	5
1.4	Justification of the study	5
1.5	Organization of study	6
CHAPTER 2	LIRERATURE REVIEW	7-40
2.1	Introduction	7
2.2	Exogenous and Endogenous Economic Growth Theories	7
2.3	Total Factor Productivity and Economic Growth	8
2.4	Human Capital-Economic Growth Nexus	12
2.4.1	Human Capital in form of Education	15
2.4.2	Health-Economic Growth Relationship	23
2.4.3	R&D and Economic Growth	25
2.5	Human Capital and Physical Capital	32
2.6	The Role of Institutions in Economic Growth	33
2.7	Human Capital and Labour Force Participation	35
2.8	Does Health affect Education?	37
CHAPTER 3	AN OVERVIEW OF HUMAN CAPITAL AND ECONOMIC GROWTH IN PAKISTAN'S ECONOMY	41-80
3.1	Introduction	41
3.2	Population of Pakistan	41

3.3	Economic growth; past and Current	44
3.4	The Status of Human Capital in Pakistan	49
3.4.1	Education	49
3.4.1.1	The Structure of education in Pakistan	50
3.4.1.1.a	Elementary Education	50
3.4.1.1.b	Secondary Education	52
3.4.1.1.c	College Education	53
3.4.1.1.d	University Education	54
3.4.1.2	Literacy Rate	55
3.4.1.3	Expenditures on Education	58
3.4.1.4	Teaching Staff	60
3.4.2	Health	62
3.4.2.1	Health Expenditure	62
3.4.2.2	Demographic Indicators of Pakistan	64
3.4.2.3	Life Expectancy	65
3.4.2.4	Health Staff	68
3.4.3	Research and Development (R&D) Profile of Pakistan	69
3.4.3.1	R& D Expenditure	70
3.5	Labour Force Participation	71
3.5.1	Labor Force Participation Rate and Unemployment Rate	71
3.5.2	Sector Wise Share in Employment	72
3.5.3	Dependency Rate	73
3.6	Institutions	73
CHAPTER 4	DATA AND METHODOLOGY	81-95
4.1	Introduction	81
4.2	Data	81
4.3	Model for Total Factor Productivity	82
4.4	Comparison of Total Factor Productivity of Pakistan with Selected Asian Countries	85
4.5	Model for Economic Growth	86

4.6	Simultaneous Equation Model	89
4.7	Test for Unit Root	91
4.8	Test for Cointegration	92
4.9	Model for Causality	93
CHAPTER 5	RESULTS AND DISCUSSION	96-133
5.1	Introduction	96
5.2	Results of Total Factor Productivity Model	96
5.3	Total Factor Productivity Comparison with Selected Asian Countries	106
5.4	Results from Economic Growth Models	111
5.5	Results from Simultaneous Equation Model	115
5.6	Results for Unit Root Test	119
5.7	Johansen Cointegration Test Results	123
5.8	Results of Granger Causality Test	131
CHAPTER 6	CONCLUSION AND RECOMMENDATION	134-143
6.1	Introduction	134
6.2	Findings of the Study	134
6.3	Conclusion and Recommendations	141
	REFERENCES	144-160
	APPENDICES	161-168
Appendix-A	Gross Domestic Product, Population and GDP Per Capita	161
Appendix-B	Enrollment in Institutions of Education in Pakistan	162
Appendix-C	Health and Education Institutions in Pakistan	163
Appendix-D	Population Per Doctor and Pupil-Teacher Ratio in Pakistan	164
Appendix-E	Research and Development Expenditure and Publications in Pakistan during 1971-2008	165
Appendix-F	Population and Labour Force in Pakistan	166

Appendix-G	Total Factor Productivity Estimates of Selected Asian Countries	167
Appendix-H	Life Expectancy in Selected Asian Countries	168

LIST OF TABLES

TABLE NO.	TILTLE OF TABLE	PAGE
Table 3.1	Province wise Distribution of Population of Pakistan	42
Table 3.2	Population Density of Pakistan and other Asian Countries	43
Table 3.3	Growth Performance of Pakistan	44
Table 3.4	Comparison of GDP growth rate of Pakistan with neighbouring Countries	45
Table 3.5	The contribution of different sector in GDP	46
Table.3.6	Primary School Enrollment in Pakistan	51
Table 3.7	Enrollment in High Schools	52
Table 3.8	A brief History of Colleges and Enrollment in Pakistan	53
Table 3.9	Number of Universities and Enrollment in Pakistan	55
Table 3.10	Literacy Trend in Pakistan	57
Table 3.11	Province wise Literacy rate in Pakistan	57
Table.3.12	Expenditure on Education in Pakistan during the Period 1971-2008	59
Table 3.13	Education Expenditure as Percentage of GDP	60
Table 3.14	Teaching staff in educational institutions of Pakistan during 1971-2008	61
Table 3.15	Health Expenditure in Pakistan	63
Table 3.16	Demographic Indicators of Pakistan	65
Table 3.17	Life Expectancy in Pakistan	67
Table 3.18	Comparison of Life Expectancy	68
Table. 3.19	Labour Force Trend in Pakistan	71
Table. 3.20	Labour Force Composition in Pakistan	73
Table 3.21	Pupil-Teacher Ratio at various level of Education	76

Table 3.22	Doctor – Patient Ratio in Pakistan	78
Table 5.1	Annual Growth Rate of Variables during 1971-2008	98
Table 5.2	Total Factor Productivity during 1971-2008	99
Table 5.3	Decade Wise Total Factor Productivity TFP	102
Table 5.4	TFP Model with Minimum Capital Share	103
Table 5.5	TFP with Maximum share of capital	105
Table 5.6	TFP Comparison of Pakistan with Neighbouring Asian Countries	110
Table 5.7	Comparison of Total Factor Productivity for the period (1971-2008)	111
Table 5.8	Results of Economic Growth Model	114
Table 5.9	Results of Simultaneous equations Model.	118
Table 5.10	ADF Test Results (With intercept but No Trend)	121
Table 5.11	ADF Test Results (With Trend and Intercept)	122
Table 5.12.1	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR.	126
Table 5.12.2	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	126
Table 5.12.3	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	127
Table 5.12.4	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	127
Table 5.12.5	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	128
Table 5.12.6	Johansen Cointegration Test Result with intercept (no trend) in CE and test VAR	128

Table 5.12.7	Johansen Cointegration Test Result with intercept (no trend) in CE and test VAR	128
Table 5.12.8	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	129
Table 5.12.9	Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR	129
Table 5.12.10	VAR Residual Heteroscedasticity Tests	130
Table 5.12. 11	VAR Residual Serial Correlation LM Test	130
Table 5.13	Results of Granger Causality Test	133

LIST OF FIGURES

3.1	Percentage share of agriculture in GDP of Pakistan (1950-2008)	47
3.2	Percentage share of Industry in GDP of Pakistan (1950-2008)	48
3.3	Percentage share of Services in GDP of Pakistan (1950-2008)	48
3.4	Increase in number of universities in Pakistan (1971-2008)	55
3.5	Research and Development in Pakistan	70
3.6	Health Institutions of Different Kinds in Pakistan (1971-2008)	77

ABBREVIATIONS

ARDL	Autoregressive Distributive Lag Model
ASR	Adult Survival Rate
BHU	Basic Health Units
CBR	Crude Birth Rate
CDR	Crude Death Rate
EFA	Education for All
ENRE	Enrollment at Elementary Schools
ENRG	Gross School Enrollment
ENRS	Enrollment at Secondary Schools
FATA	Federally Administered Tribal Areas
FDI	Foreign Direct Investment
GAM	Growth Accounting Method
GCT	Granger Causality Test
GDPPC	Gross Domestic Product Per Capita
GFCF	Gross Fixed Capital Formation
GHSS	Government Higher Secondary Schools
GNP	Gross National Product
HDI	Human Development Index
HEC	Higher Education Commission
ILO	International Labour Organization
IMF	International Monetary Fund
IMR	Infant Mortality Rate
LDCs	Lower Developed Countries
LHVs	Lady Health Visitors
OECD	Organization for Economic Co-operation Development
OLS	Ordinary Least Square
PDR	Patient Doctor Ratio
PES	Pakistan Education Statistics
PIHS	Pakistan Integrated Household Survey
PTR	Pupil-Teacher Ratio
PWT	Penn World Table
R&D	Research and Development
RGDPPC	Real Gross Domestic Product Per Capita
RHCs	Rural Health Centers
SBP	State Bank of Pakistan
TFP	Total Factor Productivity
TFR	Total Fertility Rate

TOT	Terms of Trade
TOLS	Two Stage Least Squares
UGC	University Grants Commission
UK	United Kingdom
UNDP	United Nations Development Programme
UPE	Universalization of Primary Education
US	United States
UNESCO	United Nations Educational Scientific and Cultural Organization
WDI	World Development Indicators
3SLS	Three Stage Least Squares

Dedicated

to

My Parents, My Wife and Kids

Chapter 1

INTRODUCTION

1.1 Introduction

Positive economic growth has always been considered as the core objective of economic policies in both developed and developing countries. Sustainability of economic growth is the main determinant that explains the huge gap in standard of living in these countries. The emphasis on explaining the dynamics of economic growth increased after World War-II, when former colonies emerged as independent states (Easterlin, 2001). Most of the developing countries especially, the newly independent countries tried to adopt such policies that would accelerate the pace of economic growth and bring them in line with developed economies. These efforts led the economists and policy makers to work out the factors that maintain positive economic growth. Solow (1956) and Swan (1956) are considered the pioneers and their models provided basis for most of the studies dealing with economic growth. This gave birth to new models, which covered obvious limitations of previous traditional models.

The theory of economic growth took a new direction in 1960s, when the concepts of consumption, education and life expectancy were introduced in economic growth studies¹. The study of economic growth remained no more limited to physical capital and Gross Domestic Product (GDP). Along with physical capital, human capital became an integral part of economic growth literature. The work of Schultz (1961), Arrow (1962) and Uzawa (1965) concerning human capital and economic growth was modified in 1980s in New Growth Theories (NGTs), also known as endogenous growth theories. A number of indicators like school enrollment, expenditures on education, Research and Development (R&D), health expenditures, life expectancy, and labour skills were alternatively used in a common term called “Human Capital”. Becker (1993) termed expenditure on education, training and health as investment in human capital. Investment in education enhances human capital accumulation in the form of skilled, semiskilled and

¹ Schultz (1961), Arrow (1962), Becker(1964) , Uzawa (1965) and Seers (1969) used different indicators as human capital in economic growth studies

professional labour force. Educated labour force can affect economic growth through factor accumulation as well as through increase in Total Factor Productivity. Off the job training (formal education) and on-the-job training contribute to the accumulation of human capital (Lucas, 1988). Another major contributor to efficient human capital accumulation is investment in health, which contributes to labour's health and achieves better labour efficiency. Nakamura (1981) defined human capital as the skills embodied in labour and the physical attributes of labour like health and strength. Healthy workers are physically fit and considered more energetic and productive (Bloom *et al*, 2004). Health has positive and sizeable impact on productivity (Schultz, 2003). The combined effect of education and health enhances Total Factor Productivity (TFP) and accelerates economic growth.

Research and Development (R&D) emerged as another important tool for economic growth. Its role in economic growth was also emphasized in New Growth Theories. R&D results in innovation, which improves the quality and quantity of production. The research firms enjoy the monopoly benefits which they get after each innovation but these benefits are destroyed by next innovation (Aghion and Howitt, 1992).

World is emerging as a global village with an increasing trend of competition in all fields. Human capital is one of the major sources, which if properly harnessed, can accelerate economic growth in both, developed and developing countries. In Pakistan, major investment in human capital is made in the form of expenditure on education, health and training. Unfortunately, the R&D sector has not been successful to get proper attention of policy makers in Pakistan. The constitution of Pakistan places the responsibility of policy making, planning, provision and promotion of all kinds of educational facilities on the Government of Pakistan (Ministry of Education, 2005) Education is categorized into elementary, secondary, higher education and vocational education. Similarly, provision of better health facilities is also state's responsibility which the state is shares with the provinces. There is a network of hospitals on national and provincial levels. In addition, various types of training are provided from pre-service training to on-the-job training by public and private sector organizations. Thus, training coupled with R&D, plays its due role in economic growth by improving the quality of human capital. Finally, the role of institutions in determination of economic growth is

worth-mentioning. Institutions are considered primary determinant of long run economic growth in recent growth literature. Institutions relating to labour and capital have significant effect on investment (Durham, 2004).

Having discussed the basic theory relating human capital to economic growth, we proceed to discuss the situation in Pakistan, which is the country in question for this study. According to Economic Survey of Pakistan (2007-08), Pakistan is the 6th most populous country of the world with a population of 160.9 million, which indicate that Pakistan has huge pool of human resources. Still, The Human Development Index (HDI²) for Pakistan is 0.551 keeping it at 136th position in the world (UNDP³, 2008). The low HDI of Pakistan shows that education and health have been neglected in Pakistan.

Over the time, expenditure on education and health was not up to the limit as required for sustainable economic growth. The average expenditure on health remained 0.78 % of GDP during the period 1990-99 (State Bank of Pakistan, 2005). These expenditures further dropped to 0.56 % of GDP during the period 2000-08. Life expectancy in 2007 was 65 years as compared to 73 years in China (Economic Survey of Pakistan, 2007-8).

The average expenditure on education has been better than health sector in Pakistan. It was on average 2.13 % of GDP during the period 2000 to 2008 (Economic Survey of Pakistan, 2008-09). However, non-development expenditure in Pakistan remained much higher than development expenditure. The total expenditure on education was Rs.253.7 billion and out of it, Rs. 190.2 billion were allocated to non-developmental expenditure (Economic Survey of Pakistan, 2007-08). Pakistan has not been able to achieve the required target of literacy rate and Universalization of Primary Education (UPE) even after 60 years of its independence. The literacy rate was 57% in 2008. The male literacy rate in Pakistan is higher than female literacy due to socio-economic factors. The enrolment showed improvement but its pace needs to be accelerated. The growth performance of Pakistan on average had been very good during 1980s. Its economic growth rate on average was 6.42 during the period 1980-1989 (State Bank of Pakistan, 2005). The average growth rate remained 4.8% and 4.6% during the periods

² HDI is the combination of education, health and GDP per capita.

³ UNDP stands for United Nations Development Programme.

1990-99 and 2000-2008 (State Bank of Pakistan, 2005) & (Economic survey of Pakistan, 2008-09). The economy grew at a reasonable rate of 5.8 % and 6.8% in years 2005-06 and 2006-07 (Economic survey of Pakistan, 2007-08). Thus, Pakistan showed better performance in these years than countries like Korea, Indonesia, Malaysia, Thailand and Bangladesh.

After discussing the importance of factors affecting economic growth, these are being taken up in the present study. Bottlenecks to economic growth of Pakistan with special reference to human capital are addressed in this study. This study analyses as to what extent the education, health and research and development (R&D) have played their role in explaining the economic growth of Pakistan. This study will provide a sound guide to the policy makers to implement suitable policies for better long term macroeconomic performance of the economy of Pakistan. This study will also help in unveiling any existing deficiencies in education, health and R&D sectors of Pakistan.

In brief, this study will provide an in-depth analysis of the role of human capital in economic growth of Pakistan during the period 1971-2008. Similarly, the role of institutions in achieving efficient human capital and resultantly sustainable growth would be critically analyzed.

1.2 Objectives of the study

The major objectives of the study are :

1. To explore the status of human capital in Pakistan
2. To analyze the role of human capital in economic growth of Pakistan
3. To asses the impact of institutions on human capital accumulation and resultantly economic growth.
4. To explore the impact of human capital on physical capital accumulation and labour force participation.
5. To check causality between human capital and economic growth

1.3 Hypothesis

The main hypothesis of the study are that whether or not:

1. Human capital in form of different levels of education, health and R&D played significant role in the economic growth of Pakistan
2. Institutions contribute to better human capital formation and hence enhance their efficiency which can lead to economic growth

1.4 Justification of the study

Pakistan is one of the most populated countries of the world with huge pool of human resources. The huge population, if on one side is a heavy economic burden, on the positive side it provides new blood to the existing labour force but the former effect is stronger than the latter one. The major reason is that human resources have not been properly planned and utilized in Pakistan. International experience shows different scenario. China is the most populated country of the world but it has optimally utilized its population by adopting proper human resource development policies. Similarly, India has transformed huge part of its population in productive form of skilled labour and professionals. Hence, there is ample evidence around the world that efficient policies relating to human capital, results in better growth performance

Keeping in view the significance of the role of human resources in economic growth, the present study is being conducted. Most of the studies estimated the effect of education and health individually in Pakistan. The studies on the role of R&D in economic growth are rare in Pakistan. The earlier studies have computed the returns from education and contribution of health to economy but its external macro economies are missing so far. The studies conducted so far, have rarely explored the determinants of human capital in Pakistan. The present study aims to overcome these shortcomings. This study has not only used different econometric techniques to find the human capital-economic growth nexus and measure the externalities of human capital accumulation but it has also carried-out a sensitivity analysis of the contribution of Total Factor Productivity (TFP) in economic growth of Pakistan. Moreover, the present study has compared the contribution of TFP to economic growth in Pakistan to other countries of the region.

1.5 Organization of Study

This study comprises of six chapters. Chapter one consists of brief introduction of the study covering the objectives, hypothesis and organization of the study. In chapter two, an extensive review of existing literature showing studies on the issues relevant to human capital and economic growth is discussed. This consists of both theoretical and recent empirical literature. Third chapter discusses detailed profile of economic growth, education, health, R&D and institutions of Pakistan. Chapter four gives a detailed description of the sources of data , theoretical and analytical framework, models, and estimation techniques used in this study.

Chapter five is based on results and comprehensive discussion on role of human capital in economic growth of Pakistan. Chapter six consists of conclusions of the study, its policy implications and final suggestions to devise plausible human resource development policy in Pakistan.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Literature review plays an important role in highlighting the essential information relevant to the study. It provides a handy guide to the topic concerned. It is considered as stepping stone in any research study. It gives direction to the study. A detailed review of past and current literature enables us to equip with the knowledge of the data and methodologies previously used for analysis of the topics relevant to the topic under study. This chapter consists of a detailed review of the literature relevant to economic growth and the contribution of different inputs to it.

2.2 Exogenous and Endogenous Economic Growth Theories

Exogenous theories of economic growth are also known as neoclassical growth theories or Solow-Swan growth models. The literature of exogenous growth theories starts from models developed by Solow (1956) and Swan (1956). These theories used neoclassical production function by taking labour and capital as factors of production. Exogenous growth theories are based on the idea that long run rate of growth is exogenously determined. Technological progress, which is one of the most important determinants of growth in this model, is determined outside the model. These theories hold the view that economic growth is also affected by population growth rate, which is exogenously determined. Cass (1965) and Koopman (1965) extended the neoclassical growth model by introducing consumer optimization but still long run economic growth remained dependent on exogenous technological progress.

The revolutionary theoretical and empirical work of Lucas (1988), Romer (1986) & (1990), Grossman and Helpman (1991), Agion and Hewitt (1992) in 1980s and 1990s laid the foundation of new growth theories or endogenous growth theories. The

emergence of endogenous growth theories was actually the extension of neoclassical growth theories. These theories hold the view that policy measures can affect growth rate in an economy. In other words, the growth rate is now determined within the economic growth model or is endogenous. These theories introduced human capital, knowledge and R&D in growth model which are determined within the model. The work of Jones and Manuelli (1990), and Rebelo (1991) along with others is valuable contribution to endogenous growth theories. With the development of new growth theories, many large sample international datasets were introduced.

2.3 Total Factor Productivity and Economic Growth

The economic growth empirics are considered incomplete without taking into account the Total Factor Productivity (TFP). A major problem in growth empirics of Solow type models is the value of residual. The study of TFP is mainly the computation of this residual. Therefore, TFP is also known as Solow Residual. The TFP is mainly calculated by using the Growth Accounting Method (GAM), which breaks the economic growth into its associated components. The literature of economic growth is rich with TFP estimations for both developed as well as developing regions. These studies include studies for individual countries as well as cross country comparisons. This section of the present chapter presents review of such recent studies.

Young (1992) used the methodology as developed by Gollop and Jorgenson (1980) to calculate growth of TFP in Singapore and Hong Kong during 1971-1990. The capital and labour were subcategorized. The TFP growth was computed for different sub periods. The results indicated that TFP remained a significant contributor to economic growth all sub periods. Its share has been 30-50 % in all sub periods. It added 56% to the output per worker during the period 1971-1990. In case of the Singapore, the TFP growth showed negative performance. It addition to economic growth of Singapore was -8% between 1970 and 1990. The capital accumulation contributed 1175 to the growth of output per worker.

Nehru and Ashok (1994) explored some new estimates of TFP for a sample of 83 countries. The study used new data prepared by the authors. The study found that human capital is more important factor in explaining the economic growth as compared to the earlier studies. TFP growth in high income economies was found comparable with the low and medium growing economies. The study further concluded that the cross country variation in income is due to political stability and initial conditions of the economies. The actual TFP growth in Sub Saharan Africa remained lower than the TFP predicted on the basis of the political stability and initial conditions.

Sarel (1997) investigated the process of the economic growth in 12 Asian economies using internationally comparable data. The aim was to explore whether the growth is brought by increasing inputs or by the productivity growth. The study interestingly got some results different from the previous studies. The TFP growth was very high in Singapore, Malaysia and Thailand. Interestingly, the TFP growth for Philippines was found negative. The study concluded that the variation in results may be due to the type of the data used as most of the previous studies used data on national accounts. Similarly the factors shares of the labour and capital may be another reason for it.

Nelson and Howard (1999) investigated the economic growth process in major Asian economies during the period 1960-1996. The study argues that major changes in economic growth of the Asian economies were brought about by shifts in firm's size and other sectors of specialization. The capital accumulation also played its due role in the economic growth of these economies. The contribution of TFP which neglect some facts regarding the capital may lead to wrong estimates.

Sinhaji (1999) used the Growth Accounting Method (GAM) to analyze the variation in TFP in 88 countries during 1960-94. The study estimated the share of the physical capital econometrically and used the level effects. The study found both conditional as well unconditional convergences in TFP among the economies. The initial level of TFP, physical and human capital is responsible for explaining the cross-country variation in TFP levels. Other factors, which affect TFP, are the favourable Terms of

Trade (TOT), favourable economic environment, social harmony and political stability. The share of capital influence the role of the TFP in economic growth as higher share of physical capital lowers the share of TFP in economic growth. Interestingly, the share of physical capital was found 0.55 for 66 countries against the most widely share of 0.3 to 0.4.

Baier *et al* (2002) envisaged the significance of human capital, physical capital and TFP in economic growth by utilizing the data on 145 countries. The study concluded that only 3% of output growth per worker is associated with TFP in the countries under study. The contribution of the TFP to growth varied in different regions. The study divided the area in nine regions. The TFP share in output growth was 20% in three regions and zero to ten percent in other three regions. Interestingly, TFP remained negative in three regions under study. The study concluded that TFP is responsible for 87% of the variation in output per worker across countries.

Aiyer and Carl (2005) addressed different issues concerning the cross-country comparisons of productivity variation. The factor prices were taken into account rather than stocks. The study found that TFP is responsible for the disparity in income per worker in cross-country comparisons. The study used dual approach and found significant differences in TFP estimates from the two approaches. The study recommended that the one third constant share of the capital in Cobb Douglas methodology for all countries in cross-country comparisons is a good measure for estimation of the TFP.

Khan (2006) estimated the macroeconomic determinants of TFP in Pakistan using secondary data for the period 1960-2003. The study concluded that TFP played an important role in economic growth of Pakistan during the study period. The macroeconomic stability, Foreign Direct investment and financial sector development remained the major contributors to TFP in Pakistan in the period 1965-2005. the most interesting finding of the study was that education is insignificant determinant of TFP.

Ahmed *et al* (2007) analysed the role of fiscal policy, monetary policy and other factors on TFP and resultantly on economic growth in Pakistan. Time series data for the period 1973-2006 was used covering whole economy as well as major sectors like agriculture, manufacturing, construction, electricity and gas , and others sectors. The study showed that the government policies affect the TFP through better human capital, infrastructure and technology. The TFP varied from 5.6% in the period 1973-77 to 67.6% in 2003-06. The results showed that TFP is mostly affected by cotton and export of manufactured goods. As most of the exports of Pakistan are cotton based, therefore boom and crisis of cotton production significantly affect the TFP and GDP. Human capital proved as major contributor of the TFP in agriculture sector. The study concluded that the macroeconomic reforms in recent years significantly enhanced the TFP in Pakistan.

Ahmad (2007) investigated the sources of economic growth in Pakistan. The study also estimated the TFP for the whole economy as well as for the major sectors of economy during the period 1965-2005. The methods used for the calculation of the TFP were GAM, econometric method and as well as the index number method. The study estimated dual estimates of TFP called, unadjusted and adjusted TFP. The study found that the traditional method of calculation which is based on conventional measures on inputs overestimate the TFP in most of cases. Results of study indicated that the average annual growth rate of the adjusted TFP was 0.72% and unadjusted was 1.64% during the study period. This showed 128 % of over estimation. In case of agriculture sector, it showed an over estimation of 336%. TFP remained 1.42(Adjusted) and 2.34 (unadjusted) for the manufacturing sector which shows over estimation of 65 %. Domestic investment, expenditures on education and trade openness remained major contributors to economic growth in the study period. The study suggested rapid domestic investment, loosing the private credit, enhancing trade and more expenditure on education to reap the fruits of economic growth.

Ahmad et al (2008) used GAM to find the Total Factor Productivity (TFP) in agriculture sector of Pakistan for the period 1965-2005. The study found the TFP annual growth 0.28% in agriculture sector of Pakistan. It used the factors like variation in

number of hours worked, level of education and training of the labour force. The study recommended proper treatment of TFP in agriculture sector. It further suggested to update the farmers information, bringing more area under cultivation, and provision of fertilizers and other inputs at lower prices to the farmers to increase TFP and value added growth in Pakistan.

2.4 Human Capital-Economic Growth Nexus

The neo classical literature mainly begins with the model of economic growth given by Solow (1956). Labour, Capital and technology were taken as factors of production in Solow model. According to this model, a part of output produced is consumed and the rest is saved which is then invested.

The very initial form of the model is

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

Where K is Capital and L is labour. The rate of saving is $s(Y_t)$ and Stock of capital is K_t such that the rate of growth of capital (K') becomes equal to the saving rate $s(Y_t)$. Constant returns to scale were assumed to labour and capital when combined, and diminishing returns to scale when used separately. Economy will converge to balanced path at the point where breakeven investment becomes equal to actual investment. Rate of return on capital is low in countries having more capital per worker and this paves way for outflow of capital, which help poor countries in convergence. Most of the economic growth studies have used the Solow model in different augmented forms. It has been augmented with human capital in form of education, health, R&D, Innovation and many other variables in literature.

Schultz (1962) concluded that the capabilities of human beings can be improved through investment in human capital. Human capital is embodied in person and it cannot be separated from him. Whatever capabilities an individual needs, are not naturally endowed, but depends on investment in human capital. Investment in human capital is mostly made through education, on-the-job training, improvement in health of masses and searching information. Investment in human capital has both static and dynamic

effects i.e. it increase individual and national income, and accumulate human capital. In absence of education, experienced labour, and lack of information regarding economy, output will fall until their capabilities are raised through investment in human capital.

Weisbrod (1962) examined the role of investment in human capital in United States. The results show that investment in human capital not only leads to technical progress but also provides an avenue for further development. The major forms of direct investment in productivity and people are health, learning and location. Education and health cover largest part of spending in both public and private sector in United States. Investment in education not only expands knowledge and raise productivity but also improve health by increasing life expectancy. The results also show that investment in human capital has both internal & external economies. Internal economies take place in the form of good health of children, informal education at home etc. On the other hand external economies are in the form of good colleagues and neighbors. Education provides individuals better financial return, more financial options and opportunity options. These economies create incentive for public expenditure in human capital.

Mincer (1962) carried out a study about on-the-job training, which estimated its returns and compared it with costs. With formal and informal training, he also considered learning from experience as formal education is end of a preparatory stage for learning occupational skills through performance in labour force. The study revealed that investment in on-the-job training is mostly in the form of education, which covers a substantial part of US expenditure. According to their findings investment in on-the-job training in medical, apprenticeship, and specialization have approximately same returns as college education. Returns to private investment in formal education were found higher than on-the-job training.

Becker *et al* (1990) studied human capital, fertility and economic growth assuming endogenous fertility and rising rate of return as human capital stock increases. The rate of return on investment in people is higher than rate of return on children in human capital abundant economies while in human capital abundant economies, it is less

than rate of return on children. This study shows close relationship between the human capital and economic growth. Investment in human capital leads to raising level of technological and scientific development, resulting in economic development. This means that accumulation of human capital is an important factor, which leads to economic growth. Investment in human capital, choice of family size, human capital-physical growth nexus and steady state equilibria are the major variables, which help some countries, grow at higher rate than others do.

Naidoo (2004) analyzed the role natural capital in economic growth of a country during the period 1960-1999. The augmented form of Solow model was used by introducing natural capital with other forms of capital. Linear regression models were used to derive estimates. The study used forest as natural capital and the results show that economic growth of more than seventy seven countries of the world was found positively associated with natural capital. The results of this study are in contrast to those studies which emphasize to control deforestation as the results of this paper show that in cross-section of large number of countries the forest clearance lead to accelerate economic growth. The countries with huge initial stock of forest grew slower than those with little forests and the countries which have cleared much of their area by deforestation grew faster than those retaining their stock of forest.

Oketch (2006) examined the role of human capital in economic growth of 47 African countries by using methods of Ordinary Least Square (OLS) and Two Stage Least Squares (TSLS). Human capital was measured by investment in basic and advanced education as percentage of GDP. The results showed that physical and human capitals are two most important determinants of economic growth in African countries. The causal relationship between human capital and economic growth was found two-way. The study recommended increasing investment in human resource development through education for sustained economic growth.

Canlas (2003) used Solow's neoclassical model to study economic growth of Philippines. The results of the study were encouraging. The empirical results supported

the views of neoclassical model and all the variables were found in expected direction. The saving and population growth were statistically significant but human capital or education showed insignificant results. It was suggested to raise saving and investment rates and reduce population growth to put Philippines on path of sustained economic growth. Accumulation of human capital along with physical capital be an effective tool in this connection.

Anwar (2008) explored the role of Foreign Direct Investment (FDI) and human capital in long run growth of manufacturing sector of Singapore by using annual data for the period 1980-2005. Singaporean economy is dependent to a great extent on manufacturing sector which is directly related to FDI. The empirical evidence showed that along with FDI, human capital accumulation is significantly associated with development of manufacturing sector which is an important determinant of Singaporean economic growth. Due to small size of economy and low saving rate, the economy is expected to depend on FDI in near future. The appreciable expenditure on R&D and innovation in 1990s provided some support to economy. Private firms are not spending much on human resource development in Singapore. In order to reap the fruits of comparative advantage in human capital intensive goods, the study suggested diversification of exports and enhancing expenditures on R&D and higher education. The human capital and economic growth studies both empirical and theoretical with different forms of human capital are given below:

2.4.1 Human Capital in form of Education

Lucas (1988) developed his theory of economic growth by introducing human capital as a factor of production. He investigated the variations in cross country incomes and incomes within countries. Human capital was introduced in form of education in the model. The model is based on neoclassical growth theory. The model explains how individual allocation of time to different current activities influences the productivity or his level of human capital in coming years. Because time allocated for human capital accumulation today will bring fruits in form of increased productivity tomorrow. Human

capital is embodied in person and it enhances the productivity of labor as well as physical capital. Human capital formation depends on returns in human capital accumulation. It positively affects economic growth.

Barro (1991) modeled the human capital-economic growth relationship for 98 countries for the period 1960-1985. School enrollment rates were used as proxy for human capital. The real GDP per capita growth rate showed positive association with initial human capital measured by school enrollment rates of 1960. The real per capita growth rate was found negatively associated with initial level of GDP per capita of 1960. The countries with high human capital were found with lower total fertility and comparatively higher physical capital-GDP ratios. The poor countries can follow the rich countries if they have higher human capital per person. Political instability showed negative relationship with the investment and economic growth.

Jorgenson and Fraumeni (1992) analyzed the role of education in US economy during postwar period. The growth of education and non-education sectors was aggregated to get a new measure of economic growth for United States. Education was treated as investment in human capital due its lifetime impacts on the receiving person. The study took impact of education on lifetime labor income including time spent outside the market as a measure of educational output. The benefits of education are not only in market but in non-market also. It provides non-market benefits in form of parenting and leisure also. It was observed that the growth rate of US economy slowed down since 1973. Investment in human capital as well non-human capital is needed in order to bring back the economy on track of rapid economic growth.

Mankiw *et al* (1992) examined the consistency of exogenous growth model given by Solow (1956) using a large set of cross-country data for period 1960-85. Education was taken as proxy for human capital. The Cobb Douglas production function used by Solow was extended in this model. SCHOOL was used as proxy for human capital which shows the percentage of working-age population that is in secondary school. The study shows that output is result of not only physical capital and labor but also of human

capital. Physical capital accumulation has no externalities and has greater impact on Per capita income as compared to Solow model. The results confirmed the consistency of Solow model empirically. The countries with similar technological level, rate of accumulation and population growth converge in income per capita at slower pace than Solow suggested. This model finds an economy at halfway to steady state in 35 years as compared to Solow's prediction of 17 years. The cross-country difference in per capita incomes depends on level of saving, education and population growth.

Romer (1994) suggested higher investment in children, which will have emotional, physical and cognitive effects on their lives. Higher investment in children will help them in achievement of higher economic capabilities as compared to those children, who get less investment. Lower investment will result in lower income, poor health and poor economic capabilities. It will affect the society as a whole in form on unequal distribution of income, poor skills, higher crime rate and more dependent population. Therefore, the societies, which invest more will have more social and economic benefits than the societies which invest less in their children. The societies with less investment in children will have a higher proportion of population unproductive and dependent of public resources.

Kocherlakota and Kei (1995) rejected the view of traditional cross-section regression in distinguishing between exogenous and endogenous growth. A simple growth model was developed for this purpose. The model showed that conditioning on initial income can be wrong if technology shocks are allowed to vary across economies. Therefore, to distinguish between endogenous and exogenous growth both initial income and capital levels should be considered. The model insists on the sign of initial capital instead of initial income for this purpose.

Pritchett (1996) showed by using cross-sectional data on economic growth that increase in education of labour force has no positive impact on growth rate of output per worker. The growth of human capital has large, negative and significant impact on total factor productivity. It is possible that schooling may not create human capital but it raises

the private wage. In those economies where demand for educated labour is stagnant, marginal returns to education are falling. The institutional environment in many countries is bad and this may led to less contribution of educated labour to economic growth. Human capital does raise productivity but it needs proper environment for utilization.

Evans (1998) developed a method for comparison of endogenous and exogenous growth theories by using panel data. The model found evidence against different trend growth rates for selected developed countries and countries with well educated population. The empirical results found exogenous growth theories consistent for 13 rich countries and 27 countries with relatively well educated population. The endogenous growth theories which describe the growth experience of 27 countries with least educated population in 1950s are supported by empirical evidence. The model suggested that the technical knowledge may be out of reach in those economies where the per capita stock of human capital is small.

Asteriou and G.M, (2001) analyzed the human capital-economic growth relationship in Greece assuming that formal education is the principal institutional mechanism for developing human skills. The study found GDP cointegrated with all educational variables which show long run positive relationship. Primary and secondary enrollment causes GDP growth while in case of higher education enrollment the causality is in opposite direction. The finding in case of higher education indicates that acquisition of higher degrees may not improve ability to do a productive work. The study suggested that further research and technological development can change the causality in right direction from mathematicians, applied scientists, IT Experts to economic growth.

Abbas (2001) used primary schooling, secondary schooling and higher as proxies for human capital to find its association with endogenous growth in Pakistan and Sri Lanka during the period 1970-1994. The empirical results based on growth accounting method showed negative impact of primary school enrollment on economic growth in both countries Pakistan and Sri Lanka in the study period. When the human capital is proxied by secondary school enrollment the impact becomes positive in case of both

countries. The overall results confirm the positive role of human capital in economic growth of Pakistan. The study suggested improving the poor condition of primary education in Pakistan and also continuing improvement in Sri Lanka. The investment in secondary and higher levels of education should go ahead as these levels of education significantly affect the economic growth in the selected countries.

Seren (2001) analyzed across country empirical relationship between human capital and economic growth in the period 1960-1990 using Cobb-Douglas production function. Human capital and per capita output showed a level effect of education on economic growth. Level of income showed a positive impact on human capital accumulation.

Petrakis and Stamatakis (2002) used endogenous growth theories to link human capital to economic growth in three groups of countries with different levels of development by using pooled data. These countries were less developed, developed and advanced countries. The developed and advanced countries were covered by taking Organization for Economic Co-operation Development (OECD) countries while less developed countries considered those poor countries out of OECD. It investigated the growth effect of education and the level of development. The effect of education was checked for its three components primary, secondary and higher education. The empirical evidence showed that contribution of education varies with variation in the level of development. There is strong link between education and economic growth. The study shows that the effect of primary and secondary education in economic growth is higher in less developed countries as compared to OECD countries. The higher education contributed more to economic growth in OECD countries than less developed countries.

Harman *et al* (2003) estimated returns to education by taking education as private decision to investment human capital. The results showed a return of 7% and 9% for men on one year of schooling in United Kingdom (UK). It showed 9% and 11% returns for an additional year of schooling in case of women. The returns to education differ in wage distribution. Methods Quintile regression models suggest higher returns for those who are

in top deciles of income distribution and lower returns for those who are at the bottom. The study concluded positive effects of schooling from education and the returns are higher than other investments

Albatel (2004) worked on the Saudi Arabia economy to study the impacts of human capital on economic growth during 1965-99. The study used Johansen- Juselius cointegration test for long run relationship. The results showed expenditure on Human resources and related policies had positive impacts on economic growth of Saudi Arabia. Foreign labor in Saudi Arabia satisfied domestic demand and made significant contribution to output growth during the study period. Knowledge and skills are beneficial not only for individuals but also for the Societies as a whole. The data supported the hypothesis of human capital as engine of economic growth. It suggested that government should go beyond emphasis on saving and investment only and investment in human capital and technology should be enhanced. Investment in Research and people will generate beneficial externalities in form of knowledge and skill diffusion in the economy.

Brempong and Mark (2004) investigated the health-per capita growth rate nexus in sub-Saharan African and OECD countries by using panel data. Expanded form of Solow growth model was used for analysis. The empirical evidence supported positive and significant relationship between growth rate of per capita Income and health human capital. The effects were quadratic in nature. The study found that even after controlling other variables, 22% to 30% growth rate of per capita income in the study area due to health human capital and the cross-country differences in income are positively correlated with cross-country differences in stock of health human capital. The study concluded that higher steady state incomes can be derived by increasing the stock health human capital.

Glewwe and Hanan (2004) investigated the relationship Household resources and demand for education in Vietnam during 1993-1998. The period of was taken due to high secondary school enrollment in Vietnam. Consumption expenditure was used to measure

household's wealth. The results show that increasing returns to education played no significant role in determination of education demand in Vietnam in mid 1990s. school enrollment increased in those households fastly who got greater increase in wealth. The model predicted an increase of 10.3% against actual increase of 1% for children of age 10-18 during 1993-1998. The relationship between wealth changes and variation in demand for education was found positive and significant. The wealth does play its role even if some of important variables like returns to education, quality of schools and opportunity cost are controlled.

Limam and Stephen (2004) got positive association between quality of capital and output in a group of 80 countries. The quality of labour however had positive impinge on economic growth in Africa, East Asia and the west. The effect was negative and significant in Latin America and South Asia.

Khan (2005) compared Pakistan's growth performance with selected Asian countries during the period 1980-2002. The study used data set of 72 countries taken from Barro and Lee (2000), and World Development Indicators (WDI). The quality of human capital along with conventional factors of growth was also considered. Education and health showed significant contributions to growth. Investment in education and health can generate highly productive labor force and increase total factor productivity. The growth performance of Pakistan Economy was found on average better than a large group of low and middle-income countries. The results show that improving institutions and raising investment contribute to economic growth significantly. It was suggested to accumulate physical capital and to enhance the quality of institutions to accelerate the pace of growth.

Echevarría and Amaia (2006) developed an overlapping generations model showing the effects of mortality rate on the life expectancy of individuals, their education human capital and economic growth. The model finds the average change in human capital as engine of economic growth. The level of human capital is derived by the educational level and decision of retirement of individuals. The demographic

characteristics also affect the quality of human resources. A change in mortality rate brings a change in the life expectancy which results in behaviour effect as well as composition effect. This paves path for economic growth. The study got negative relationship between social security and per capita GDP growth rate.

Lin (2006) studied the impact of human capital (education) on economic growth in Taiwan during period 1964-2000. The study used augmented form of Cobb Douglas production function. The study used human capital as average number of years in formal education system in employed population instead of whole population. Various levels of education showed different types of effects. Elementary education contributed to economic growth at higher rate than other levels of education in the study period. It was suggested to improve the quality of higher education training as well as elementary and secondary education training to achieve economic growth.

Akintoye and Adidu (2008) used Nigerian data to find out whether national growth optimization is possible through human resource investment using a time series data for the period 1979-2002. Augmented Solow model was used for analysis. The results show a negative relationship between human capital investment and per capita income growth. Income strongly influences human capital as compared to impact of human capital on income. Capital spending on education promotes more than recurrent spending. The study suggested emphasis on qualitative education and strong attention to science and technology in Nigeria to achieve the desired level of economic growth.

Bhattacharyya (2009) used dynamic panel regression model average growth rate over five year periods to examine the partial effects of institutions and human capital on economic growth. Human capital was measured by average years of schooling. The regressions results show that log-level regressions may not be helpful in interpreting the significance of institutions and human capital in economic growth due to threat of multicollinearity. Dynamic panel regressions give valid cross country analysis without the problem of multicollinearity. The study funds significant impact of institutions and

human capital on economic growth and interrelationship between human capital, human capital and economic growth.

2.4.2 Health-Economic Growth Relationship

Ozcan *et al* (2000) developed an overlapping generation model to study the role of rising life expectancy in speeding up human capital investment to achieve economic growth. The study examined the mortality decline-education relationship. Mortality decline induces investment in education and raises life expectancy. The higher life expectancy encourages schooling as returns are expected over a longer period. Empirical evidence showed a significant relationship between declining mortality and length of schooling. Lower mortality also effects consumption. However, the impact is larger on consumption. The study concluded that declining mortality and increasing investment in education are the two most important aspects of economic growth.

McDonald and Jennifer (2002) supported the view that education alone is insufficient proxy for human capital in determination of economic growth. The role of different forms of capital change, with variation in income. The coefficients on investment vary inversely with level of income. The health capital seems more significant at low income and education more significant at high level of income. The study supported the view that life expectancy is meaningful in macroeconomic context. The study concludes that without health capital augmented Solow growth models produce misspecification biases and health is one of most important determinants of economic growth.

Bhargava *et al* (2001) developed a model to find the proximate determinants of economic growth using panel data taken from Penn World Table (PWT) and World Development Indicators (WDI). Life expectancy, Adult Survival Rate (ASR) and Total Fertility Rate (TFR) were used to measure health. The results revealed significant positive effects of ASR on economic growth in countries like Burkina Faso, Burundi,

India, Ivory Coast and Nigeria. The effects were negative in advanced countries like USA, France and Switzerland.

Wang and yudong (2003) examined the sources of growth in China during 1952-1999 by using Growth Accounting Method. The results showed a very rapid human capital accumulation in China. Its contribution to economic growth and welfare remained positive and significant in the study period. Human capital accumulation was measured by average years of schooling of population of age 15-64 years. Total Factor Productivity also played significant role in economic growth even after the reform period in China. Physical capital accumulation accounted 51% of growth during the period 1953-1999. It contributed 25.4% to economic growth during 1978-1999. The study concluded to give high priority to human capital accumulation and productivity growth to keep china on path of sustained economic growth.

Bloom *et al* (2004) investigated the role of good health and work experience in economic growth using a production function model of aggregate economic growth. The effect of good health proved positive and sizeable even if the work experience is kept constant. Estimation results revealed that one-year improvement in life expectancy of population contributes 4% increase in output. This fact justifies public expenditure on health, as it will improve public health leading to raising productivity of labour. Improvements in health increase output not only through increase in labour productivity but also through human capital accumulation. The study found no evidence of greater effects of education and experience in macroeconomic studies as compared to microeconomic studies.

Rico *et al* (2005) tried to find out the impact of health on economic growth using cross-country data. All factors that affect health were considered. Solow model with human capital was evaluated through panel data analysis. This study developed ordinal health index from determinants of health. The results showed a significant impact of health on economic growth of various countries. It was suggested to create higher level of mass awareness in third world countries to achieve sustainable economic growth. Health

differences across countries significantly explain growth differences in these countries. Therefore, Investment in health was recommended as a macroeconomic tool in future policy making.

Hartwig (2009) applied the panel Granger-Causality framework to find whether human capital in form health caused economic growth in 21 rich countries in longrun. The results found no evidence that health expenditure or rise in life expectancy Granger caused per capita GDP growth in OECD countries. These results are amazing as the findings in most of health-economic growth literature are against the findings of this study. The study concluded that health did not cause economic growth in longrun in study area possibly due to three reasons. Firstly, may the relationship be positive in short run. Secondly, May the time lags in this paper be too long for analytical framework. Thirdly, it is possible that people of study area may take health from welfare point of view instead of economic point of view.

2.4.3 R&D and Economic Growth

Aghion and Howitt (1992) developed a model of endogenous growth by including the role of R&D in economic growth. This model used the idea of creative destruction. It assumes that the individual research can also affect the whole economy. The model derived equilibrium through forward-looking difference equation. It means that the pace of research in a period, depends on present research and on the productivity of research. The research firms get monopoly rent of their innovations, which are replaced by future innovations. Each innovation result in a new intermediate good, which is then used to produce final good more efficiently. This study analyzed the positive and static properties of stationary equilibrium with R&D. Economic growth is the result of innovations, skilled Labour force and productivity of research.

Engelbrecht (1997) extended the Coe and Hellmann's study of international R&D spillover by introducing a general human capital variable which accounts for innovation outside the R&D sector. The human capital enters into production not only as a factor of

production but also as the endogenous theories predicted. The results show highly significant coefficient for domestic as well as international R&D spillover. The study suggested diverse role of human capital and R&D in domestic innovation and international spillover of knowledge. This spillover leads to economic growth.

Fagerberg *et al* (1997) used simultaneous equation model to find the interrelationship between GDP per capita growth, employment growth and innovation with technology diffusion in various regions of Europe during the period 1983-89. GDP per capita and unemployment proved to be inversely related as poor regions faced higher level of unemployment rates. The net inward migration showed positive relationship with GDP per capita growth. The backward regions have very little emphasis on R& D and raise in R&D expenditure is very crucial for growth of poor European regions. It will accelerate growth of these regions without effecting growth of any other region. The R&D expenditures growth should be supported by high quality of institutions.

Borensztein *et al* (1998) analyzed empirically the role of Foreign Direct Investment (FDI) in technological diffusion and economic growth by developing a model of endogenous growth. The data was taken for 69 developing countries from Barro and Lee (1994), International Monetary Fund (IMF) and Organization for Economic Co-operation (OECD) publications for the period 1970-89. The study investigated the channels through which the FDI inflow from industrialized countries can affect economic growth. The study concluded that FDI is more productive in those countries where the human capital accumulation is comparatively low. This shows the affect of FDI on economic growth through the improved human capital and technology diffusion. The education and FDI are strongly and positively related.

Blackburn (2000) integrated Research and development with human capital accumulation in an endogenous growth model. Constant returns to scale to education and diminishing returns to scale to inventions and innovation were assumed. Research and development leads inventions and innovation, which improves the quality of manufacturing and updating of existing technologies. The model used the ideas of the

models developed by Lucas (1988), Uzawa (1965), Grossmann and Helpmann (1989), and Romer (1990). The model recommends accumulation of skills and knowledge for people in an economy in order to get economic growth. Human capital accumulation not only accelerates economic growth but also provides incentives for research and innovations. It improves the quality of manufacturing.

Frantzen (2000) used cointegration and Error Correction Model techniques to know R&D, human capital and international technology spillovers on Total Factor Productivity (TFP) in 21 OECD countries during the period 1961-1991. The results support the view that both R&D and human capital play a significant role in TFP. Both domestic and foreign R&D showed a significant impact on TFP but the impact of domestic R&D played more significant role in growth in richer countries as compared to smaller economies. The results further show that both, level and pace of increase of human capital are important determinants of productivity growth.

Ballot *et al* (2001) studied the effects of human and technological capital on productivity of firms in France and Sweden economies by using Generalized Method of Moments (GMM). Panel data for the period 1987-1993 was used which was taken from large Swedish and French firms. The study used R&D and Human capital stock as inputs in the model. Technological capital was measured by R&D and human capital by firms sponsored training. The results show significant role of human and technological capital in determination of firm's productivity in Sweden and France. The interaction effects between R&D and human capital stock were not found robust. The study suggested the importance of training as input for France. R&D showed more significant result in Sweden as compared to France. The rate of return for R&D was found 38% for France and 32% for Sweden which within the range as in industrial countries.

Zeng (2001) developed a multi-sector dynamic general equilibrium growth model to view the role of innovation and imitation in economic growth. This model assumed investment in innovation and imitation endogenous. This model considers innovation and imitation in same sector at same time. Changes in these variables occur in natural way.

This model shows that subsidy to innovation will push economic growth and subsidy to imitation will move it in opposite direction. The welfare consequences of innovation and imitation are not sure.

Chou (2002) examined the contribution of research and development, and human capital in Australian economy using country-level data during the period 1960-2000. This model shows that long run steady state growth is the result of local as well as global research and development of new ideas. The growth accounting method was used for the analysis. The study concluded that the growth of Australian per capita income is not totally due to factor accumulation but also due to enhancing efficiency of transformation of inputs into outputs. 28 % of growth was due to educational attainment and 27-57 % due to research intensity in Australia as well as in G-7 countries. Australian economy is expected to continue its growth and the R&D will continue its role in economic growth of Australia.

Jones (2002) introduced world of ideas in his growth model. This model states that the economic growth of an economy in long run depends on globally developed ideas. The hoard of ideas in long run is directly proportional to the worldwide research and the population of that economy. The model was applied to United States economy. The US economic growth per capita remained almost constant in last century but stock of human capital increased to great extent. The sources of economic growth in US include education, R&D, world population growth and other factors. The education, health and related factors explain about 80% of US economic growth while 20% of growth is result of world population expansion. In future the contribution of research (Ideas) will continue for sometime and market for ideas will expand. The world population will resultantly become sufficiently skilled.

Lee (2005) assessed Korean economy by using methods of growth accounting and level accounting. The results show that output per worker gap between Korea and United States has been fallen during past three decades. The study finds Korea on path of sustained growth due to increasing stock of human as well as physical capital. The

manufacturing industries got good pace but the performance of the service industry is not up to the mark. The study suggested Korean economy to increase R&D expenditure for innovation in technology and improve quality of education so that desired level of growth may be achieved. For educational quality, improvement is needed in educational institutions and their management. Liberalization of educational institutions and inter school competitions can be helpful in achievement of desired goals.

Kwack and Yang (2006) analyzed Korean growth experience from neoclassical growth perspective. Annual data for the period 1971-2002 was used for this purpose. Investment rate, R&D, Education and size of government emerged as major determinants of longrun economic growth in Korea. The Study provided evidence for endogenous growth theory. The study showed that public and household's expenditure on education and R&D investment are major contributors to innovation and improving quality of labour. Higher dependency ratio of youngs and older people adversely affected Korean growth rate. Improvement of political, cultural and social institutions was recommended to achieve longrun sustained economic growth rate.

Ornaghi (2006) analyzed the role of knowledge spillovers in the productivity and demand of firms. The model modified the Griliches (1979) approach by introducing demand equation in production function. The model concludes that knowledge spillovers improve the quality of product produced by firms and it adds to the productivity of firm. The study finds difference technology innovation and process innovation. The former's effect was found greater than the latter one. The model gives justification to subsidies to R&D small and medium projects as adopted by several industrialized countries.

Grossman (2007) developed a model to find the contribution of R&D subsidies and publicly provided science education to economic growth. The study concluded that R&D subsidies may not contribute economic growth and public welfare and the intertemporal knowledge spillovers are the externalities of Firms expenditure on R&D. The subsidies to R&D increase income inequality. The model confirmed that publicly provided education aiming at higher skills in science and technology will contribute

positively to economic growth of a country. As public education contributes to economic growth more efficiently than R&D subsidies, therefore, it was suggested to develop R&D through promotion public education of scientists and other skilled persons.

Afza and Nazir (2007) worked on the role of human resource management in economic competitiveness in South Asian economies with special reference to Pakistan. It was observed that Pakistan did not avail the golden opportunities created by globalized world. Weak skill base is one of the major factors keeping Pakistan away of taking advantages from global markets. The study suggested improvement in skill base, expansion of education and training, and development of R&D for better economic consequences. Basic education is key to for human resource development in Pakistan. It was also suggested to accelerate the manpower export to reduce poverty and improve macroeconomic indicators. Similarly, integration of available physical and human capital and joint technological ventures can reduce the regional economic disparities to a great extent.

Falk (2007) developed a dynamic empirical model to know significance of R&D investment in long run economic growth of OECD countries using panel data set. The study provided a new evidence for R&D-economic growth relationship. The results were derived through GMM (generalized method of moments).The study investigated whether higher R&D investment push economic growth keeping investment ratio, industrial R&D intensity and human capital constant. Five yearly and ten yearly averages were used. Higher R&D investment was found positively related to GDP growth in working age populations. The results were robust in both 5-year and 10-year cases.

Goel *et al* (2008) premeditated the trends in various components of R&D and its contribution to economic growth in USA by using disaggregated data of half century. Surprisingly, USA experienced decline in defense R&D outlays and federal R&D expenditure. The non-federal R&D funding expanded sharply during the period. Interestingly, the estimation showed strong association of economic growth to federal R&D expenditure rather than non-federal R&D outlays. The economic growth posed

strong relationship to defense R&D instead of non-federal R&D. The study proposed substantial push up in defense R&D and non-federal R&D in USA for sustainable economic growth.

Kuo and Yang (2008) examined the effects of knowledge capital and technology spillover on regional economic growth in China. The results showed that R&D, capital and technology import contribute significantly to economic growth in China. The elasticity of R&D to economic growth was as large as of technology showing same contribution to economic growth of China. The study suggests the existence of R&D spillover as well as international knowledge spillovers. Tax incentives, financial assistance and R&D grants can be helpful tools to encourage research activities and innovation in economy. Similarly policies which encourage investment in education and job training were recommended for China.

Sterlacchini (2008) conducted a study to find out the association of regional disparities in R&D and higher education with regional economic growth. The data was taken from 197 regions of 12 European countries for the period 1995-2002. The empirical evidence supported positive and significant impact of knowledge, educational attainment and intensity of R&D expenditure on economic growth of European regions. The results showed that equal growth opportunities in EU regions may not be achieved by only gearing investment in public and private education. R&D expenditures were found significant only in most developed regions of EU. Therefore to reap the benefits of innovation and knowledge, public support for higher education and R&D can be effective tool. The study concluded that weak relationship between public universities and business firms may be one of the most important reasons keeping European Union (EU) regions away from reaping the fruits of R&D and higher education.

Jin (2009) analyzed the causal relationship between rising research productivity and economic growth in five Asian countries by using Granger causality framework. The relationship was found bidirectional in Hong Kong. Hong Kong is small open economy offering numerous kinds of services and tertiary education may have direct and immediate

effect on services in management and other sectors. In Japan, the relationship was unidirectional as from economic growth to Research and productivity. In Korea and Taiwan, research productivity caused economic growth during the study period. Singapore with a small number of higher education institutions has limited number of publications and that the reason that research-economic growth relationship is not significant.

Barro and Sala-i-Martin (2004) thinks the work of Adam Smith, David Ricardo and Alfred Marshal provide basis for theory of economic growth in the form concepts of consumption, competition, diminishing returns and human capital.

2.5 Human Capital and Physical Capital

Bazo and Rosina (2008) analyzed the effects of investment in human capital on Physical capital in Spanish economy during 1980-2000. The study used the methodology based on duality theory. The study suggested that the methodology based on duality theory make it possible to find out direct and indirect effects of human capital on economic growth as compared to traditional approaches, which introduce human capital as input in production function. The results showed the direct effects of Spanish worker's education on their productivity. Each additional year of worker's education brought 19% increase in stock of physical capital in Spanish economy during the past two decades. Returns to physical capital would have been much lower in case of lower investment in human capital. The study concluded that improvement in human capital accumulation makes investment in physical capital more attractive as higher skills of workers.

Siddiqui (2009) used panel data of sixty four countries for the years 1996 and 2004 to explore the priority of expenditure in physical capital and expenditure on human development strategies. The study used Ordinary Least Squares (OLS), Two Stage Least Squares (TSLS) and dummy variable approach, fixed and random effect approaches for estimation. The empirical results for different regions were different. Random effect results show variation in human development strategies across individual countries. The

study concluded that productive expenditure is prioritized in most cases in human development strategies. The study suggested on the basis of empirical results that Pakistan should focus on investment in physical capital instead of education and health to achieve the desired status in the region as well as in the world.

2.6 The Role of Institutions in Economic Growth

Street (1987) introduced intuitionist theory of economic development based on general body of Institutional theory. This theory considers poor performance of existing system of institutions and less utilization of existing knowledge and skills as major obstacles in economic growth of third world economies. The widening technological gap between poor and advanced countries is also hindering growth in developing countries. The theory considers proper planning for improvement of social, cultural and educational institutions and comprehensive strategy for domestic scientific and technological development crucial for third world countries to cover the gap and achieve the desired level of economic growth.

Acemaglu *et al* (2003) stated that major reason for higher level of instability Lower Developed Countries (LDCs) are unsustainable macroeconomic policies and weak institutional set up during post-war period. The cross-countries differences in instability are due to institutional performance. Weak institutions lead to economic instability. There is strong link between institutions and volatility as well as institutions and economic growth. The study however did not identify the channel through which institutional weakness lead to economic instability.

Conceicao *et al* (2003) analyzed the role of infrastructure and institutions in development of social capital which leads to economic growth using Portuguese data from within European Union. The study attempted to build a relationship between learning and social capital for achievement of knowledge based growth. The role of newly developed as well as old institutions was analyzed in this study. The society provides applicants to education system and gets output in form of graduates.

Universities link society and economy. The study concluded that institutions and infrastructure play an important role in enhancing the stock of social and human capital. The study therefore, suggested re-examining the role of institutions to develop a diversified system to achieve desired social and economic targets.

Knab and Christina (2005) explored the role of quality of education, institutions and cross-country differences in human capital accumulation. Quality of education was measured by pupil-teacher ratio. Pupil-teacher ratio is associated with capital per worker and the relationship is stronger in developed countries as compared to developing countries. Expenditure on education showed similar impact on human capital accumulation in most of countries. Similarly average years of schooling also showed significant results. The study concluded that the quality of educational institutions, average years of schooling and expenditure on education affect human capital accumulation in most of countries.

Butkiewicz and Halit (2006) investigated the role of institutions in past empirical growth studies. The study used Three Stage Least Squares (3SLS) Method for estimation. The study explored unlike other studies the impact of democracy in economic growth. The previous studies insisted the rule of law but democratic institutions showed no effect on economic growth in these studies. The study found that both play an important role in economic growth. Democratic institutions play a significant role especially in the economic growth of the developing countries. The developing nations mostly benefit from developed political system and the institutions established under such system. The contribution of such institutions in upholding economic growth cannot be overruled.

Dias and John (2006) developed a model to find the role of institutions and entrepreneurs in human capital accumulation, which leads to structural transformation. Educated entrepreneurs encourage their employs to invest in their own education in order to improve their career. The model shows that efficient institutional set up provides sufficient number of entrepreneurs, enhanced demand for human capital and faster structural transformation. Empirical evidence from Brazil showed entrepreneurs

instrumental in raising the educational achievement of workers. Educational subsidies proved helpful but not powerful tool in this process. The study suggested that provision of public education supported by institutional reforms.

Khalil *et al* (2007) examined the significance of institutions in overall development of OECD countries using a fixed-effects panel model. It was concluded that both legal and economic environment can explain economic growth. The study recommended economic freedom and enforcement of strong property rights to create environment for sustainable economic growth.

Qayyum *et al* (2008) investigated the constraints in economic growth of Pakistan. Major constraints identified were government's failure and institutional shortcomings. The educational institutions do not furnish good quality of labour force and legal institutions do not provide protection to lender institutions against the loan defaulters. Educational and legal institutions were found responsible for low quality of labour and financial markets. Innovation which is essential for a growing economy has been very low in Pakistan due lack of competitive environment. It was suggested to improve the state of governance and institutions to achieve sustained economic growth.

2.7 Human Capital and Labour Force Participation

Bound *et al* (1999) worked on relationship between health status and labour force participation at older stage of life. The aim was how health shocks at various times bring changes in labour force participation in form of exit, job change or other form. The model focused on existing as well as lagged values of health in order to examine the effects of declining health on labour force participation or labour force behaviour. The results show that health is equally important determinant for both male and female labour force participation. Withdrawal from work is result of declining health conditions. About half of labour at older age exit work due to poor health and those who continue working apply or try to apply for disability insurance.

Jacobsen (1999) explored the trends in United states labour force participation of both sexes, male and female. The study found that women participation rate increased from 18% in 1890 to 60% in 1997. The high female labour participation brought about a change in the structure of the socio-economic life of the Americans. The study concluded that major causes of increase in female labour participation rate was due to increase in over all demand for labour, demand for women labour force in some specialized professions, increase in women education, changes in family composition and fall in male wages. The male participation fell due to change in sectoral demand for labour and increasing participation of female.

Pelkowski and Mark (2004) examined the effects of health problems on labour force. The effects on employment, working hours and wages were taken. The impacts of transitory and eternal diseases were estimated by using Ordinary Least Square (OLS) and fixed effects methods. Other variables of study were education, marital status and race of labour force. The results show that health problems affect male and female labour force variously. Current permanent health evils negatively affect average hourly wages of labour force. Women are affected worsely as compared to male by permanent health problems. Temporary health hazards showed modest impact on wages or working hours of labour force. The undesirable effects of permanent health conditions are at top when male labour force is in 40s and female are in 30s.

Lin (2004) divided higher education in four disciplines in Taiwan to examine the effect of higher education on three sectors of economy during the period 1965-2000. The higher education was divided into humanities, Science, social sciences and education and treated as factor of production. International degree holders were not included in the study. The results show that three out of four disciplines have positive and significant effect on output level in Taiwan during the study period. The results show that one percent increase in higher education brings 0.19% increase in real output. Various forms of higher education showed various types of effects on real output in the study area. The humanities didn't fit the labour force need and natural sciences played most important role in economic growth.

Cai (2010) used simultaneous equation model to analyze the health-labour force participation relationship. The two stage and full information maximum likelihood methods were used for estimation. The study confirmed the positive and significant impact of health on male and female labour force participation. The reverse effects were found different for both male and female labour force. Labour force status reverse effects are negative and significant in case of male labour but positive and weakly significant for female. The reverse effects in case of male reject the common view that the labour which is out of labour force may overstate the health conditions to justify their nonparticipation. The study rejected the ergogeneity hypothesis on health.

2.8 Does Health affect Education?

Wolfe (1985) used simultaneous equation model to find the impact of poor health on school outcomes in New York. The data was collected from a sample of ill school age children and well children. The techniques of Ordinary Least Squares (OLS), Two Stage Least Squares (TSLS) and Three Stage Least Squares (3 SLS) were used. The study results show that students with chronic health diseases find problems in physical adjustment and peer communication which affects their school outcome. Those children with ordinary diseases find no problem in physical activities and do as normal children do. Special classes and tutoring have positive affect on school achievement. Health conditions which are opposed by doctor affect school attendance. The study suggested specific differences programmes to improve the process of education of those children who are facing such problems.

Adams (2002) examined the interrelationship of education and health in elderly persons controlling the individual and family characteristics using the OLS and TSLS methods in USA. The sample was restricted to US born persons of ages between 51 years and 61 years. The OLS results showed positive effect of educational attainment on older people. This effect is stronger in women as compared to men. The TSLS results also show similar effects independent of omitted variables. Most of the estimates are positive

and significant at 10% level of significance. The estimates which are not significant are also positive.

McMahan (1998) extended the endogenous growth theory to find the association of levels of enrollment and public as well as private expenditures on human capital with the economic growth in fastly growing economies in east Asia. The study also investigated the role of education in physical capital formation in the study area. The study finds the impact of huge initial investments in human and physical capitals highly significant in explaining economic growth in the study region. The initial investments in secondary education and public investment in secondary education provide favourable climate for investment in physical capital. The study took into account the effects of initial per capita income (PCI) and income growth on secondary enrollments. Initial primary enrollment was also found significant. Universalization of primary education has already been attained in East Asian economies. Higher education enrollment was not found as important means of economic growth. The study suggested expenditures on secondary and higher education along with universalization of primary education.

Vuori *et al* (2008) developed a Working Life Group Method to find whether a single method can promote the transition of pupils from basic education to secondary or from secondary to vocational education and improve their mental health for further studies. It also aimed to find a method which may prepare them to meet challenges of rest of their life. Data was collected from a sample of 1034 students. Group method was found beneficial for the students with depression and learning difficulties either. The intervention decreased the symptoms of depression. The study found the method developed helpful especially for those who need guidance. The study further research to find the impact of group method on other levels of education.

Berger and J. Paul (1989) used traditional models showing schooling-health relationships to find reasons of positive relationship of schooling to good health. The models used four different measures for health including disability, functional limitation, systolic and diastolic blood pressures. The results show that major reason for the

observed education-health correlation is direct effect of schooling on efficiency of producing health. The study suggested education programmes aimed at public awareness about health in order to improve the overall health of society.

Summary:

This chapter reviewed the theoretical and empirical literature concerning the human capital, its different forms, educational institutions and economic growth. The chapters explained the initial theories of economic growth, the exogenous and endogenous growth theories in detail. The concept and studies relevant to the Total Factor Productivity are also explained which are basics of economic growth studies. The review of literature shows that there are many determinants of economic growth. Apart from the traditional factors of production, capital and labour, human capital became an integral part of economic growth literature in recent decades.

The review of the literature shows that human capital has been used in different forms. The literature regarding the human capital in form of education is rich. There are also studies relevant to health and economic growth nexus. Vary few studies have used the health and education both as human capital in economic growth literature. Recently, a new source of growth has been identified known as Research and development (R&D). A number of studies in developed countries have used R&D as determinants of economic growth but such examples are rare especially in the study area.

Interestingly, no study has so far used all forms of the human capital known as Education, health and R&D as determinates of economic in the study area. The studies relevant to R&D-Economic growth relationship are rare even in many developing countries. The sensitivity study of Total Factor Productivity (TFP) seems nowhere in the empirical economic growth literature of Pakistan. This has created some gap in economic growth research. The present study is being conducted to bridge the gap. It will explain the past and existing status of human capital and economic growth in Pakistan, have a very comprehensive sensitivity analysis of TFP in Pakistan, Compare the contribution of

TFP to economic growth in Pakistan to seven Asian economies, analyze the human capital-economic growth nexus during 1971-2008 in Pakistan and suggest some policy implication on the basis of the results of the study.

Chapter 3

AN OVERVIEW OF HUMAN CAPITAL AND ECONOMIC GROWTH IN PAKISTAN'S ECONOMY

3.1 Introduction

This chapter consists of a meticulous view of human capital and economic growth history, and existing situation in Pakistan. This will provide sound basis for exploring the long run human capital-economic growth nexus. A detailed profile of economic growth, education, health, Research and Development (R&D), and institutions promoting human capital in Pakistan, will enable us to identify the strengths and weaknesses of Pakistan economy, which will be beneficial in perspective planning.

Pakistan emerged as an independent state on the world map on 14th august 1947. Its total area is 796096 Square kilometers. It has four provinces and an autonomous state Azad jamu and Kashmir. The Federally Administered Tribal Area (FATA), which consists of seven agencies, is also its part. The provinces are Punjab, Khyber Pakhtunkhwa (previously N.W.F.P), Sindh and Balochistan. Punjab is the most populous province and Balochistan is the least populous province due to its huge area and harsh environment. Balochistan is the biggest province area wise. Islamabad is the capital of Pakistan, which is located on Potohar Plateau. The Political system in Pakistan is parliamentary system with Prime Minister as Head of Government and President as Head of state. Poverty, unemployment, inflation, unequal distribution of wealth, illiteracy and overpopulation are major challenges for economy of Pakistan.

3.2 Population of Pakistan

The total population of Pakistan was 169.9 million in June 2009 with an annual growth rate of 2.05 % (Economic Survey of Pakistan, 2009-10). It is the 6th most

populous country of the world. The population projections show that if the population continued to grow at the current pace, Pakistan will become the 4th most populous nation of the world in 2050. This means that in the upcoming years still Pakistan will have an increase in mouths to feed, families to house, more children to be educated and more labour to be utilized. The median age in Pakistan is 20 years. Out of the total population, 104 million of its residents still have to cross the age of 30 years. The urban population in 1998 was 32.5%, which increased gradually to 36 percent of total population. This shows a rising trend of urbanization.

Table 3.1 Province wise Distribution of Population of Pakistan

Year	Population (Millions)						
	Pakistan	Punjab	Sindh	Khyber Pukhtunkhwa	Baluchistan	FATA	Islamabad
1951	33.74	20.54	6.05	4.56	1.17	1.33	.095
1961	42.88	25.46	8.36	5.73	1.35	1.85	0.11
1972	65.31	37.61	14.16	8.39	2.43	2.49	0.24
1981	84.25	47.29	19.03	11.06	4.33	2.20	0.34
1998	132.35	73.62	30.44	17.73	6.57	3.18	0.81

Source: Population Census Organization of Pakistan

The table shows that Population of Pakistan was only 33.74 million in 1951. Punjab was the most populated province with a population of 20.54 million. Balochistan was the least populated province with a population of 1.17 million. The population increased with different annual rates from 1951 to 1981, when it became 84.25 million with again Punjab as the most populous province. It became 132.35 million in 1998. Out of the total population in 1998, 73.6 million was living in Punjab, 30.44 million in Sindh, 17.73 million in Khyber Pakhtunkhwa and 6.73 million in Baluchistan. The population of FATA increased from 1.33 million in 1951 to 3.18 million in 1998. Similarly, the same trend prevailed in Islamabad and its population increased manifold. The population of Islamabad became more than doubled during 1981-98. Due to increasing population, population density in Pakistan also showed an upward trend during the study period. The

population density was 78.6 in 1971, which moved upward to 107.32 in 1981 (WDI⁴, 2010). A comparison of population density of Pakistan with the neighbouring countries is shown in table 3.2.

Table 3.2 Population Density of Pakistan and other Asian Countries

Country	Population Density			
	1980	1990	2000	2008
Pakistan	107	140	179	215
India	236	286	342	383
China	105	122	135	142
Iran	24	33	39	44
Nepal	105	134	170	201
Bangladesh	694	888	1081	1229
Srilanka	231	265	290	312

Source: World Development Indicators (2010)

The table shows a comparison of population density of Pakistan with India, China, Iran, Nepal, Bangladesh and Srilanka in 1980, 1990, 2000 and 2008. It is evident from the table that in the year 1980, the population density of Bangladesh was greater than all other countries in the above given list and India was the second highest densely populated country, while Pakistan was the fourth most populated country. The population density of Bangladesh, India, Srilanka and Pakistan was 694, 236, 231 and 107 in 1980. With the passage of time, the population density in all the countries increased and Bangladesh dominated all the countries in 1990 and 2000. The same pattern of population density prevailed during till 2008 and Bangladesh remained the most densely populated country of the world with a very high population density of 1229 and Iran remained least densely populated country as compared to the countries in the list. Pakistan with

⁴ World Development Indicators (Various Issues)

population density of 215 maintained its fourth position in 2008 like 1980, 1990 and 2000. This shows the increasing tendency of population growth in Pakistan.

3.3 Economic growth in Pakistan

The economic growth performance of Pakistan remained impressive during last few decades. Agriculture, industry and services sectors have been and are still major contributors to Gross Domestic Product (GDP) growth. However the contribution of agricultural sector is decreasing and the share of industry is increasing. The share of agriculture to GDP, which was 53.2 % in 1950, fell down to 30.6% in 1980 and 23.3% in 2005 (State Bank of Pakistan, 2005). Industry which provided 9.6% of GDP increased its share to 22.6%. Pakistan economy grew at the rate of 2 % during 2008-9 (Economic Survey of Pakistan, 2008-9).

The following table shows the average GDP growth profile of Pakistan.

Table 3.3 Growth Performance of Pakistan

Period	Average GDP growth (percentage)
1951-1960	3.14
1961-1970	6.8
1971-1980	4.6
1981-1990	6.15
1991-2000	4.41
2001-2008	4.68

Source: State Bank of Pakistan (2005)

The table shows, when Pakistan came into being, its growth rate remained 3.14 % in its first decade. The low growth performance was due to agricultural and industrial backwardness, low exports and developing trade relations. The growth performance remained sustained during 1961-1970 but again fell to 4.6% in 1970s. The biggest tragedy of Pakistan happened during this decade when Pakistan disintegrated into two

independent states, Pakistan and Bangladesh. The period 1991-2000 was a comparatively relaxed period in Pakistan growth history and its economy grew at 6.15 % during this period. During this period Pakistan experienced democracy from 1991 to 1998 and military government in the remaining part of the decade. The economic growth rate remained 4.68% during the period 2001-2008. Pakistan annual growth performance has been shown in the following table with comparison of growth performance of neighboring countries.

Table 3.4 Comparison of GDP Growth Rate of Pakistan

Year	GDP Growth rate (Annual %)				Year	GDP Growth rate (Annual %)			
	Pakistan	India	China	Bangladesh		Pakistan	India	China	Bangladesh
1971		2	7	-5	1990	4	6	4	6
1972	1	-1	4	-14	1991	5	1	9	3
1973	7	3	8	3	1992	8	5	14	5
1974	4	1	2	10	1993	2	5	14	5
1975	4	9	9	-4	1994	4	7	13	4
1976	5	2	-2	6	1995	5	8	11	5
1977	4	7	8	3	1996	5	8	10	5
1978	8	6	12	7	1997	1	4	9	5
1979	4	-5	8	5	1998	3	6	8	5
1980	10	7	8	1	1999	4	7	8	5
1981	8	6	5	4	2000	4	4	8	6
1982	7	3	9	2	2001	2	5	8	5
1983	7	7	11	4	2002	3	4	9	4
1984	5	4	15	5	2003	5	8	10	5
1985	8	5	14	3	2004	7	8	10	6
1986	6	5	9	4	2005	8	9	11	6
1987	6	4	12	4	2006	6	9	13	7
1988	8	10	11	2	2007	6	10	14	6
1989	5	6	4	3	2008	2	5	10	6

Source: World Development Indicators (WDI) 2010

The table shows that during the period 1971-79, china achieved the highest GDP growth rate of 12% in 1978 as compared to Pakistan, India and Bangladesh. Bangladesh got the GDP growth rate of 10% in 1974 while the highest annual growth rate of Pakistan remained 8% in the year 1978. China, maintained its position during 1980s. It surpassed the neighboring countries in achievement of growth rate. The highest growth rate of china remained 15% in 1984 while the highest growth rate of India and Pakistan remained 10%. Pakistan achieved it in 1980 and India in 1988. Similarly, in the period 1990-1999, the growth rate of china remained highest as compared to Pakistan, India and Bangladesh. It was 14% each in the year1992 and 1993. The highest growth rate of Pakistan remained 8% in 1992 and of India 8% in 1994 and 1995. However, the economy of Bangladesh grew within the range of 3% to 6% during 1990s. During the period 2000-2008, the highest rate of china and India remained 14% and 10% respectively in year 2007. Pakistan achieved a growth rate of 8% in 2005 and Bangladesh attained growth rate of 7% in 2006.

Table 3.5 The Contribution of Different Sector in GDP

Year	Agriculture	Industry	Services
1971	35.3	23.3	41.4
1981	30.8	22.6	46.6
1991	25.7	25.8	48.8
2001	24.4	23.1	52.5
2005	21.6	25.1	53.5

Source: State Bank of Pakistan (2005)

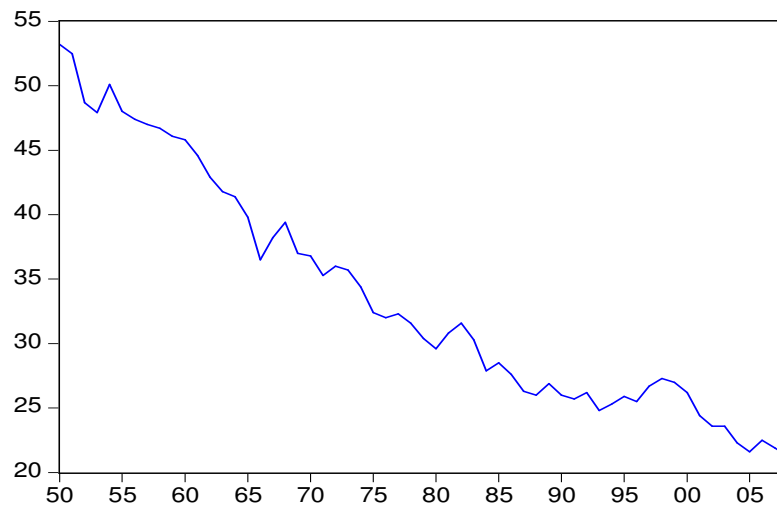
The three major contributors to GDP in Pakistan are agriculture, industry and services sectors. Their contribution is shown in table 3.5. The contribution of agriculture includes the addition made by major as well as minor crops, fishery, livestock and forestry. The contribution of industry consists of large and small scale industry, mining, construction, and electricity and gas distribution. In case of services transport, storage, communication, wholesale and retail business, finance and insurance, public

administration and defense, and community services have been undertaken for contribution to GDP. At the beginning the study period, agriculture added 35.3% to GDP and services sector contributed 41.4% to GDP. The share of industrial sector was little bit smaller than these two sectors. In 1981, the share of both agriculture and industry fell down but the share of the services sector increased to 46.6%.

The share of agriculture sector showed continuous decline from 1971 to 2005 as shown in the table 3.5. The behaviour of the industry remained mixed. It showed ups and down. It failed to achieve remarkable increase. The services sector showed consistent growth and its contribution increased from 41.4% to 53.5% during the study period.

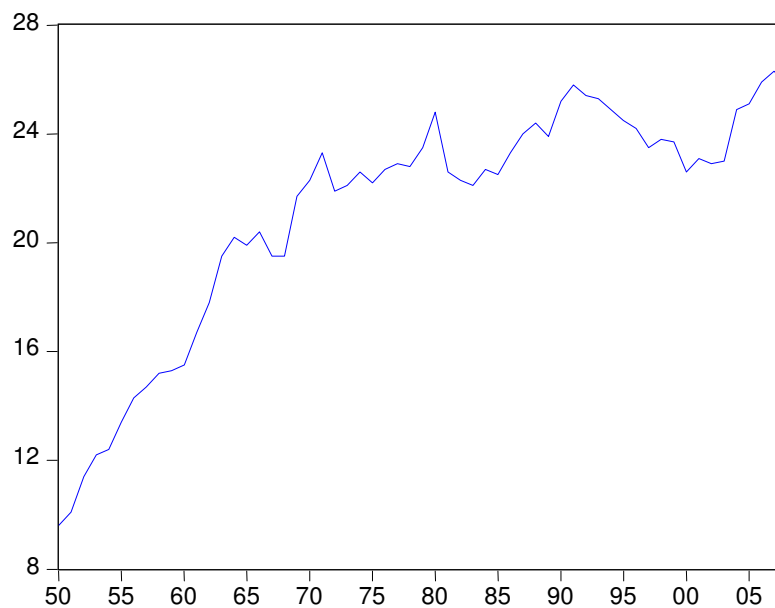
The contribution of agriculture, industry and services also depicts from figures 3.1-3.3

Figure 3.1: Percentage Share of agriculture in GDP of Pakistan 1950-2008



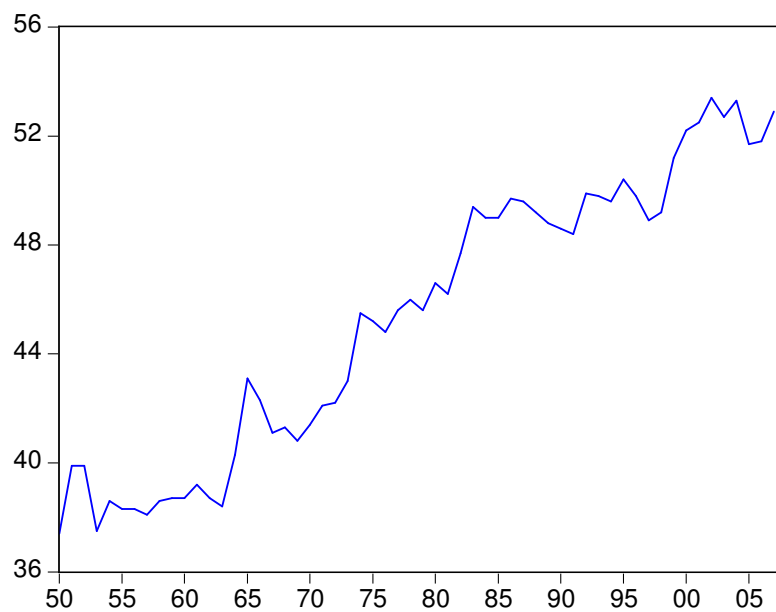
Source: Author's Computation from the data taken from State Bank of Pakistan (2005)

Figure 3.2: Percentage Share of Industry in GDP of Pakistan(1950-2008)



Source: Author's Computation from the data taken from State Bank of Pakistan (2005)

Figure 3.3: Percentage Share of Services in GDP of Pakistan (1950-2008)



Source: Author's Computation from the data taken from State Bank of Pakistan (2005)

3.4 The Status of Human Capital in Pakistan

Pakistan is one among the human resources enriched countries. Its population is growing at the rate of 2.05 % per annum (Economic Survey of Pakistan, 2009-10). The huge population of Pakistan can be utilized by equipping it with skills, improving health conditions and updating their knowledge. The skilled and well trained population will play not only overarching role in the development of the country but will also insert a cross cutting impact on all aspect of life. It will also fetch a handsome foreign exchange by sending remittances if sent abroad.

This section of the chapter consists of a brief history and current status of Education, Health, and R&D in Pakistan.

3.4.1 Education

Education is the most powerful weapon to utilize the huge pool of human resources in Pakistan. Education not only improves productivity and creates awareness among the masses but also increases quality of life. It is an indispensable weapon for human resource development and a pre-requisite for social and economic growth of a country. When Pakistan came into being in 1947, it had a very low education profile but soon the need for education was felt and much has been achieved since then. Very few people at that time were able to read and write. Literacy rate, which is considered as an important tool to know the percentage of the people who can read and write in country, was very low at the time of independence. It was only 16 % in 1947. The government of Pakistan at present is leaving no stone unturned for the provision of educational facilities to its masses. The continuous efforts on part of government of Pakistan and massive campaigns for Universalization of Primary Education (UPE) and Education for All (EFA), made it possible to bring the literacy level to 57% in 2010 (Economic survey of Pakistan, 2009-10).

This section of the chapter will provide a brief profile of education including the structure of education, enrollment at all levels of education, educational institutions, literacy rate, and teachers working in public as well as private sector educational institutions.

3.4.1.1 The Structure of education in Pakistan

Education in Pakistan has been divided into different phases or stages. This consists of elementary and secondary levels of school education, college education and university education. A detailed view of the structure of education in Pakistan is given below.

3.4.1.1.a Elementary Education

The elementary education in Pakistan starts from pre-schooling stage to Grade-VIII. The elementary education comprises of two stages, primary and middle stage. The primary stage starts from grade I and ends at grade V while the Middle stage consists of grades from VI to VIII. Some of the schools called elementary or middle schools offer education from grade I to VIII but mostly education from grade I to V is offered by public sector and private sector primary schools in various parts of the country. The pre-Primary education called prep or Kachi class is mostly offered by the primary and elementary schools in Pakistan.

According to the Economic Survey of Pakistan (2008-09), there were 7.403 million students enrolled at Pre-Primary stage with ages 3-4 years. 17233231 students were enrolled in 157899 primary schools. Similarly 5365907 students were enrolled at 40837 middle schools in 2007-08.

Table 3.6 Primary School Enrollment in Pakistan

Year	Enrollment in Primary Schools of Pakistan (Thousands)			Enrollment in Middle Schools of Pakistan (Thousands)		
	Male	Female	Total	Male	Female	Total
1971	2,930	1,060	3,990	771	180	951
1976	4,170	1,549	5,719	953	294	1247
1981	3,692	1,782	5,474	1053	359	1412
1986	4,729	2,365	7,094	1394	516	1910
1991	7,162	3,475	10837	1970	842	2821
1996	8,825	5,702	14,527	2335	1270	3605
2001	10,242	6,893	17,135	2304	1455	3759
2006	10074	7710	17757	2131	2191	5322
2008	10328	8032	18360	3148	2279	5427

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (various Issues)

Table 3.6 shows that there has been consistent increase in enrollment in primary and middle schools in Pakistan. The increase in enrollment has been in both, male and female primary and middle schools. The total enrollment in primary schools increased from 2,930 thousands in 1971 to 7,162 thousands in 1991. The same further swelled to 10242 thousand in 2001 and 10328 thousands in 2008. The enrollment in female primary schools was 1060 in 1971 and it increased about 70% at the end of the decade. Similarly it doubled in middle schools during the same period. The enrollment in male schools also demonstrated a noteworthy boost in next decade. This trend persisted till the end of study period as shown in the Table 3.6.

The enrollment in middle schools also showed an upward trend during the study period. The gross enrollment in middle schools of Pakistan was 951 thousands in 1971 which tripled in next 20 years. It remained 3759 thousand in 2001 and 5427 thousands in 2008. Along with the total enrollment, both male and female enrollment at this stage showed remarkable increase. However, during 1971-1991 the increase in female

enrollment was higher than the male enrollment. Similarly, the overall increase in female enrollment at middle stage remained higher than the male enrollment which is a good omen for a transitional society like Pakistan. This was because of massive awareness regarding the benefits of education and increased access to education.

3.4.1.1.b Secondary Education

The secondary phase of education starts after grade-VIII and it consists of two classes 9th and 10th. In Pakistan, secondary education is provided by the high schools around the country. The high schools have middle and high sections. Due to this secondary schools have students from grade VIII to X. At the time of independence there were only 62,000 students enrolled in 6800 high schools of Pakistan (State Bank of Pakistan, 2005). This number increased with each passing day. The number of enrolled students crossed the figure of 365.5 thousands in 1970, 511 thousands in 1980 and 1901000 in 2004. The enrollment of students in high schools during the period 1961-2008, is given in the following table.

Table 3.7 Enrollment in High Schools

Year	Enrollment in High schools(000)		
	Male	Female	Total
1961	149	31	180
1971	322	83	405
1981	412	137	549
1991	790	304	1094
2001	997	659	1656
2008	1485	1071	2556

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (Various issues)

It is clear from the table that both male as well as female participation at secondary level increased during the study period. In 1961 the total, male and female

enrollment at secondary level was 180,000, 149,000 and 180,000 respectively. The participation made by all these three doubled in 10 years. The female participation tripled in 1981 and manifold till the end of the study period. The male enrollment also increased many times as compared to the beginning of the study period.

3.4.1.1.c College Education

Intermediate and degree level education is being offered by colleges inside Pakistan. The intermediate level education is also provided by some of schools called Government Higher Secondary Schools (GHSS) having a network spread over all provinces. The college level starts after 10 years of education and its terminal stage is 14 years of education. Interestingly, in some cases 16 years of education is provided by the colleges as some of the colleges are affiliated with universities and award degrees also. Now the 16 year education in all degree colleges is being started which will replace the traditional 2 year BA/B.Sc.

The college profile of Pakistan can be explained with the help of Table 3.8.

Table 3.8 A Brief History of Colleges

Year	Number of Colleges	Enrollment in colleges		
		Male	Female	Total
1970-71	411	168512	53870	222382
1980-81	533	256048	109448	365496
1990-91	711	504246	251003	755249
2000-01	1268	501809	410540	912349
2008-09	4529	748565	754686	1503251

Source : State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues)

Table 3.8 shows a detailed view of the number of colleges and number of students enrolled in it. In the year 1970-71, there were 2,22, 382 students enrolled in 411 colleges of Pakistan. Out of these students 168512 were male while 53870 were female students. The number of students increased to 3, 65,496 in 1980-81, with 256048 male and 109448

female students. This shows that during a period of ten years the number of female students doubled in colleges while the male enrollment showed encouraging results.

The number of colleges raised to 711 in next decade, 1268 in 2000-01 and 4529 in 2008-09. The enrollment in 4529 colleges of Pakistan increased to 1503251 in 2008-9.

3.4.1.1.d University Education

The universities in Pakistan are major source of higher education and its growth showed dramatic expansion during the last decade. Realizing the crucial role of higher education and quality research for sustained education and economic development, the government of Pakistan dissolved University Grants Commission and established Higher Education Commission (HEC) in 2002 through a presidential Ordinance. The major objective of HEC is to strengthen the higher education with special focus on research in applied fields of science and technology within the country. It focused on development of higher education and R&D in the country and produced far-reaching results. New universities were established, existing universities were updated with huge pool of resources, the quality of education was updated and the criterion for various higher education levels is being standardized. The number of higher education institutions increased dramatically in recent decade.

There were only seven universities in Pakistan in 1970-71 which increased to 19 in 1980-81. In 2008-9, there were 124 universities in Pakistan both in public as well as private sector. Interestingly, there were only 26 universities in Pakistan a decade ago but during 2000-2009, the number increased manifold.

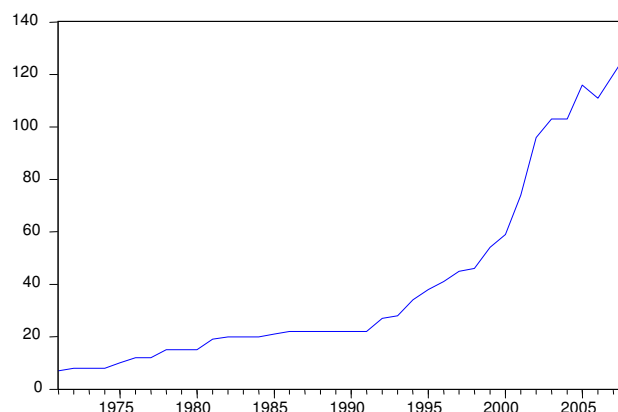
The universities in Pakistan are providing education from graduation to Ph. D level in all fields. These universities are nurseries for R&D.

Table 3.9 Number of Universities and Enrollment in Pakistan

Year	Number of Universities	Enrollment in Universities		
		Male	Female	Total
1970-71	7	13354	3703	17057
1980-81	19	35575	7113	42688
1990-91	22	50190	11667	61857
2000-01	59	174504	101770	276274
2008-09	129	447274	356233	803507

Sources: State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues)

Figure 3.4 Increase in Number of Universities in Pakistan during the period 1971-2008



Source: State Bank of Pakistan, Federal Bureau of Statistics

3.4.1.2 Literacy Rate

The literacy rate of a nation shows its concern for education. The literacy rate of most of developed countries has crossed the target of 100% mark against very low literacy rates of developing countries. Literacy rate has been defined variously in Pakistan.

A person is said to be literate if he can read a clear print in any language of Pakistan (Census Report, 1951). In 1961, it was modified and a person was declared literate if he can read a letter in any language and understands it. It was further modified in 1972 census when reading and writing of a simple letter in any language of Pakistan was set as standard for literacy. According to 1998 census a literate is “one who can read a newspaper and can write a simple letter in any language”

Pakistan started with very low literacy profile but with the passage of time, it achieved a part of its literacy rate target. The Literacy rate in Pakistan was 21% for both sexes in 1971 including 30.2% for male and 11.6% for female. The government of Pakistan failed to bring any outstanding improvement in it during the period 1972-1980. The literacy rate touched the level of 26.2 % in 1981. During 1980s, literacy rate improved by 10% reaching the level of 36% for both sexes, 46.4% for male and 24.3% for female in the year 1991 (Economic Survey of Pakistan (2001-02)).

The 50% population of Pakistan became literate by the year 2001. The literacy rate for male was 58% and for female 32% (PIHS⁵, 2001-02). Interestingly, rising trend was seen in literacy rate till 2008. The literacy rate at the end of financial year 2008-09 was 57% both sexes, 69% for male and 45 % for female. The literacy trend in Pakistan can be shown in Table 3.10.

Huge disparity has been observed in literacy rate among the various provinces of Pakistan, which show huge gaps in human capital formation in different administrative units of Pakistan. It is shown in Table 3.11.

⁵ Pakistan Integrated Household Survey, Federal Bureau of Statistics, Pakistan

Table 3.10 Literacy Trend in Pakistan

Literacy Rate (%)							
Year	Male	Female	Both sexes	Year	Male	Female	Both Sexes
1981	35.1	16	26.2	1995	52	26	39
1982	36	16.7	27.1	1996	53.4	30	42.2
1983	37	17.4	27.9	1997	54.9	31.3	43.6
1984	38.1	18.1	28.8	1998	59	31	45
1985	39.2	18.9	29.8	1999	59	35.4	47.1
1986	40.3	19.7	30.8	2000	61.3	36.8	49
1987	41.4	20.6	31.7	2001	58	32	50.5
1988	42.6	21.5	32.7	2002	63	38	50.5
1989	43.9	22.4	33.8	2003	66	41	54
1990	45.1	23.3	34.9	2004	65	40	53
1991	46.4	24.3	36	2005	65	42	54
1992	47.7	25.4	37.2	2006	67	42	55
1993	47.3	26.5	38.4	2007	69	44	56
1994	50.5	27.6	39.6	2008	69	45	57

Source: Economic Survey of Pakistan (Various Issues), State Bank of Pakistan, Pakistan Integrated Household Survey (Various Issues), Pakistan Education Statistics (Various Issues)

Table 3.11 Province wise Literacy rate in Pakistan

Year	Literacy Rate (%)				
	Pakistan	Khyber Pakhtunkhwa	Punjab	Baluchistan	Sind
1961	16.7	13.8	16.1	9.8	21.0
1972	21.7	14.5	20.7	10.1	30.2
1981	26.2	16.7	27.4	10.3	31.4
1998	41.5	32.1	43.8	30.7	43.6
2008	57.0	50	59	45	59

Source: Economic Survey of Pakistan (Various Issues)

It is evident from Table 3.11 that in 1961, there was huge variation in literacy rate of provinces. Sind was the leading province with literacy of 21 % which was double of the literacy rate of Baluchistan province. Surprisingly, within next decade this difference further increased and the literacy rate in Sind became triple as compared to Baluchistan. Similarly, during the period 1961-71, the gap between literacy rates of Punjab and Khyber Pakhtunkhwa further increased. The same pattern of literacy rates prevailed during the period 1971-81. In 1980s, the situation in all provinces improved and Baluchistan achieved the literacy rate of 30.7 as compared to 43.6 % of Sind.

3.4.1.3 Expenditures on Education

The expenditures on education by a country indicate the value, the country gives to education as compared to the other sectors of economy. The expenditures on education include the expenses which incur on provision of educational facilities in form of services as well as infrastructure.

Pakistan is one of those developing countries that spends a small percentage of their GDP on education. The expenditures on education were 1.5 % of GNP in 1970-71, which was too low for huge population of the country. With passage of time, the education expenditures were increased but regular fluctuations occurred in the same. The expenditures on education during the study period can be shown in Table 3.12

The total expenditures on education was Rs.570.1 million, which included Rs. 160.72 million for development expenditure and Rs .410.60 million for non-development expenditure. The education expenditure increased manifold during the decade and at the end of decade it was Rs.3502 million. Out of this Rs. 673 million was development expenditure and Rs. 2829 million was non-development expenditure. The education expenditure was 1.4% of Gross Domestic Product (GDP) in 1979-80.

Table.3.12 Expenditure on Education in Pakistan during the Period 1971-2008

Year	Development Expenditure	Non-Development Expenditure	Total Expenditure	Year	Development Expenditure	Non-Development Expenditure	Total Expenditure
1970-71	160.72	410.60	570.1	1990-91	4067.4	19500	23567.4
1971-72	120.41	500.4	620.81	1991-92	3860	23630	27490
1972-73	232.4	623.3	855.7	1992-93	5390	24590	29980
1973-74	312.2	841.1	1153.3	1993-94	4870	29930	34800
1974-75	522.3	1253.1	1775.4	1994-95	5230	37770	4300 0
1975-76	715.6	1560.2	2275.4	1995-96	2585	39610	42195
1976-77	573.5	2726.1	2299.6	1996-97	1968	40536	42504
1977-78	655.8	2309.7	2965.5	1997-98	2984	46100	49084
1978-79	658.8	2453.4	3112.2	1998-99	2427	46979	49406
1979-80	673.1	2829.6	3502.7	1999-00	2430	51572	54002
1980-81	973.1	3218.5	4191.6	2000-01	1966	54396	56362
1981-82	1380.7	3620.6	5001.3	2001-02	8770	64975	73745
1982-83	1460.2	4694.3	6154.5	2002-03	10400	79500	89900
1983-84	1548.6	5974.3	7522.9	2003-04	29900	94300	124200
1984-85	1975.6	7375.2	9350.7	2004-05	33400	106600	140000
1985-86	2244.2	8467.00	10711.2	2005-06	41900	128900	170800
1986-87	3669.3	11217.8	14887.1	2006-07	56600	159900	216500
1987-88	3881.6	13250.7	17132.3	2007-08	63500	190200	253700
1988-89	3981.8	15501.0	19482.8	2008-09	200.4	75.1	275.5
1989-90	4644.8	16239.6	20884.4	-	-	-	-

Source: Economic Survey of Pakistan (Various Issues)

Table 3.13 Education Expenditure as Percentage of GDP

Year	Education Expenditure (Percentage of GDP)	Year	Education Expenditure (Percentage of GDP)	Year	Education Expenditure (Percentage of GDP)
1970-1	1.5%	1983-4	1.6%	1996-7	2.62%
1971-2	1.3%	1984-5	1.8%	1997-8	2.34%
1972-3	1.3%	1985-6	1.9%	1998-9	2.40%
1973-4	1.3%	1986-7	2.4%	1999-0	1.7%
1974-5	1.6%	1987-8	2.4%	2000-1	1.6%
1975-6	1.7%	1988-9	2.4%	2001-2	2.0%
1976-7	1.5%	1989-0	2.3%	2002-3	1.86%
1977-8	1.6%	1990-1	2.3%	2003-4	2.2%
1978-9	1.5%	1991	2.2%	2004-5	2.15%
1979-0	1.4%	1992	2.2%	2005-6	2.24%
1980-1	1.4%	1993-4	2.2%	2006-7	2.5%
1981-2	1.4%	1994-5	2.4%	2007-8	2.47%
1982-3	1.5%	1995-6	2.00%	2008-9	2.10%

Source: Economic Survey of Pakistan (Various Issues)

The upward tendency in education expenditure continued during 1980s. The government of Pakistan spent Rs. 23567.4 million on provision of educational infrastructure and services during the year 1990-91 enhancing the education expenditure as a percentage of GDP from 1.4% in 1979-80 to 2.3 % in 1990-91.

The education expenditures as a percentage of GDP again fell to 2% in 2001-02. The development expenditure was increased to Rs. 216.5 billion in 2006-07 and Rs. 275.5 billion in 2008-09.

3.4.1.4 Teaching Staff

The quantity and quality of education depends on the availability and professionalism of teaching staff. The number of teachers and their education level plays a significant role in improvement of educational quality.

There were 169100 teachers in schools scattered within the country in 1970-71. There were 10673 teachers of different cadres in colleges of Pakistan and 1571 teachers in Pakistani universities in 1970-71. The number of school teachers doubled in next 10 years. Similarly, the number of university teachers increased significantly during the same period.

There were 506900 school teachers and 25336 college teachers in Pakistan in the year 1989-90. The number of university teachers increased to 5000 at the end of 1990s increasing the total number of teacher to 533754 in Pakistan. The total number of teachers increased to 921566 in the year 2001-02, which included 878900 school teachers, 36678 college teachers and 5988 university teachers.

The government of Pakistan continued its policy of continuous efforts for the improvement of the quality of education in 2000s. Along with the provision of other educational facilities, the labor force in education was also increased. The increase in teaching staff in educational institutions decreased the student-teacher ratio, which can result in improvement in quality of education.

The total teaching staff in educational institutions of Pakistan in the year 2007-08 was 1276391 including 1133600, 95898 and 46893 school, college and university teachers respectively. The number of teachers in educational institutions of different levels is given in the following table.

Table 3.14 Teaching Staff in Educational Institutions of Pakistan

Year	Number of teacher/faculty members of all cadres			
	School	College	University	Total
1971-2	181900	10192	1649	193741
1975	235300	14400	2726	252426
1980	271300	16096	3357	304973
1985	323500	19424	3740	346664
1990	521800	25336	4744	551880
1995	585300	32354	5417	623071
2000	878900	36678	5988	921566
2005	978900	70060	37509	1086469
2008	1225100	97360	50825	1373285

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (various Issues)

3.4.2 Health

Health plays an important role in human development. Healthy population is an asset for a country because it pushes up the efficiency of labour. Good health helps in human capital accumulation and is itself an important form of human capital. Poor health affects school enrollment, employment level and labour force participation rate which negatively affects the economic growth.

Pakistan, like other developing countries, has a large number of health problems like limited access to health facilities, poor sanitation, lower life expectancy, malnutrition, high infant mortality rate and pitiable living conditions. Despite efficient efforts on part of government malnutrition is still a major problem which is especially affecting the health of women, girls and new born babies. The mortality rate both infant and maternal is still very high as compared to the economies with similar level of income. A number of untimely deaths of preventable diseases can be reduced through proper health planning. The new diseases like cancer and HIV/AIDS also needs special attention in Pakistan. The increasing number of cases of these diseases is alarming. The government of Pakistan is involved in making serious efforts for achieving the Millennium Development Goals (MDGs) on health set by the United Nations and Global Community (Economic Survey of Pakistan, 2008-9).

This section of the present chapter explains the present and past health conditions in Pakistan and the government efforts in health sector in Pakistan.

3.4.2.1 Health Expenditure

Health sector in Pakistan is mostly financed by the public sector. Pakistan is spending about 0.5 % of its GNP on health (Economic Survey of Pakistan,2008-09). The public sector finances health education and training in Pakistan. Similarly provision of health infrastructure is also a key responsibility of public sector in Pakistan. Pakistan experienced fluctuations in health expenditure during its history. The health expenditure

which was on average 0.492 % of GDP during the period 1961-65 increased to 0.762% of GDP during the period 1981-85. The health expenditure as a percentage of GDP remained higher during the period 1986-90 which was on average 1.054 % of GDP per annum (State Bank of Pakistan, 2005). It again fell to 0.54% of GDP during the period 2006-08. The health expenditure as percentage of GDP, average annual Health expenditure and per capita expenditure of Pakistan is given in the following table.

Table 3.15 Health Expenditure in Pakistan

Period	Health expenditure as percentage of GDP	Health Expenditure(Annual) (Million Rupees)	Per Capita Health Expenditure
1961-65	0.492	107.14	2.32
1965-70	0.416	149.872	2.706
1971-75	0.478	341.128	5.26
1975-80	0.712	1125.80	15.078
1981-85	0.762	2559.99	29.036
1985-90	1.054	6375.54	62.68
1990-95	0.788	9703.40	83.6
1995-2000	0.780	9037.47	145.538
2001-2005	0.672	28854.70	-
2006-2008	0.54	34800.00	-

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues)

The annual expenditure on health showed upward trend in the study period. The annual health expenditure on average remained Rs.107.14 million during 1961-65. It increased several times during the period 1981-85. It got surprising increased in 2000s. It was Rs.28854.70 pr annum during 2001-05 and Rs.34800 in period 2006-08.

It is evident from the table that the Per Capita Health Expenditure (PCHE) remained very low during 1960s. The PCHE was Rs. 2.32 in the period 1961-65 and Rs.2.706 in the period 1966-70. It increased to Rs. 5.26 during 1976-80 and almost doubled in next five years. It was again doubled during the period 1986-90 when it was increased from Rs.29.04 to Rs.62.68. The Per Capita Health Expenditure remained good as compared to previous period.

3.4.2.2 Demographic Indicators of Pakistan

The demographic indicators showed improvement during the study period. The demographic indicators include Total Fertility Rate (TFR), Infant Mortality Rate (IMR), Birth Rate and Crude Death Rate (CDR). Pakistan is one of the developing economies with very high Total Fertility Rate (TFR). It was 7.0 in 1972. TFR fluctuated in the range of 6.5 to 7.0 during 1970s. Similarly, the same remained at the level of 7.0 even after a decade in 1981. It stucked to the figure of 7.0 in early 1980s but declined to 6.4 in 1989 (WDI, 2010). The TFR remained on average 5.4 during the period 1991-99 (State Bank of Pakistan, 2005). The continuous efforts on part of government of Pakistan and Non-Governmental organizations brought it to 3.9 in 2003 and 3.8 in 2005 (SIP, 2007). It further declined to 3.0 in 2008 (Economic survey of Pakistan, 2008-09).

Infant Mortality Rate (IMR) is another important demographic factor, which shows the health status of a country. Pakistan faced huge vacillations in IMR during 1970s. The IMR, which was 106 in 1971 increased to 123 in 1975 surprisingly (WDI, 2010& State Bank of Pakistan (2005). This shows negligence of public health sector in early 1970s. The government of Pakistan had striven hard to drag it to 117 in 1980 besides upward and downward trends in late 1970s. It remained in triple digits till 1994 but dropped to double digit in 1995. Table 3.16 shows a view of Total Fertility Rate, Infant Mortality Rate, Crude Birth Rate and Crude death Rate in Pakistan.

Table 3.16 Demographic Indicators of Pakistan

Year	Total Fertility Rate(TFR)	Infant Mortality Rate	Birth Rate(Crude)	Death Rate(Crude)
1971	7.0	106	44	16
1975	7.0	123	43	14
1980	7.0	117	42	13
1985	7.0	116	43.3	11.5
1990	6.2	105	40.6	10.6
1995	5.6	93	36.6	9.4
2000	4.3	80	30.2	8.3
2005	2.8	77	26.1	8.2
2008	3.0	70.2	25	7.7

Sources: State Bank of Pakistan (2005), World development Indicators (2010) and Social Indicators of Pakistan (2007)

The Economic Survey of Pakistan (2008-09) shows that the Crude Birth Rate (CBR) in Pakistan is 25 and Crude Death Rate (CDR) is 7.7. Both of these demographic indicators were very high in 1970s. The CBR and CDR were 44 and 16 respectively in 1971. No significant change was seen in these indicators in till late 1970s. However at the CBR and CDR fell to 40.6 and 10.6 in 1990. During 1990s, continuous downward trend was seen in both of these indicators. This improvement in the aforementioned indicators was increased due to health expenditure, policy measures on part of government and increased awareness of masses regarding health measures. Both of these indicators continued their downward trend 2000s. The CDR which was 8.3 in 2000 further fell to 7.7 in 2008. Similarly the CDR declined from 30.2 in early 2000 to 25 in 2008.

3.4.2.3 Life Expectancy

Life expectancy is an important health indicator and it is used as measure for human development. It is an integral part of Human Development Index (HDI) calculated and issued by the United Nations Development Programme (UNDP) on annual basis.

The human development history of Pakistan has not been appreciable. The Human Development Index (HDI) was 0.551 with Pakistan at 136th position in the world. This shows poor health and education facilities in it. Due to poor health conditions the life expectancy in Pakistan remained very low throughout the history. The life expectancy in Pakistan during different years has been shown in the table 3.17.

The life expectancy at birth in Pakistan was 49 years for both sexes, 50 years for male and 49 years for female in 1960. It increased to 52, 53 and 51 years for both sexes, male and female respectively in 1965. It continued upward movement during 1960s and 1970s. The life expectancy crossed the figure of 60 years in 1984 when it became 60.9 years for both sexes, 60.5 years for male and 61.4 years for female in Pakistan. It moved up and down within the range of 60 years and years till 2000. According to Economic Survey of Pakistan (2008-09), life expectancy in Pakistan is 67 years for both sexes, 67 years for female and 66 for male in Pakistan.

In 1971, the Life Expectancy in Pakistan was better than its neighbouring countries India, Iran and Afghanistan but lesser than china. The life expectancy was also 55 years, which was lesser than 63, 63, 59 and 63 years of Srilanka, Uzbekistan, Turkmenistan and China respectively. Most of these countries have been able by 2000 to improve the health conditions and reducing the death rate. This lead to rise in life expectancy of both sexes, male and female in almost all of countries but the improvement in life expectancy of Iran, Bangladesh and Nepal was remarkable in 2001. The life expectancy in Pakistan increased from 55 years in 1971 to 67 years in 2008 as compared to that of Iran from 54 to 71 years and of Bangladesh from 44 to 67 years.

Table 3.17 Life Expectancy in Pakistan

Year	Life Expectancy at birth in years (Both Sexes)	Life Expectancy at birth in years (Male)	Life Expectancy (Female)	Year	Life Expectancy at birth in years (Both Sexes)	Life Expectancy at birth in years (Male)	Life Expectancy (Female)
1960	49	50	49	1985	60.9	60.5	61.4
1961	50	51	49	1986	60.9	60.5	61.4
1962	50.5	52.4	48.7	1987	60.9	60.5	61.4
1963	50.5	52.4	48.7	1988	60	60	60
1964	50.5	52.4	48.7	1989	60	60	61
1965	52	53	51	1990	61	60	61
1966	52	53	52	1991	61	61	61
1967	53	53	53	1992	61	61	61
1968	53	54	53	1993	62	61	62
1969	54	54	54	1994	62	61	62
1970	54	55	54	1995	63.5	62.8	64.2
1971	55	55	54	1996	63.5	62.8	64.1
1972	55	55	55	1997	63.7	62.8	64.6
1973	55	56	55	1998	64.4	63.3	65.6
1974	56	56	56	1999	65.0	64.0	66.0
1975	56	56	56	2000	65.0	64.0	66.0
1976	56.5	56.1	57.0	2001	64	64	65
1977	56.5	56.1	57.0	2002	64.4	62.2	65.2
1978	56.5	56.1	57.0	2003	65	64	66
1979	56.5	56.1	57.0	2004	65.1	64.1	65.7
1980	58	58	58	2005	66	65	66
1981	58	58	58	2006	66	66	66
1982	58	58	58	2007	66.2	65.9	66.5
1983	59	59	59	2008	67	66	67
1984	60.9	60.5	61.4	--	--	--	--

Sources: World Development Indicators (Various Issues) and ,State Bank of Pakistan (2005)

Table 3.18 Comparison of Life Expectancy

Country	Life Expectancy in 1971			Life Expectancy in 1981			Life Expectancy in 1991			Life Expectancy in 2001			Life Expectancy in 2008		
	Both Sexes	Male	Female	Both sex	Male	Fe,male	Both Sexes	Male	Female	Both Sexes	Male	Female	Bothe Sexs	Male	Female
Pakistan	55	55	54	58	58	58	61	61	61	64	64	65	67	66	67
India	49	50	49	55	55	55	58	58	59	62	61	63	62	62	65
Afghanistan	35	36	35	40	40	39	41	42	41	42	42	42	44	44	44
Iran	54	55	54	59	58	60	65	64	66	69	68	71	71	70	73
Bangladesh	44	44	45	48	48	49	55	54	55	62	61	63	66	65	67
Srilanka	63	61	65	68	66	71	70	67	73	72	68	76	74	70	78
Kazakistan	-	-	-	-	-	-	68	63	73	66	61	71	66	61	72
Ubbakistan	63	60	67	66	62	69	67	63	70	67	64	70	68	65	71
Turkemanistan	59	55	62	61	58	65	63	59	67	64	60	68	65	61	69
Kryghistan	-	-	-	-	-	-	69	65	71	69	65	73	67	63	72
Nepal	43	43	43	48	49	49	54	55	55	63	62	62	67	66	67
China	63	62	63	66	65	67	68	67	70	72	70	73	73	71	75

Source : World Development Indicators (WDI).

3.4.2.4 Health Staff

The number and quality of health officials play a significant role in achieving acceptable standard of health. The smaller the number of people per health official, the better the efficiency expected. In Pakistan, Population per doctor is 1212 and per dentist is 18010 (Economic Survey, 2008-09).The population per Bed was 1575 in 2008-09.

At the time of independence, Pakistan had only 1360 doctors, 88 nurses 1 midwife and 4 Lady Health Visitors (LHVs). The number of health official increased continuously with public interest and increasing number of educated masses and health training institutions. The number of doctors increased to 14862 in 1971 and 26668 in

1981. In next decade this number almost doubled touching the figure 60949 in 1992.it became 113206 in 2004 and 1, 33,956 in 2008-09 (State Bank of Pakistan, 2005 & Economic Survey of Pakistan, 2008-9). This shows government efforts on improvement of health quality in Pakistan. The registered dentists in Pakistan were 846 in 1979, 2193 in 1991 and 4611 in 2001. This indicates the consistency of public health policy. The number of dentists increased to 9012 in 2008. Nurses play an important role in improving health standard. The number of nurses increased from 88 in 1948 to 5075 in 1971. It crossed the figure of 18000 in 1991 and reached 48,331 in 2004. There were 65,387 registered nurses in Pakistan in the year 2008-09 (Economic Survey of Pakistan, 2008-9).

The midwife is considered an integral part of the process of pregnancy and childbirth. With increase in population and increased awareness of dangers of childbirth, demand for midwives increased manifold. There were 3594 registered midwives in Pakistan in 1979.The number of midwives increased to 23559 in 2004, which was still less for such a huge population.

3.4.3 Research and Development (R&D) Profile of Pakistan

Research play an important role in economic growth of a country through technological advancement and spillover effects. Research and Development expenditure can be more productive if made on high-tech sector than other sectors (Nadiri, 1993). In Pakistan, expenditure on R&D is mostly made by the government of Pakistan through investment in higher education. Universities are considered home for research and expenditure made on higher education does play an important role in R&D. There are also few specialized organization concerned with R&D in Pakistan. The research expenditure and quality has improved in recent decades after the formation of Higher Education Commission (HEC) of Pakistan in 2001. Before the formation of HEC, in 1976 the number of publication in Pakistan were 271 per annum only (ISI, 2010).This number almost doubled in 1984-85 when the number of publications reached 512. The 2000s is a decade of research for Pakistan because the number of publication, number of

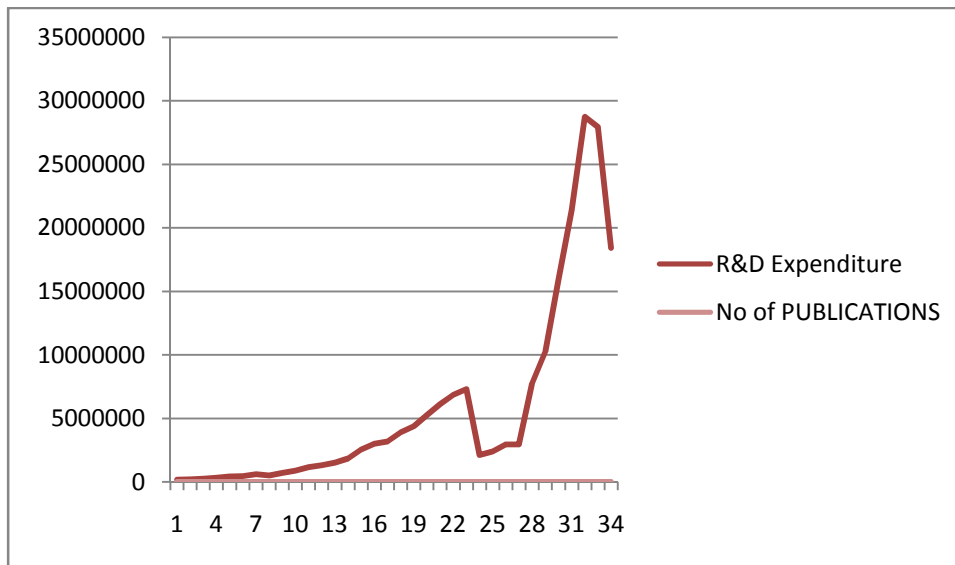
research organizations and expenditures on research all increased with acceptable pace. The publications increased from 1305 in 2000-01 to 7661 in 2008-09.

3.4.3.1 R& D Expenditure

The expenditures in Research and Development (R&D) by a country show its interest in science and technology and other sectors which lead to economic development. It has been observed that rich countries of the world with huge pool of resources spend huge amounts of money on R&D. During the year 1999-2000 the world expenditures on R&D increased from 410 billion USD to 755 billion USD and out of this 80% was made by OECD countries (UNESCO, 2004).

Due to lack of availability of data on R&D the expenditures of higher education was taken as expenditure on R&D because in Pakistan most research is conducted in higher education institution. Another justification for the use of this expenditure as expenditure on R&D is that high correlation has been noted in higher education expenditure and number of scientific publications. This can be shown in the following figure.

Figure 3.5 Research and Development in Pakistan



Source: Economic Survey of Pakistan (Various Issues), WDI (2010)

The figure shows that with increase in the higher education expenditure the number of publication also showed a rising trend..

3.5 Labour Force Participation

Labour is one of the most important determinants of production which plays a fundamental role in economic growth. The productivity of the labour depends on racial qualities, working environment, skills and, education and training of labour. Pakistan is naturally endowed with rich human resources. It has huge pool of human resources but unfortunately it has not been able to utilize these resources. The labour force in Pakistan is mostly unskilled. The long run economic growth effected to a great extent strength, efficiency and employment rate of labour force.

3.5.1 Labour Force Participation Rate and Unemployment Rate

Pakistan has been ranked as 10th largest nation of the world with huge pool of labour force. It is endowed with 53.72 million of labour force (Economic Survey of Pakistan, 2008-09).The crude activity rate is 32.2 % and refined activity rate is 45.2 % in Pakistan. The labour force showed increasing trend during the last few decades in Pakistan as shown in the following table.

Table 3.19 Labour Force Trend in Pakistan

Year	Population (Million)	Total Labour Force (Million)	Employed Labour force(Million)	Labour participation rate(%)
1971	61.49	18.70	18.37	30.41
1975	72.12	21.54	21.08	29.87
1980	83.84	25.65	24.70	30.60
1985	97.67	28.05	27.02	28.72
1990	112.61	30.99	29.04	27.52
1995	124.49	33.60	31.80	26.99
2000	139.76	39.84	36.72	28.51
2005	153.96	46.82	43.22	30.41
2008	166.41	53.72	50.79	32.8

Source: Economic Survey of Pakistan (Various Issues)

The total labour force with increase in population in Pakistan showed an escalating trend during the study period. The employed labour force showed growing pattern with few jumps in some periods. The total population in 1971 was 61.49 million which consisted 18.71 million of civilian labour force. Out of the total labour force 18.37 million was employed and the participation rate of labour was 30.41. The rising trend left up the population, total labor force and employed labour force to 83.84, 25.65 and 24.70 respectively in 1980. The next decade added 30 million to population, five million to total labour force and 4.5 million to employed labour force. The Crude activity rate showed zigzag trend during 1971-90.

The same pattern of the population and labour force continued in 1990s. The population of Pakistan attained the level 153.96 million in 2000 which left up the labour force to 39.84 and employed labour force to 36.72. The crude activity rate also increased during this era. The population of Pakistan became 166.41 in 2008 which increased the labour force from 46.82 in 2005 to 53.72 in 2008. The employed labour force was 50.79 million in 2008 while the labour force participation rate remained 32.8 %.

3.5.2 Sector Wise Share in Employment

The labour force in Pakistan is spread over four major sectors, namely Agriculture, manufacturing, construction and trade. Agriculture has been and is still the largest employment sector for Pakistan because most of population of Pakistan lives in rural areas and they derive their livelihood from agriculture sector. But with passage of time the trend of urbanization is reducing the share of agriculture sector in employment. Agriculture employed 57.32 % of labour force in 1971. The manufacturing, construction and trade sectors employed 12.92, 3.41 and 9.89 percent of labour force while 16.46 percent were engaged in other sectors of economy. The share of agriculture in employment fell to 52.71 percent in 1981 and to 48.27 percent in 1991. The share of manufacturing sector increased in 1981 but decreased in 1991. The shares of the other sectors augmented in 1980s and 1990s. The same mold prevailed in 2000s. The labour force composition of Pakistan is given in table 3.20.

Table 3.20 Labour Force Composition in Pakistan

Year	Agriculture	Manufacturing	Construction	Trade	Others
1971	57.32	12.92	3.41	9.89	16.46
1981	52.71	13.81	4.83	11.72	16.93
1991	48.27	12.28	6.33	13.10	20.02
2001	42.09	13.84	6.05	14.85	23.17
2008	45.1	13.0	6.6	15.01	20.29

Source: Economic Survey of Pakistan (Various Issues), State Bank of Pakistan (2005)

3.5.3 Dependency Rate

The dependency ratio or dependency rate is defined as the ratio of population less than 15 years and over 64 years to the population between 15-64 years of age. Pakistan has very high dependency ratio in labour force. One of the major causes may be due to the reasons that it has huge young population working between the age 15 years and less participation of women in labour force. The dependency ratio in Pakistan is on decline. The decline mainly started in 1990s and it decreased from 86% to 75%. This pattern will continue because due to increased awareness and access to education. The population under 14 years is decreasing and the labour force participation in range of 15-64 years of ages is increasing which will result in further fall in dependency ratio.

3.6 Institutions

Institutions play an important role in human capital formation and economic growth of an economy. If there are large number institutions, it will ensure easy access to education and health facilities which can improve the human capital. The education and health institutions are addressed in the current study. The details of education and health institutions are given below:

Education in Pakistan can be categorized into Primary, secondary and higher education. The school level education has various stages like pre-primary, primary,

secondary and sometimes higher secondary stage also. The pre-primary stage is mostly adjusted in primary schools and middle stage into high schools.

The colleges are the institutions for intermediate and degree levels (14 years education). The higher education of 16 years and above is offered in universities. The educational institutions showed an upward inclination during the period. The number of schools, colleges and universities increased to a great deal.

The standard and quality of human capital depends on the level, type and quality of education. The government of Pakistan has been engaged throughout its history to improve the quality of education. The expansion in educational institutions network and continuous employment of teachers is an effort for the improvement of the quality of education. The role of education in socio-economic development of a country depends on the quality of education. The quality of education depends on the quality of education institutions. The higher the quality of educational institutions, the more effective will be the role of education. The quality of educational institutions is mostly measured by the Pupil-Teacher Ratio (PTR). A lower PTR means more chances for effective education and higher ratio means lack of teachers at a particular level of education. The PTR at a particular level of education is calculated by simply dividing the gross enrollment by number of teacher at that level. The PTR at different levels of education in Pakistan is shown in table 3.21. The table shows that the PTR at school, college and university level showed variation throughout the study period. It fluctuated in both up and down directions. The PTR at school level was 29.22 in 1971. It showed a decline by reaching 26.22 till 1980 but increased to 28.86. In 1995 it further jumped up to 33.64 but after 1995 till the end of the study period it showed a downward trend. The PTR at college was 26.08 showed a continuous increase till 1995 when it became 121.07. This was mainly due to rapid increase in college enrollment both sexes male and female as shown in the table.3.21. It fell to 116.50 in 2000 due to increase in number of teachers at college level and since then it has a downward trend. It was 59.08 in 2008.

The university education seems very rare at the beginning of the study period with only 17690 students enrolled in all over Pakistan in universities. There were 1649 teachers

of all cadets to teach them. Thus, PTR was comparatively low. The PTR showed upward movement till 1985 and then downward trend in next ten years. It showed a big up jump in 2000 due to massive increase in university enrollment but big fall in 2005. It was due to opening of new universities both in public as well as private sector in Pakistan. The PTR was 14.58 in 2008.

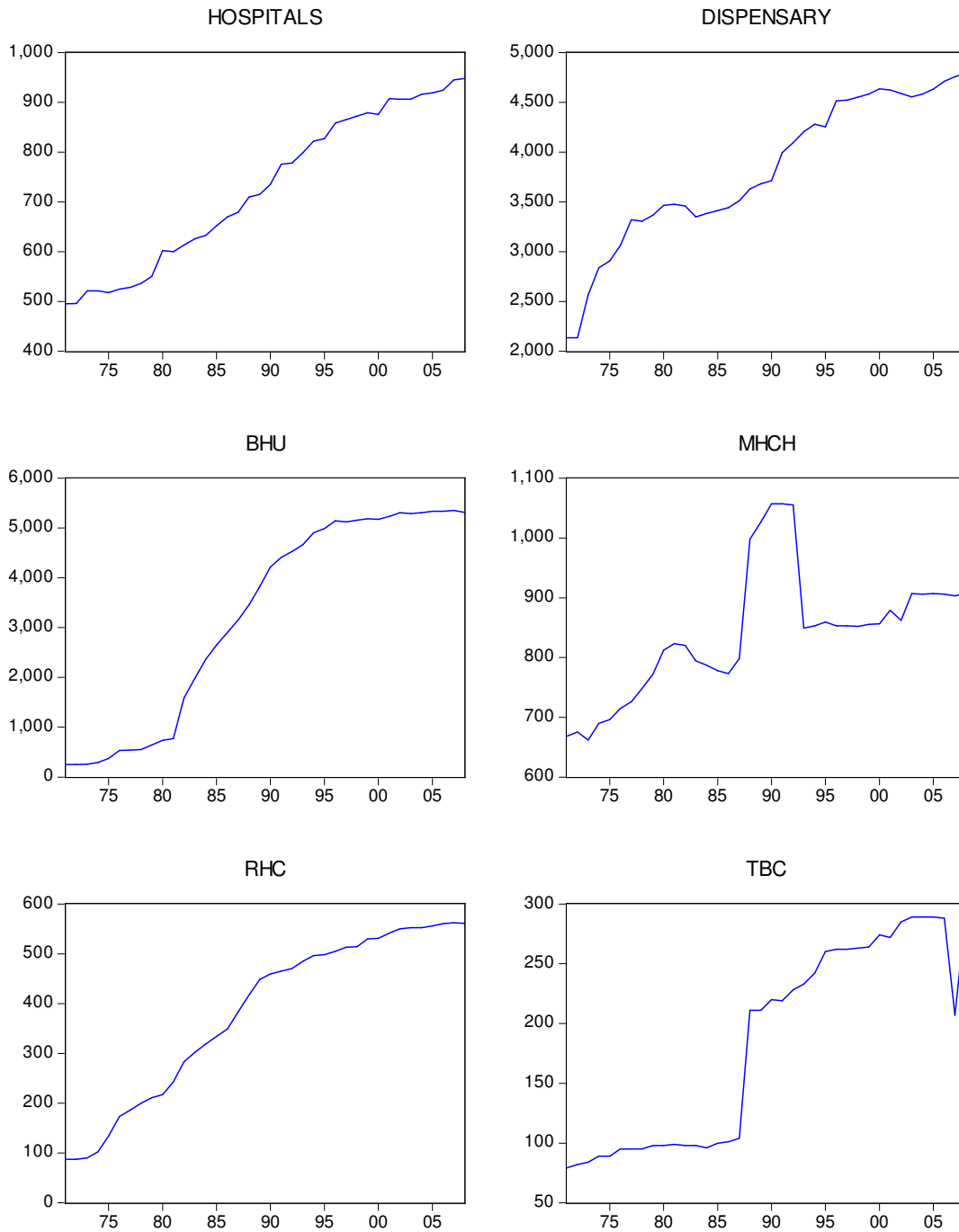
The quality of health in Pakistan shows continuous improvement although still it faces the problems of malnutrition, prevention of curable diseases and other health problems. The number of health institutions is increasing as well as the number of the health officials. The increase in health institutions can be shown in figure 3.8

Table 3.21: Pupil-Teacher Ratio at various level of Education

Year	Gross Enrollment in Schools	Total No of School Teachers	Student-teacher Ratio at school level	Gross College Enrollment	Total Number of College Teachers	Student-teacher Ratio at college level	Gross University Enrollment	Total Number of University Teachers	Student-teacher Ratio at university level
1971	5314500	181900	29.22	979245	10192	26.08	17690	1649	10.72
1975	6680400	235300	28.39	1240437	14400	86.14	21395	2726	7.85
1980	7115000	271300	26.22	1463479	16096	90.92	41810	3357	12.45
1985	9335000	323500	28.86	1864169	19424	95.97	59891	3740	16.01
1990	14027000	521800	26.88	2681310	25336	105.83	67803	4744	14.29
1995	19691000	585300	33.64	3916969	32354	121.07	80651	5417	14.88
2000	25077000	878900	28.53	4272985	36678	116.50	114010	5988	19.039
2005	23688000	978900	24.20	5003275	70060	71.41	471964	37509	12.58
2008	25037000	1225000	20.44	5751810	97360	59.08	741092	50825	14.58

Source: Author's Calculations from the data obtained from State Bank of Pakistan (2005) and Economic Survey of Pakistan(Various Issues)

Figure 3.6 Health Institutions of Different Kinds in Pakistan (1971-2008)



Source: Economic Survey of Pakistan, State Bank of Pakistan(2005) , Social Indicators of Pakistan(2007)

The number of health institutions increased from 3635 in 1971 to 10178 in 1990. This includes the institutions of all kind like hospitals, Dispensaries, Basic Health Units (BHU), Rural Health Centers (RHCs), TB centers and Maternity homes. But increase in number insufficient for

rapidly growing population. Therefore the upward movement in number of health institutions continued till 2008. The figure 3.8 shows that the institutions of health of all kinds increased with little shocks in few years.

The quality of health institutions is measured by the Patient Doctor Ratio (PDR). It is calculated by dividing the population in a particular year by the number of doctors in that year. The Patient-Doctor Ratio during the study period is shown in table 3.22.

Table 3.22: Doctor – Patient Ratio in Pakistan

Year	Health Institutions	Doctor- Patient Ratio
1971	3635	4231
1975	4629	3949
1980	5833	3598
1985	7826	4696
1990	10178	2259
1995	11423	1803
2000	12069	1578
2005	12348	1359
2008	12521	1225

Source: economic Survey of Pakistan (Various Issues), State Bank of Pakistan (2005), Social Indicators of Pakistan (2007)

The Patient Doctor Ratio (PDR) is following the downward trend since in 1971. There were 4231 persons for one doctor in 1971 and 3949 in 1975. This number further fell to 3598 in 1980. Similarly, the Patient –Doctor Ratio kept on the downhill drift. The PDR fell down from 3598 to 1578 in 2000 and 1225 in 2008. This shows the augmented availability of doctors in Pakistan.

Summary

This chapter presented a brief back ground of human capital and economic growth in Pakistan. It described in detail the developments in education, health, R&D, labour and economic growth during 1971-2008. Pakistan is the sixth most populous country of the world with huge pool of human resources. These resources have dual effect on economy of Pakistan. It

is adding to labour force on one hand but on other hand it is a burden on the economy while the effect of the latter is stronger. The reason is that human resources have not been properly planned and utilized in Pakistan. China, the neighbouring country of Pakistan has very huge population and is experiencing very high GDP growth due to its good quality of human capital. The economic growth performance experienced fluctuation in its history. It remained very good in some years but below average in others. The GDP growth remained 6.15% and 4.68% during the periods 1981-90 and 2001-08 respectively. Agriculture remained the chief contributor to economy.

Unfortunately, education an important sector has never been top priority of political governments of Pakistan besides a very low literacy profile. It started with 16% of literacy rate in 1947 and still it has not been able to achieve 60% of literacy rate even at the end of the study period. It is spending a very small percentage of its GDP on education. The education expenditure remained 2.47% of GDP during 2007-08. The major portion of education expenditures is allocated to Non-Development Expenditure (NDE). The enrollment, the number of educational institutions and number of teachers showed continuous increase during the study period but the pace needs to be accelerated. The achievement of higher education remained exemplary during the last decade when the number of universities, enrollment in universities and the research publication increased in dramatic style. The establishment of Higher Education Commission of Pakistan made it possible, which is playing key role in higher education and R&D in Pakistan.

The expenditures on health remained much lower than education. It gets about 0.5% of GDP, which is a meager allocation for such a huge population with enormous health problems. Pakistan has been able to control some of its demographic indicators during the study period. The TFR fell from 7.0 in 1985 to 3.0 in 2008 and the birth rate from 44 to 25. The Infant Mortality Rate (IMR) is still very high and needs to be controlled. The life expectancy is about 67 years for both sexes. R&D which plays a significant role in innovation and is base of technological development has always been neglected in budget allocations. The research publication in Pakistan remained very low till late 1990s. It was accelerated during 2000s after

the establishment of HEC due to appreciable efforts on part of HEC and budget allocation for higher education.

Pakistan has huge labour force but it has not benefited the economy due to two major reasons. The first reason is that the labour is unskilled and the second is that due some cultural constraints majority of female labour force is not working. Labour force participation rate is 32.8 percent. Agriculture sector is the major source of employment and it has engaged 45% of labour force.

The institutions providing education and health facilities at various levels showed continuous expansion during the study period. The quality of institutions is measured by health institutions (Patient-Doctor Ratio) and educational institutions (Pupil-Teacher Ratio). The PTR is lower at school and university level but higher at college level. The population per doctor needs to be reduced.

Chapter 4

DATA AND METHODOLOGY

4.1 Introduction

It is imperative for any good research to have a sound, well-developed and recognized tools, techniques, and methodologies. This chapter deals with the analytical framework and research methodology, developed to achieve objectives of the study. This section of present research explains types of data used and also highlights the sources of data. The methods of treatment of data have also been addressed in this chapter. The theoretical framework for empirical analysis has been developed in this chapter. Different models have been introduced for analysis. It includes models for Total Factor Productivity (TFP), Economic Growth, Simultaneous Equation, Cointegration and Causality. The Model for TFP has been derived by using Growth Accounting Method. In Model for economic growth, different levels of education have been incorporated in different equations. The econometric techniques used for estimation have also been discussed in this chapter. These techniques include Ordinary Least Squares, Two Stage Least Squares, Johansen Cointegration Test, and Granger Causality test. The detailed introduction to different variables of the study is also given in this chapter.

4.2 Data

The present study is based upon the secondary data and it covers the period 1971- 2008. The data has been obtained from the following sources:

1. A Hand Book of Statistics on Pakistan economy, State. Bank of Pakistan
2. Economic Survey of Pakistan (various Issues) Government of Pakistan
3. World Development Indicators, World Bank
4. United Nations Educational Scientific and Cultural Organization
5. Human Development Reports, UNDP (various issues)
6. Social Indicators of Pakistan, Government of Pakistan
7. Pakistan Integrated Household Survey, Government of Pakistan

4.3 Model for Total Factor Productivity

The present study aims at finding out the role of human capital in economic growth of Pakistan during the period 1971-2008. In order to achieve objectives of the study, Growth Accounting Method (GAM) is being employed here. Growth Accounting is the process, which breaks the observed economic growth into elements associated with variation in factor inputs (Barro, 1999). The growth accounting has been widely used in economic growth literature. A number of studies like Solow (1957), Kenderick (1961), Jorgenson and Zvi (1967), Jorgensen and Fraumeni (1992), and Young (1995), used this method for finding the effects of various factors on economic growth. This method is considered best because, it provides estimates of factoral share in economic growth. The problem, which is faced in growth regressions, is the value of the residual which is unknown. This value is referred to as Solow residual or Total Factor Productivity. The calculation of TFP is placed in a central position in the empirical growth studies as it covers all omitted factors. Chen (1997) called it, a measure of our ignorance. The Growth Accounting Method (GAM) helps in calculation of this residual. The Starting point of this method is standard production function as given below

$$Y = F(A, K, L) \quad (1)$$

Where Y shows output, A shows the level of technology or effectiveness of labour, K is capital input and L is labour input

Differentiating (1) with respect to time and dividing by Y , we get

$$\frac{Y'}{Y} = g + \frac{F_k K}{Y} \cdot \frac{K'}{K} + \frac{F_L L}{Y} \cdot \frac{L'}{L} \quad (2)$$

Where

The symbol ' g ' shows growth due to technological change. $\frac{F_k K}{Y}$ and $\frac{F_L L}{Y}$ are the capital and labour input shares in total output. As the share of capital is its rental price and the share of labour is wages, so we denote their shares in the output by S_k and S_L respectively.

So the form of equation becomes

$$\frac{\dot{Y}}{Y} = g + S_k \frac{K'}{K} + S_L \frac{L'}{L} \quad (3)$$

If $y = \frac{\dot{Y}}{Y}$, $k = \frac{K'}{K}$ and $l = \frac{L'}{L}$ then

$$y = g + s_k k + s_L l \quad (4)$$

Now the share of technological progress can be computed as

$$g = y - s_k k - s_L l \quad (5)$$

The value of ' g ' is generally known as Total Factor Productivity, which shows contribution of other factors in economic growth than the observed factors. This is also called Solow Residual.

As major objective of the present study is to find out the role of human capital in economic growth of Pakistan, therefore by introducing human capital in TFP Model, the model becomes of the form

$$(6)$$

In equation (6), ' y ' is the growth rate of the GDP Per Capita, ' k ' is the growth rate of physical capital (Gross Fixed Capital) and is growth rate of human capital. The human capital has been measured by Education and Health for calculation of TFP.

A different approach to the calculation of Total Factor Productivity is the dual approach elaborated by Barro (1999). In dual approach, TFP is computed by using growth of factor prices instead of growth of factor quantities. This approach computes TFP from the given equation

$$Y = rK + wL \quad (7)$$

Where ' r ' is the rental price of capital and ' w ' is the wage rate of labour. Taking derivative of equation (7) with respect to time and dividing by Y

$$\frac{Y}{Y} = \frac{1}{Y}[rK + rK] + \frac{1}{Y}[wL + wL] \quad (8)$$

And after simplification we get

$$S_K [r / r] + S_L [w / w] = TFP \quad (9)$$

Where, S_K and S_L are the shares of capital and labor in factor incomes.

The computation of Total Factor Productivity becomes easy, if the factor shares in total factor incomes or the rental price of capital and wage rate of labour data is available. This is done mostly in case of developed countries but unfortunately the data relevant to rental price of capital and wages of labour in developing country is mostly not available, which creates hurdles in computation of TFP. The same is the case in the present study, where wage data is not available so the factor share is difficult to compute.

In order to tackle the problem of factor shares, different solutions are suggested in empirical studies. One solution for this problem used in literature is the partial elasticities obtained from the regression of Cobb Douglas Production Function. But in this method major problem is of endogeneity as the growth of factor inputs can be correlated to the value of the residual.

The second solution for the problem of non-availability of factor shares as adopted by number of studies is the use of constant share of labour and capital. The constant share of capital used in economic growth literature varies from 0.3 to 0.40. Besudeb and Bari (2000), Baier (2002), Iwata *et al*, Josephson (2002) used constant capital share in the range of 0.30-0.35. Some of the studies used this share in the range of 0.25 to 0.50 in economic growth literature⁶

Therefore, due to non-availability of proper data for factor shares and on the basis of studies relevant to Pakistan and similar economies, the present study has used constant shares of factors as 0.33 for capital and labour, and 0.34 for human capital⁷. The equation used for TFP estimation is given below

$$g = y - 0.33 k - 0.33 l - 0.34 h_c \quad (10)$$

The Total Factor Productivity has been computed on five and ten yearly basis. This is done to find out the expected effect of time variation on TFP. The study has also used different measures of human capital to find the extent of sensitivity of TFP to these measures. The extreme bounds of TFP in economy of Pakistan have been worked out by exercising the extreme shares of capital, labour and human capital used in literature. Therefore, by taking into account these shares the following models are used for this purpose.

$$g = y - 0.25k - 0.37 l - 0.34 h_c \quad (11)$$

$$g = y - 0.50 k - 0.25 l - 0.25 h_c \quad (12)$$

In equation (11) and equation (12), 0.25 and 0.50 are the extreme shares of capital. These equations are expected to give an extreme contribution of the TFP to economic growth of

⁶Young (1992), Sarel (1997), Nelson (1999), Ahmad (2008) and Park (2010) used the fixed capital share from 0.25 to 0.50 for the estimation of Total Factor Productivity in different countries.

⁷ Besudeb & Bari (2000), Baier (2002), Leauvan (2007), Ahmad (2008), and Park (2010) used similar shares for South Asia, Vietnam, Indonesia and a set of 145 countries.

Pakistan. It will provide the range in which TFP can lie in empirical studies relevant to TFP and determinants of economic growth.

4.4 Comparison of Total Factor Productivity of Pakistan with Selected Asian Countries

Human capital is thought to be an important source of economic growth. A study of industrialized economies shows that they have achieved the current status mainly due to human resource development. The Pakistani governments in different time periods, emphasized the importance of literacy and health but human resource development has never been a key priority area. Therefore, progress in this field is not up to the mark. The human capital accumulation empowers the government to effect productivity directly or indirectly through the technological progress. This is often reflected in TFP. The focus of this section of the present study is to compare the contribution of Total Factor Productivity (TFP) and human capital in form of health in Pakistan with seven Asian countries. These countries include India, China, Bangladesh, Indonesia, Iran, Nepal and Srilanka. All these selected countries are neighbouring countries or countries of more or less similar nature in the region. The reason for selection of the listed economies is easy availability of data and similarity in characteristics. All of them are developing countries and some of them like India and China are having very high growth rate in recent years. The optimum capital, labour and human capital shares have been used as 0.33, 0.33 and 0.34. It has been used in a number of studies for the developing countries⁸.

The TFP for the selected countries has been computed for the study period as whole (1971-2008) and for four sub periods 1971-1980, 1981-1990, 1991-2000 and 2001-2008. This section is expected to highlight a comparative analysis of economic growth, contribution of TFP, and, physical and human capital to economic growth in Pakistan and selected economies. This will make the present study rare so far in the study area.

⁸ Young (1992), Collins and Bosworth(1996), Sarel (1997), Besudeb & Bari (2000), Ghani and Suri (2001), Gollin (2001), Bosworth and Collins (2003), Rodrick and Subramanian (2004), and Baier (2002), used similar shares for labour and capital for estimation of Total Factor Productivity for individual countries of the Region or cross-country comparisons.

4.5 Model for Economic Growth

Most of the empirical studies relevant to economic growth used regression approach to find the determinants of economic growth in different countries and regions of the world. This practice prevailed in past and prevails today in economic growth literature. Starting from the classical growth models or exogenous growth theories, an addition of new ideas continued even after the endogenous growth theories. The present study is using an augmented form of the Cobb Douglas Production Function for estimation as given below

$$Y = A K^{\alpha} L^{\beta} H^{\gamma} \quad (13)$$

By taking ln of equation (13), the model becomes

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \gamma \ln H \quad (14)$$

In equation (14) Y = GDP Per Capita (Real), K = Physical capital, L = Labour and ' H ' stands for human capital. Human capital is considered as engine of economic growth as concluded by Tallman and Wang (1994) , Steven (1999), Bedard (2001), Gokcekus (2001), Gungluch (2001) and Tamura (2001). Most of growth studies have used Education, Health, Research and Development, Training, or experience as measures for human capital. The present study is undertaking education, health and R&D as variables for human capital. Therefore, by including the variables for human capital, the functional form of model becomes

$$Y = f(K, L, ENRS, He, RD) \quad (15)$$

where

$ENRS$ = Education

He = Health

RD = Research and Development

By introducing these variables in the model, the empirical form of the model for estimation becomes

$$(16)$$

This is the major growth model, where 'ENRS' shows human capital in form of education, 'Health' shows human capital in form of health while 'RD' in form of Research and Development.

It is mandatory to introduce the variables used in the present study before proceeding to empirical estimation. Economic growth in most of growth studies has been measured by Gross Domestic Product (*GDP*). It has been used in form *GDP* per capita, Real *GDP* per capita, growth rate of *GDP* and *GDP* per capita in studies like by Asteriou and Agiomirgianakis (2001), Bloom et al (2000), Bhargava et al(2001), Barro (1991) and Borensztein (1998).The present study is using Per capita GDP in real terms as the measure for economic growth. The Physical capital has been measured by Gross Fixed Capital Formation (GFCF) following the economic growth literature⁹.

Education is the most widely used measure for human capital in literature concerning human capital-economic growth nexus. It has been used as average years of education, primary education, and secondary education and somewhere as gross enrollment. The present study has used secondary school enrollment as proxy for human capital as used by Asteriou and Agiomirgianakis (2001), Abbas (2001), Barro (1991), Canlas (2003), and McMahan (1998)

“Health is wealth” is widely used proverb, which shows the importance of health in life. Healthy people have healthy mind and they are expected to be more efficient. It is expected to add to human efficiency and is treated as a good measure for human capital. Barro and Lee (1994), Barro and Sala-I-Martin(1995), Barro (1996), Caselli *et al* (1996), Bloom and Malanaey (1998),Bloom *et al* (2000), Sachs and Warner(1997), McDonald and Jennifer (2002) and Ozcan et al(2000) considered life expectancy as best measure for health so the present study is following their way and using life expectancy as measure for health.

Labour is another important variable in current study. The labour force supply and composition of human resources in an economy settle on the labour force participation rate. The present study has used total labour force in the economy for labour in the model .

Research and Development (R&D) is another important variable inducted in growth determinants in New Growth Theories. Much struggle has been made to get data for R&D. Unfortunately, not much data is available on R&D in Pakistan. Only a few years’ publication data was available. As most of research is carried out in higher education institutions in Pakistan,

⁹ Lin(2004),

so the expenditure on higher education was considered a proxy for it. This is also justified on the ground that high correlation was found between the Expenditure on higher education and publication per year from 1975-2008. This means that increase in higher education expenditure led to increase the research activities in Pakistan so this proxy is being used in the present study. The final equation of economic growth for estimation is given as below

$$\ln Y = \alpha_0 + \alpha_1 \ln ENRS + \alpha_2 \ln Health + \alpha_3 \ln GFCE + \alpha_4 \ln L + \alpha_5 \ln RD + U_i \quad (17)$$

The level of education can be Elementary, secondary or higher education. This present study also aims to explore the role of different levels of education on economic growth so by introducing different levels of education, the affect of human capital on economic growth has been analyzed through the following models

$$\ln Y = \alpha_0 + \alpha_1 \ln GFCE + \alpha_2 \ln L + \alpha_3 \ln ENRE + \alpha_4 \ln Health + \alpha_5 \ln RD + U_i \quad (18)$$

$$\ln Y = \beta_0 + \beta_1 \ln ENRG + \beta_2 \ln Health + \beta_3 \ln GFCE + \beta_4 \ln L + \beta_5 \ln RD + U_i \quad (19)$$

$$\ln Y = \gamma_0 + \gamma_1 \ln ENRHE + \gamma_2 \ln Health + \gamma_3 \ln GFCE + \gamma_4 \ln L + \gamma_5 \ln RD + U_i \quad (20)$$

In equation (18), ENRE shows elementary education and the present study has measured Elementary education by school enrollment at elementary schools of Pakistan. ‘ENRG’ in equation (19) shows gross school enrollment. The term ‘ENRHE’ in equation (20) shows enrollment in higher education institutions.

After establishing economic growth model, the method of estimation is an important debate in empirical literature. Chen (2009) used the methods of Ordinary Least Squares (OLS) for the estimation of returns from schooling in china. Knowels and Owen (1995) followed the same path for Human Capital and cross country variation in income per capita. Li (2008) used the OLS method for the impact of health and education on economic growth in china. Mankiw *et al* (1992), Jones (1995) and Temple (1999) exercised the OLS method economic growth studies. Park (2006) used OLS with White-Heteroscedasticity Adjustment for human capital and economic growth study for 94 countries dataset. Murthy and Chien (1997) also used OLS with White-Heteroscedasticity consistent variance for the empirics of economic growth in OECD

economics. Therefore, Ordinary Least Squares (OLS) method has been employed in the present study for the estimation of economic growth equation.

4.6 Simultaneous Equation Model

In world today, the interdependence of variables is a common phenomenon. Often some of the variables in econometric studies are determined simultaneously. It means the variables show their effect as dependent as well as independent variables, thus resultantly, developing a set of equations (Asteriou and Stephen, 2007). Given the following economic growth model

$$\ln RGDP_{PC} = \alpha_0 + \alpha_1 \ln GFCF + \alpha_2 \ln L + \alpha_3 \ln ENRS + \alpha_4 \ln Health + \alpha_5 \ln RD + U_i \quad (21)$$

Education, health and R&D which are exogenous variables in above economic growth equation can take the form of endogenous variables, which in turn can create the problem of simultaneity bias. This necessitates the use of simultaneous equation model. Therefore, the interdependency of the variables has been treated by the use of simultaneous equation model.

Human capital in form of education can be affected by improvement in health conditions¹⁰, development of educational institutions and GDP growth or increase in income¹¹. This is explained in the following equation.

$$E = f (Y, Edins, Health) \quad (22)$$

Now the human capital in form of education is affected not only by easy access to educational institutions but also by the quality of institutions¹². The model for education after incorporating the quality of educational institutions can be written as

$$ENRS = f (Y, Edins, PTR, Health) \quad (23)$$

The model for estimation in log linear form is expressed in form of the following equation.

$$\ln ENRS = \alpha_0 \ln RGDP_{PC} + \alpha_1 \ln Edins + \alpha_2 \ln PTR + \alpha_3 \ln Health + U_{1i} \quad (24)$$

In equation (24), 'Edins' and PTR shows the number and quality of educational institutions respectively.

¹⁰ Wolfe (1985) suggested health measures for children for better education

¹¹ Glewwe and Hanan (2004) found positive nexus in wealth and demand for education

¹² Behram and Nancy (1983), and Kingdon (1996) highlighted the benefits of educational institution's quality. Khan (2005) found significant impact of quality of institutions on economic growth of a cross-section of countries.

Similarly, health which is explanatory variable in major growth models can take the form of dependent variable. One of the important determinants of health discussed in literature is education¹³. The level of national income and, the number and quality of health institutions are believed to play their role in improving health status in country. Therefore, by taking into account the various factors which can affect the health, the model for health can be expressed in the following form.

$$Health = f (RGDPPC, ENRS, DPR) \quad (25)$$

In order to estimate the health model, it is being written in log linear form as

$$\ln Health = \beta_0 + \beta_1 \ln RGDPPC + \beta_2 \ln ENRS + \beta_3 \ln DPR + U_{2i} \quad (26)$$

R&D is an important measure of human capital and widely used in literature of human capital-economic growth relationship. The R&D in a country to a great extent depends on the level of income, the level of education and quality of educational institutions. The model for R&D can be written as

$$RD = f (RGDPPC, ENRS, Edins, LPTR) \quad (27)$$

$$\ln RD = \gamma_0 + \gamma_1 \ln RGDPPC + \gamma_2 \ln ENRS + \gamma_3 \ln Edins + \gamma_4 \ln PTR + U_i \quad (28)$$

Bazo and Rosina (2008), and Oketch (2006) found significant effects of human capital on physical capital. These studies found that higher level of human capital ensures higher returns from physical capital, which paves way for further investment in human capital. The model for physical capital takes the form

$$GFCF = f (RGDPPC, ENRS, Health, L, RD) \quad (29)$$

$$\ln GFCF = \rho_0 + \rho_1 \ln RGDPPC + \rho_2 \ln ENRS + \rho_3 \ln Health + \rho_5 L + \rho_4 \ln RD + U_i \quad (30)$$

Following objectives of the study, the model for Labour Force Participation Rate (LFPR) is introduced in the study. The human Capital is one of the strongest determinants of the LFPR as human capital in form of education and health positively affects the LFPR¹⁴. Therefore, the effect of the human capital in the present study is investigated through the model given below

¹³ Wesbrod (1962), Berger and Paul (1989), Hartog and Hassel (1998), and Giiskie and Ammi (1998) found effects of education on health.

¹⁴ Nam (1991), Bratti (2003), Sphor (2003), Pelkowski and Mark (2004), Sheran (2007) and Gameraen (2008) concluded the positive effect of human capital on Labour Force Participation Rate.

$$L = f (RGDPPC , ENRS, Health, L) \quad (31)$$

$$\ln L = \delta_0 + \delta_1 \ln Y + \delta_2 \ln ENRS + \delta_3 \ln Health + \delta_4 \ln L + U_i \quad (32)$$

Two methods are usually suggested for the estimation of the simultaneous equations models. The method of Indirect Least Squares is applied in case the model is exactly identified and the method of Two Stage Least Squares (TSLS) is used when the model is over identified. The TSLS is mostly used and considered best method for the estimation of simultaneous equation models because it gives identical results for exactly identified equation like derived from ILS and appropriate method of estimation for over identified equations (Asteriou and Stephen, 2007). The study in hand therefore, uses the method of TSLS for the estimation of the simultaneous equations model.

4.7 Test for Unit Root

To get reliable estimates for time series data, it is indispensable to check the stationarity of data. It is crucial because in stationary data, shocks are temporary and are eliminated overtime, while in case of non-stationary data the shocks are everlasting. Several studies like Nelson and Charles (1982), and Hall (1978) analyzed the relationships of the time series variables and found that in most of cases these variables track random stride. Granger and Newbold (1974), Granger (1986), Philips (1986) and Ohanian (1988) concluded that regression results from non-stationary time series can be spurious and disingenuous for policy recommendations. It is therefore, obligatory to conduct test of stationarity or test for unit root before analyzing the time series for long run relationship. The mean and variance of stationary time series remain constant over time and the auto covariance also not vary with over time¹⁵

Therefore, to get reliable results stationary test will be conducted by using Augmented Dickey Fuller (ADF) test. The stationarity will be checked constant once and then with constant

¹⁵ Enders, Walter. (2004). *Applied Econometric Time Series*. Second Edition, John Wiley & Sons, Inc., River Street, Hoboken, New Jersey.

and trend. The test will be based on the null hypothesis that the series has a unit root. If the series has a unit root, it is considered as non-stationary. Symbolically, $H_0 : \beta-1= 0$ is null hypothesis for the ADF test. The null hypothesis will be checked with alternative hypothesis of $H_1: \beta-1 < 0$ which means that the series is stationary. In test for stationarity, an imperative issue is mostly the selection of lag length. The study in hand will use the Minimum Akaike Information Criteria for this purpose. The software Eviews will be employed for the derivation of result for unit root test.

The variables Gross Domestic Product Per Capita (LRGDPPC), Physical Capital (LGFCF), Labour (LL), Secondary School Enrollment (LENRS), Elementary School Enrollment (LENRE), Gross School Enrollment (LENRG), Higher Education Enrollment (ENRHE), Health (LHealth), Research and Development (LRD), Labour Force Participation Rate (LLFPR), Educational Institutions (LEdins), Pupil- Teacher Ratio (LPTR), and Patient-Doctor Ratio (LDPR) will be tested for the existence of unit root by using the Augmented Dickey Fuller test (ADF).

4.8 Test for Cointegration

After testing the data for the existence of unit root, if the null hypothesis of having unit root is accepted, then the results derived from Ordinary Least Squares become unreliable. There is possibility that the results may be spurious. In order to avoid the doubt of the spurious regression, the long run relationship of the variable is checked. Cointegration is considered as an important tool for this purpose. In economics, two variables are said to be cointegrated if they have long term relationship between them¹⁶. There are many techniques for testing Cointegration among the variables. The Engle-Granger technique (1987), Johansen Cointegration approach (1988, 1991, 1995) and the Autoregressive Distributive Lag Model (ARDL) are the widely used techniques for testing the Cointegration among the variables. The use of a particular technique depends on the properties and kind of data. The study in hand intends to employ the Johansen Cointegration technique. This approach is considered the most popular approach and most of the

¹⁶ Gujarcati,D.N (2003), “Basic Econometrics”, 4th ed, pp-822, Mc graw Hill, New york

studies comparing different techniques for Cointegration have concluded in its favour¹⁷. This approach is used when all variables of the interest are integrated of order I(1). It is expected from this model that it will point out the number of cointegrating equations in the models used in OLS and Simultaneous equations. This will help in long run analysis of human capital, Physical Capital and Labour with economic growth, and as well as of the determinants of factors which affect human capital in long run. If the variables which are stationary at I(1) were found cointegrated, this will show long run relationship among these variables.

4.9 Model for Causality

The present study also aims at finding-out the existence of any possible causal relationship between human capital and economic growth. If two variables ' X_i ' and ' Y_i ' are cointegrated then there are four possibilities. First possibility is that ' X_i ' may cause ' Y_i '. Secondly ' Y_i ' may cause ' X_i '. Similarly it is possible that ' X_i ' may cause ' Y_i ' and ' Y_i ' may cause ' X_i '. In first two cases the causality is unidirectional while in the third case the causality is bidirectional. The fourth case may be such that neither ' X_i ' causes y nor ' Y_i ' causes ' X_i ' which shows the existence of no causal relationship.

The use of Granger-Causality tests is very common in economic growth empirical literature. In case of two variables X_t and Y_t , Y_t is said to granger cause X_t , if it is better predicted by using past values of Y_t as compared to the case when these values are not used (Granger, 1969).

The Granger Causality Test (GCT) is conducted by making the data Stationary. The results of GCT drawn can be spurious if both of them or one of them is nonstationary (He and Koichi, 2001). GCT has been widely used in empirical growth literature. Ghali (1997), Chuang and Cesar (2000), Bader and Aamer (2003), Hsieh and Kon (1994), Vanhoudt (1998) used GCT for studying the impact of different factors on growth in different regions of the world. The use of GCT for human capital and economic growth nexus is also not very uncommon. Self and

¹⁷ Ahking (2002) and Gonzolo (1994) concluded in favour of Johanson approach while comparing it to different techniques of Cointegration.

Richard (2004) used GCT for education and economic growth relationship in India for the period 1966-96, and found the direction of causality from primary and secondary education to economic growth. The causality from primary education to economic growth seemed stronger than the causality of secondary education to economic growth. Mayer (2001), Narayan and Russel (2004), Meulemeester and Denis (1995)¹⁸ and a number of other studies used GCT for studying the causal relationship between human capital and economic growth in one form or other. These studies found significant causal relationships from human capital to economic growth and in some cases bidirectional relationships. However, Diebalt and Litago (1997) argued that the relationship between education and economic growth can neither be approved nor disapproved by using single time series. (Chaung, 2000), found positive significant Granger causality from higher education to economic growth and bidirectional causality from exports to economic growth in Taiwan.

The present study intends to check the causal relationship between human capital and economic growth in Pakistan because rare studies have been conducted to check such relationship. In order to achieve the objectives of the study, the causal relationships Primary education-economic growth, Secondary education economic growth, health and economic growth and R&D- economic growth will be analyzed by using the GCT test procedure. It is expected that there may be some unidirectional or possibly bidirectional relationships in human capital and economic growth.

Summary:

This chapter explained the type and sources of data, models and techniques used to estimate the models. The chapter started with TFP model derived on the basis of Growth accounting Method (GAM). The different ways for sensitivity analysis of TFP have been explained. The model for economic growth is derived from Cobb Douglas Production Function by incorporating the human capital. The simultaneous equation model is introduced which consists of different

¹⁸ Mayer(2001) used Granger Causality Test for the investigation of causal relationship between health and economic growth, Narayan and Russel (2004) found bidirectional causality in human capital and exports, Meulemeester and Denis(1995) found causal relationship in higher education and economic development in Sweden, United Kingdom, Japan and France but not in Italy or Australia.

equation for economic growth, education, health, R&D, Labour Force Participation Rate and Physical capital. The methods for estimation of economic growth and simultaneous equation models are described as Ordinary Least Squares Method and Two Stage Least Squares Method. In order to check Stationarity of the data ADF test will be used. If a time series has a unit root, it will be made stationary by taking first difference. If the data showed the existence of unit root then long run relationship will be checked by using Johansen Cointegration test. At the end Granger Causality test will be used to achieve objectives of the study.

Chapter 5

RESULTS AND DISCUSSION

5.1 Introduction

In this chapter, the empirical results from the models of the study are given. The results have been explained in detail from economic and econometric point of view. Almost all results are reasonable and are found significant according to the theoretical models. The Total Factor Productivity (TFP) models, economic growth models and simultaneous equation models have been analyzed by using Growth Accounting, Ordinary Least Squares (OLS) Method, and Two Stage Least Squares Method (TSLS) respectively. In order to avoid the problem of spurious regression, stationarity has been checked by using Augmented Dicky Fuller (ADF) test. The variables, which are not stationary, are made stationary in light of the results of ADF test. In order to find out the relationship of human capital and economic growth in the long run, Johansen Coitgration test has been used. The existence of causal relationship between human capital and economic growth has been analyzed by using Granger causality test. The results of the study have been presented in the form of tables and equations.

5.2 Results of Total Factor Productivity Model

Over the last three decades, there has been a lively debate on the determinants of economic growth. It is being studied whether factor accumulation or TFP is the determinant of variation in per capita GDP growth. The economic growth literature relevant to Total Factor Productivity (TFP) is rich in case of developed countries but there are fewer studies in case of developing countries. The foremost reason is data availability problems in these economies. In case of Pakistan, we find limited studies but most of them concentrated on sector- wise TFP especially on agriculture and manufacturing sectors.

The present study is based on Growth Accounting Method (GAM) for calculating the TFP in Pakistan Economy during the period 1971-2008. The major obstacle in calculation of TFP was the factor shares. It was a tough task to get appropriate shares of physical capital (S_K), labour (S_L) and human capital ($1 - S_K - S_L$). Following the Studies relevant to Pakistan and other

economies of same nature, the constant share of capital has been used as 0.33, the share of labour as 0.33 and share of human capital as 0.34¹⁹.

It may be useful, to give a cursory look to the growth of variables relevant to Total Factor Productivity before proceeding to empirical results. The variables of the study grew at different rates during the study period as shown in Table.5.1. The Gross Domestic Product Per Capita (GDPPC) grew at 4 percent during 1971. It showed handsome increase in next two years but a visible fall in 1975 and 1976. Its growth rate remained in double digit till 1984 but it remained in single digit the following years till 1989. In 1990s, the growth rate of GDPPC remained good but at the end of the decade it fell to 0.05. The growth rate of GDPPC stayed stable in 2000s. The overall growth of GDPPC remained 13 percent during the period 1971-2008.

The growth rate of physical capital (GFCF) showed huge variation in the study period. In 1971, the growth rate of physical capital was 3 percent but in 1974 and 1976, it remained exemplary. The growth rate of physical capital remained stable during 1980s and 1990s with the exception of last few years of 1990s. During the 2000s, it showed much higher fluctuations. As a whole, it grew on average at 17 percent during the study period.

The labour growth rate was 3% at the beginning of the study period. The growth rate of labour remained mostly below 5% annually during 1970s. During 1980s, the growth rate behaved in similar fashion with the exception of two years 1982 and 1989, when it remained 5% and 12% respectively. The growth rate of labour mostly remained below 5% till the end of the study period except the years 1996 and 2005. The overall growth of labour during 1971-2008 remained 3% per annum. Human capital in form of education (ENRG) also elucidated massive variation. The growth rate of ENRG increased from 3% in 1971 to 7% per annum in 1973 and 12% in 1976. The growth rate of ENRG remained substantially low from 1977 to 1980. However, the growth rate increased to 11% in 1984 but the rate was not stable as it fell down in next 4 years. The overall growth of ENRG during 1971-2008 is 4% percent. The growth rate of health (Life Expectancy) remained mostly within the range of 1% to 3%. It showed zero growth for many years during the period 1971-2008. The R&D sector in Pakistan experienced dramatic fluctuations. Its growth rate was negative (-15%) in at the beginning of the period but it increased very rapidly in following years of 1970s. The same behaviour of growth rate of R&D

¹⁹ Besudeb & Bari (2000), Park (2010), Ahmad *et al* (2008), and Baier (2002) used the capital share within the range of 0.33-0.40 for various developing countries including Pakistan.

continued in 1980s and 1990s. Its growth rate seemed exemplary till mid of 2000s but huge shocks can be seen 2006 to 2008. The overall growth rate of R&D remained 18.9% during the study period.

Table 5.1 Annual Growth Rate of Variables during 1971-2008

Year	GDPPC	GFCF (k)	School Enrollment (ENRG)	Labour	Health	R&D
1971	0.04	0.03	0.03	0.03	0.02	-0.15
1972	0.19	-0.03	0.05	0.04	0.00	0.19
1973	0.29	0.12	0.07	0.00	0.00	0.32
1974	0.23	0.39	0.07	0.04	0.02	0.15
1975	0.12	0.15	0.05	0.01	0.00	0.41
1976	0.10	0.87	0.12	0.04	0.01	0.21
1977	0.14	0.16	0.00	0.04	0.00	0.22
1978	0.08	0.10	-0.08	0.02	0.00	0.26
1979	0.15	0.09	0.01	0.03	0.00	0.31
1980	0.14	0.25	0.02	0.03	0.03	0.08
1981	0.14	0.21	0.04	0.03	0.00	0.33
1982	0.10	0.14	0.05	0.05	0.00	-0.17
1983	0.11	0.13	0.06	0.01	0.02	0.38
1984	0.12	0.12	0.11	0.00	0.03	0.24
1985	0.09	0.13	0.01	0.04	0.00	0.33
1986	0.08	0.12	0.04	0.00	0.00	0.14
1987	0.10	0.14	0.07	0.03	0.00	0.14
1988	0.07	0.11	0.04	0.02	-0.01	0.22
1989	0.08	0.20	0.16	0.12	0.00	0.39
1990	0.16	0.11	0.11	0.00	0.02	0.18
1991	0.15	0.20	0.05	0.00	0.00	0.06
1992	0.08	0.26	0.01	0.03	0.00	0.23
1993	0.14	0.14	0.14	0.03	0.02	0.12
1994	0.16	0.09	0.06	0.03	0.00	0.21
1995	0.18	0.13	0.09	0.04	0.02	0.16
1996	0.13	0.16	0.00	0.07	0.00	0.12
1997	0.10	0.08	0.05	0.02	0.00	0.07
1998	0.05	0.02	0.10	0.02	0.01	-0.71
1999	0.06	0.01	0.05	0.05	0.01	0.13
2000	0.30	0.48	0.04	0.02	0.00	0.23
2001	-0.16	0.09	-0.10	0.01	-0.02	0.00
2002	0.08	0.03	0.02	0.04	0.01	1.62
2003	0.39	0.08	0.04	0.05	0.01	0.33
2004	0.15	0.18	-0.06	0.01	0.00	0.55
2005	0.14	0.15	0.06	0.10	0.01	0.34
2006	0.12	0.57	0.02	0.05	0.00	0.34
2007	0.19	0.15	0.02	0.02	0.00	-0.03
2008	0.19	0.16	0.01	0.03	0.01	-0.34
1971-2008	0.13	0.17	0.04	0.03	0.01	0.189

Source: Author's Calculations based on data from Economic Survey of Pakistan (Various Issues), State Bank of Pakistan(2005), World Development Indicators (various issues), Human Development Reports

The Total Factor Productivity has been computed on five yearly basis and for the whole period. The results show that TFP has been a very important contributor to economic growth. It contributed 59.8 % during 1971-1975. Its contribution remained 7.9 %, 32.9%, 13.6%, 42.8% and 39.3% during periods 1976-1980, 1980-85, 1986-1990, 1990-95 and 1996-00. The total factor productivity share remained very high during the period 2001-05 but it again exhibited a shock of 50% in next five years period. This means that only observed factors are not responsible for economic growth for Pakistan but also the unobserved factor played a significant role in economic growth of Pakistan. The overall contribution of Total Factor Productivity to growth rate of GDPPC in Pakistan remained 38.76% during the study period. The results are more or less similar to the estimates of Besudeb (2000), Ahmed *et al* (2007) and Ahmad (2007)²⁰. The results are shown in Table 5.2.

Table 5.2 Total Factor Productivity during 1971-2008

Period	Contribution of factor inputs (%)			Total Factor Productivity	
	Capital	Labour	Human Capital	Estimate	Contribution (%)
1971-75	25.03	4.55	10.55	0.10416	59.86
1976-80	79.52	8.66	3.90	0.00966	7.92
1980-85	43.02	7.66	16.39	0.03688	32.93
1986-90	45.8	11.45	29.14	0.01334	13.61
1990-95	38.11	2.33	16.76	0.06078	42.80
1996-00	38.67	9.28	12.75	0.0503	39.30
2000-05	29.15	11.55	2.26	0.07388	61.57
2005-08	56.29	5.82	4.00	0.0576	33.88
1971-2008	43.15	7.62	10.46	0.0504	38.77

Source: Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, Sate Bank of Pakistan (2005). Note: The sum of percentage shares may possibly be not equal 100 as the figures are rounded off

²⁰ Ahmed (2007) derived the estimates for contribution of TFP as 36.61 percent for manufacturing sector and 33.86 for agriculture sector in Pakistan. Ahmad et al(2007) and Besudeb (2000) also derived more or less similar results for economy of Pakistan.

The share of TFP in GDP per capita growth shows high fluctuations, when the TFP is figured on five year basis. Therefore, decade wise TFP has also been computed. The sensitivity of TFP to human capital measures have also been analyzed by using education, health and R&D as proxies for human capital separately. The TFP has been estimated by using the following model.

$$TFP = y - 0.33k - 0.33l - 0.34h_c$$

where 'y' shows the growth rate of GDP Per Capita, 'k', 'l' and 'h_c' are growth rates of physical capital, labour and human capital respectively. This model takes the optimum shares of capital and labour. The results have been displayed in table: 5.3. The fluctuations in TFP values seemed to be reduced when education was used as proxy for the human capital and the TFP was calculated decade wise. The maximum value of TFP remained 47.98 during 2001-2008 and the minimum value was 22.87 during 1981-90. The TFP has also been computed in similar fashion by using health as proxy for human capital instead of school enrollment. The contribution of TFP to GDP per capita increased when health was used as proxy for human capital.

The contribution of TFP to GDP per capita increased to 47.74% during the study period with health as measure of human capital. The fluctuation in TFP value, were also reduced as the extreme values remained 44.22% in 1981-90 and 47.32 in 2001-08. The contribution of health to GDP per capita growth remained very low with a range of 0.94% in 2001-08 to 1.65 in 1981-90. However the overall input of TFP to economic growth remained 47.74% in case of health as measure of human capital.

Research and Development is considered another form of human capital in New Growth Theories (NGT). When R&D was exercised as human capital, the TFP contribution knocked down to 18.27% during the study period. Interestingly, high jumps were noted in TFP when health was replaced by R&D. Surprisingly, the contribution of TFP seemed negative in the period 1981-90. The TFP remained very low with a value of 0.81% in 1971-80 but very high with a value of 47.76% in 2001-08. This high value may be to very huge investment in the R&D and higher education sectors during 2001-08.

The effects of factors shares on TFP were captured by incorporating two separate models for the estimation of TFP. In first model minimum possible share of the capital as 0.25 was taken. The model used in this case is given below

$$TFP = y - 0.25k - 0.37l - 0.38h_c$$

Where, 0.37 is the labour share and 0.38 as human capital share.

The results are displayed in table 5.4. The results show that the TFP contribution to GDP per capita growth rate increased to 46.72 % in case of Education and 57.08% in case of health during the study period. However, it remained 24.14 % during the same period in case of R&D. The share of Capital in GDP per capita growth decreased to 32.64 % during the study period. The contribution of labour and education also showed some improvement. This shows that the TFP is sensitive to capital share.

Table 5.3 Decade Wise Total Factor Productivity TFP

Period	Contribution of Labour and Capital to GDP Per capita (%)		Contribution to GDP (Education as Human Capital) (%)		Contribution to GDP (Health as Human Capital (%))		Contribution to GDP (R&D as Human Capital) (%)	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	46.93	6.78	7.67	38.62	1.64	44.65	45.48	0.81
1981-90	44.58	9.55	23.00	22.87	1.65	44.22	70.36	-24.49
1991-00	38.44	5.68	15.15	40.74	1.60	54.28	15.33	40.56
2001-08	42.37	9.37	0.27	47.98	0.94	47.32	0.49	47.76
1971-2008	43.09	7.72	10.72	38.47	1.45	47.74	30.93	18.27

Source : Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, State Bank of Pakistan (2005)

Table 5.4 TFP Model with Minimum Capital Share

Period	Contribution of Labour and Capital to GDP (%)		Contribution to GDP (Education as Human Capital) (%)		Contribution to GDP (Health as Human Capital) (%)		Contribution to GDP (R&D as Human Capital) (%)	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	35.55	7.60	8.57	48.28	1.84	55.01	54.04	6.02
1981-90	33.78	10.70	25.71	29.81	1.84	53.68	51.34	23.12
1991-00	29.12	6.37	16.93	47.58	1.78	62.73	44.26	47.39
2001-08	32.09	10.50	0.30	57.09	1.04	56.35	48.79	56.84
1971-2008	32.64	8.66	11.98	46.72	1.62	57.08	49.61	24.14

Source: Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, Sate Bank of Pakistan (2005). The formula used for calculation of TFP is $TFP = y - 0.25k - 0.37l - 0.38hc$

The share of capital if increased to 0.50 and shares of the labour and human capital decreased, TFP shows variation. This has been analyzed by using the following model.

$$TFP = y - 0.50k - 0.25l - 0.25h_c$$

The results are displayed in Table 5.5 which show that by taking maximum value of capital and minimum value of labour, the share of TFP declines from 46.72% (with capital share 0.25) to 20.99%, if education is used as human capital measure. The contribution of TFP is 27.80 % in case of Health and surprisingly, 6.13 % in case of R&D. the share of capital.

Summarizing the discussion of TFP and economic growth of Pakistan during 1971-2008, it is concluded that TFP contributes 38.47% to the GDP growth rate of Pakistan. Among the set of factor inputs, the contribution of capital is highest and of labour is smallest. The contribution of capital, labour and education in GDP growth is 43.09 %, 7.72 % and 10.72 % respectively. The TFP contribution in GDP growth rate depends on measure of human capital to a great extent.

Changing the human capital measure brings variation in TFP. In other words, the contribution of TFP to economic growth of Pakistan is sensitive to the proxy for human capital. Similarly, TFP shows higher jumps in short periods but when calculated decade wise the fluctuations were controlled to some extent. Similarly, the share of factors is also an important determinant of TFP contribution to economic growth. As in case of the present study, the observed shares of capital were taken as 0.33 and 0.33 on the basis of the previous studies relevant to Pakistan and similar economies. The higher capital share leads to higher contribution of capital to economic growth and lower share reduces its contribution to economic growth.

Table 5.5 TFP with Maximum share of capital

Period	Contribution of Labour and Capital to GDP		Contribution of TFP to GDP with Education as Human Capital		Contribution TFP to GDP with Health as Human Capital		Contribution TFP to GDP with R&D as Human Capital	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	71.11	5.13	5.64	18.12	1.21	22.55	33.44	- 9.68
1981-90	67.55	7.23	16.91	8.30	1.21	24.00	51.73	- 26.52
1991-00	58.24	4.30	11.13	26.32	1.18	36.29	11.27	26.19
2001-08	64.20	7.10	0.20	28.50	0.68	28.01	0.36	28.34
1971-2008	65.28	5.85	7.88	20.99	1.06	27.80	22.74	6.13

Source: Author's Calculations based on dataset of Economic Survey of Pakistan (Various Issues), World Development Indicators, State Bank of Pakistan (2005). The formula used for calculation of TFP is $TFP = y - .50k - 0.25l - 0.25h$

5.3 Total Factor Productivity Comparison with Selected Asian Countries

The present section is comparing the contribution of Total Factor Productivity (TFP) to economic growth in Pakistan with seven Asian countries. The countries have been selected either on the basis of geographic location surrounding the study area or on the basis of similar characteristics as Pakistan. The result is not only expected to support the previous studies conducted in the overall region but also highlight some new facts. Some of the studies like Young (1989), Young (1993) and Kim and Lau (1994) viewed the contribution of capital inputs to economic growth greater than TFP in empirical studies of Asian economies. The present study is expected to explore not only the contribution of TFP as well as physical capital, human capital and labour in the chosen economies.

India, is one of the most influential countries of the region. It has huge population size and labour abundant economy. Its economy is also gigantic with extensive trade boundaries all over the world. Interestingly, following the pattern of developing economies TFP is a major contributor to economic growth in India. It contributed 19.53% to GDP per capita during 1971-80 much lower than Pakistan. However, during the next decade its contribution jumped to 44.02 while the one of Pakistan remained steady. The contribution of TFP to GDP per capita further increased to 54.31 during the period 1991-2000. These estimates are similar to some of the previous studies²¹. The TFP declined to 38.20% during 2000-2008. However the overall contribution of TFP to GDP per Capita in India remained 44.16% against the 47.74 % of Pakistan during the whole study period (1971-2008). Physical capital is the second higher contributor to Indian economy after TFP. It contributed 40.90 % to the economic growth of India during 1971-2008. During decade wise contribution, it showed some fluctuations. However, it remained a significant part of growth process along with TFP. The results are displayed in tables 5.6 and 5.7.

The estimates of the physical capital are in line with the previous studies. The share of human capital (Health) remained very low like Pakistan. It contributed 2.12% to economic growth throughout the study period. The analysis of TFP in India as compared to Pakistan shows that there have been many fluctuations in TFP some periods. Changes in R&D expenditures, inflow of FDI

²¹ Asian Productivity Organization (2004) estimated TFP in India 49.38 for 1985-89 and 44.41 for the period 1995-99. Rodrick and Subramanian (2004) found TFP contribution around 60% during 1980-2000 in India.

and foreign inputs, changes in scale of production, evolution of private sector, and trade openness are believed to be some of the factors which have brought about fluctuations in contribution of TFP to economic growth of India.

China is considered a statist economy owing to the fact that its economy is directly or indirectly controlled by centralized authority. China has the highest number of workers around the world. It is on the path of industrialization and emerged as a global economic power in recent decades with sustained economic growth rate over the last decade and half. Chinese boundaries touch the Northern Pakistan and both countries have friendly relations. The Chinese economy is mostly dependent on foreign trade and most of researchers have struggled to explore the sources of productivity in China. Results of the present study show that TFP is an important source of Chinese economic growth. The share of TFP in economic growth remained 52.42% during the study period which is little bit higher than the one of Pakistan share in the period. Capital, Labour and human capital are the 2nd, 3rd and 4th largest contributors to economic growth of China respectively. The result of the TFP share in economic growth of China of the present study is similar to Hall and Jones (1996) and a bit smaller than Bosworth (1995). However it is different from the results of some other studies²²

During sub periods, in the 1st decade of the study period TFP added a smaller percentage of 23.82 to economic growth in China. Its share increased to 58.74% and 54.06 % in next two decades. TFP share remained 55.88% during 2000-2001 in Chinese economy. The second major portion of the GDP per capita is covered by physical capital. Initially, 57.09% of the economic growth was attributed to physical capital but gradually its share fell down. It contributed 41.4% to Chinese economy at the end of the study period as shown in the Table 5.7. This shows that the sources of economic growth in china are more or less than economy of Pakistan. It is evident from the estimates of TFP, Physical capital, Human Capital and Labour in China and Pakistan.

Iran, is another country which touches the boundaries of the study area. With extensive deposits of hydrocarbon, Iran is an influential country in oil business. TFP is a substantial

²² Iwata *et al* (2002) estimated TFP in China as 41% and Yanrui Wu (1995) found it 50%to 60 % for the period 1985-1991 in Chinese economy.

ingredient of Iranian economic growth. According to the results of present study, TFP added 55.67% to economic growth during the study period. Physical capital remained the second higher contributor and the human capital least contributor to the growth rate of GDP per capita in Iran during 1971-2008. The estimates are in between the range of studies conducted by Asian Productivity Organization (2004) and Jbili *et al* (2007)²³. In the sub periods, the contribution of TFP 55.91%, 51.185, 56.78% and 62.12% during the 1971-80, 1981-90, 1991-2000 and 2001-08 respectively. The capital contribution remained lower than TFP in all the sub periods within the range 33.03% in 2001-2008 to 41.39% in 1971-80.

Indonesia is a rising Asian economic power. With rapid industrialization, it has attained sustained economic growth. The present study is comparing the contribution of different sources to economic growth of Pakistan with Indonesia. The TFP has been the chief provider to economic growth in Indonesia throughout its history. Its addition to GDP per capita remained 58.87%, 52.27%, 58.93% and 58.91% during 1971-80, 1981-90, 1991-200 and 2000-2008 respectively. As a whole, it contributed 57.66% during 1971-2008, which the highest contribution to economic growth in all the selected countries and Pakistan during the study period. The results regarding the share of TFP in Indonesian economic growth are much higher than the estimates derived by Drydale and Huang (1995), and Iwata *et al* (2002). However, addition of its second chief contributor capital stayed lower than Pakistan and other selected countries in most of sub periods as well as in the whole study period. Its share was 36.6% during the period 1971-2008 which is much smaller than the estimation of Bosworth (1995) and Bu (2004)²⁴. This shows that the addition of TFP and other factors to the Indonesian economy is some what different from Pakistan economy.

Bangladesh is another selected country for comparison with economy of Pakistan. Bangladesh remained a part of Pakistan, previously called East Pakistan before the beginning of the study period. With agro-based economy, Bangladesh is now moving towards industrialization. Surprisingly, TFP share in economic growth of Bangladesh is the smallest among the set of selected countries. It has thrown in 36.35% to economic growth during 1971-2008. This share is

²³ The Asian Productivity Organization (2004) estimated TFP in Iran 105.64 % during 1985-89, 64.43% during 1990-94 and 37.09 % in the period 1995-99 while Jbili *et al*(2007), expected its share one third (33%).

²⁴ Bosworth (1995) estimated the share of physical capital as 3.5/5 or 70%.

much lower than the results of Klenow and Andres (1997). However, it is close to the study of Besudeb and Bari (2000)²⁵. The share of Physical capital remained on top in sources of Bangladesh economic growth. During the sub periods, TFP remained in the range of 20.11% - 43.62%. The lowest value was in 1991-2000 while the highest value was 2001-2008. The contribution of human capital also showed great variation. It fluctuated between the minimum and maximum values 1.42 % and 6.08 % during the four sub periods against the lower share of human capital in the economy of Pakistan.

In Sri Lanka, 54.20% of economic growth has been attributed to TFP during the study period. This behaviour of TFP is similar to the other Asian economies. In the four sub periods, great variation seemed in the TFP share. Its lowest estimate was 34.39% in 1971-80 which is half of the estimate in the next decade. This was due to some structural transformation in 1980s and 1990s. The sustained GDP growth in 1980s followed economic liberalization, which took the private sector investment to 19% of GDP (IMF, 2007). Physical capital is another significant ingredient of the Sri Lankan economy. Its share stayed at 40.90% in the study period. This share is close to the contribution of physical capital to the economic growth of Pakistan. Unfortunately, the study results regarding the share of physical capital are contradicted with other studies²⁶.

Nepal is another Asian economy selected for comparison on the basis of its contribution in Asian forum SAARC. It is an active member of SAARC and its efforts for political and economic activities in SAARC region of Asia are appreciable. The TFP appeared as major contributor to the economy of Nepal with a marginal difference with the contribution of Physical capital. It added 44.91 % to The GDP Per Capita as compared to the physical Capital share of 43.44%.

²⁵ Besudeb and Bari (2000) estimated the share of TFP in economic growth of Bangladesh as 42.73 for 1980s.

²⁶ Besudeb and Bari (2000) found the share of physical capital 59% during 1980s and Jerzmanowski (2007) estimated it 55% in cross country comparison.

Table 5.6 : TFP Comparison of Pakistan with Neighbouring Asian Countries

Country	Contribution of TFP to Economic Growth (%)	Contribution to Economic Growth (%)		
		Labour	Capital	Human Capital (Health)
Period: 1971-1980				
Pakistan	46.93	6.78	46.93	1.64
India	19.53	11.03	65.07	4.37
Bangladesh	36.78	4.08	57.72	1.42
China	23.82	15.16	57.09	3.93
Iran	51.91	5.23	41.39	1.47
Indonesia	58.87	3.13	36.55	1.45
Nepal	50.13	8.24	37.13	4.50
Srilanka	34.39	5.38	58.53	1.69
Period: 1981-1990				
Pakistan	44.22	9.55	44.58	1.65
India	44.02	7.10	47.47	1.41
Bangladesh	39.46	8.83	47.98	3.72
China	58.74	6.04	34.47	0.75
Iran	51.18	7.21	39.43	2.18
Indonesia	52.27	6.24	38.05	3.44
Nepal	49.63	5.78	41.81	2.78
Srilanka	69.00	3.80	26.56	0.61
Period:1991-2000				
Pakistan	54.28	5.68	38.44	1.60
India	54.31	6.63	37.78	1.28
Bangladesh	20.11	14.63	59.18	6.08
China	54.06	2.44	42.65	0.85
Iran	56.71	3.98	38.64	0.67
Indonesia	58.93	3.72	35.98	1.37
Nepal	42.99	8.46	44.23	4.31
Srilanka	53.53	3.89	42.22	0.35
Period:2001-2008				
Pakistan	47.32	9.37	42.37	0.94
India	38.20	6.60	53.00	2.20
Bangladesh	43.62	9.45	43.56	3.37
China	55.88	2.98	40.33	0.81
Iran	62.12	4.30	33.03	0.55
Indonesia	58.91	3.45	36.07	1.57
Nepal	37.39	11.28	47.15	4.18
Srilanka	60.22	2.49	36.18	1.08

Source: Author's calculations based on Data taken from World Development Indicators (Various issues), Maddison (2006), State Bank of Pakistan (2005) and Economic Survey of Pakistan (Different Issues). *The figures in calculations have been rounded off, so possibly the totals may not be necessarily equal to 100.

Table 5.7 Comparison of Total Factor Productivity (1971-2008)

Country	Contribution of TFP to Economic Growth (%)	Contribution to Economic Growth (%)		
		Capital	Labour	Human Capital
Pakistan	47.74	43.09	7.72	1.45
India	44.16	47.06	6.66	2.12
Bangladesh	36.35	53.08	7.55	3.02
China	52.42	41.40	5.02	1.16
Iran	55.67	38.28	4.94	1.11
Indonesia	57.66	36.60	3.92	1.82
Nepal	44.91	43.44	7.79	3.86
Srilanka	54.20	40.90	3.95	0.94

Source: Author's calculations based on Data taken from World Development Indicators (Various issues), Maddison (2006), State Bank of Pakistan (2005) and Economic Survey of Pakistan (Different Issues). *The figures in calculations have been rounded off, so possibly the totals may not be necessarily equal to 100.

5.4 Results from Economic Growth Models

Keeping in view the determinants of economic growth, Ordinary Least Squares (OLS) method is applied to estimate the economic growth equation. The level of GDP per capita is treated as dependent Equation. Physical Capital, labour force, Education, health and Research and Development (R&D) are among the set of independent variables. The physical capital has been captured by Gross Fixed Capital Formation. As the present study aims at exploring the role of human capital in economic growth of Pakistan, human capital was measured by three major measures Education, Health and Research & Development (R&D). School enrollment has been used as proxy for education. As there are different stages of education, therefore the impact of Gross School Enrollment, Elementary School Enrollment, Secondary School Enrollment and enrollment at Higher Levels of Education has been analyzed. The widely accepted measure for health is the life expectancy; therefore the present study has used life expectancy as measures for health.

All variables are in log linear form. Physical capital (K) is an important variable of most of economic growth studies. It is believed that increase in physical will fetch higher economic growth²⁷ so; the present study also expected that physical capital will effect economic growth positively. The results show that Physical Capital in form of Gross Fixed Capital significantly

²⁷ Sundararajan and Thakur (1980), Khan and Reinhart (1990), and Easterly and Rebelo (1993) expected positive relationship between physical capital and economic growth.

affects GDP per capita (Real). Human capital is considered as engine of economic growth and keeping in view the importance of human capital, the present study was planned to find the role of human capital in economic growth of Pakistan. In empirical studies different measure are used for human capital. Most studies have used education or health or R&D as measure for human capital.

Education, an important variable in empirical studies has been measured by School Enrollment in Pakistan during the study period²⁸. The estimation results show that human capital in form of education (Secondary School Enrollment) has positively affected economic growth in Pakistan during 1971-2008. The result appeared as statistically insignificant.

Health in form of human capital also affects the economic growth. Good health means healthy physique and mind, which improves efficiency. The results show that health in form of human capital significantly affects economic growth. The result is significant at 10 % level of significance. This aids to the views of the earlier studies. This also points out the fact that if life expectancy is higher in an economy, there are incentives to work more to preserve future. This pushes up the efficiency of labour, which leads to economic growth. Another important variable of the present study is labour. It also affects the economic growth positively and the result is significant at 1% level of significance.

Research and Development (R&D) can play a critical role in innovation, raising productivity and accelerating the pace of economic growth. The present study is different from the other growth studies in the study area in the sense that it has used human capital in form of R&D along with other measures of human capital in the study area. The earlier studies have used education or health and in rare cases R&D as human capital in growth regressions. One of the major causes of rare studies on the role of R&D in Pakistan can be the non-availability of appropriate data. Proper time series data in form of R&D expenditures, R&D Scientific Publications, Innovations and number of researcher per specific proportion of population is not available in Pakistan. The present study left no stone unturned for obtaining proper data on R&D. Only few years of publications data and limited years Expenditure data was available. So the present study has used the expenditure on higher education as proxy for the R&D after

²⁸ Barro(1991), Abbas(2001), Canlas (2003) and McMahon (1998) used school enrollment as measure for education.

consultation with human capital and economic growth experts. This is justified on the basis that universities are home for R&D in the study area and most of research except few R&D organizations is conducted in universities. For further justification on the suggestion of experts, the available scientific publication and expenditures on higher education were tested for correlation. The correlation results showed 84.5% of correlation in expenditures on higher education and scientific publications. Therefore, expenditures on higher education have been used as proxy for R&D in Pakistan in the present study. The results show that human capital in form of R&D affects economic growth positively but the result is significant statistically at 1% level of significance. The sign of the coefficient is positive as expected. However the coefficient is smaller as compared to other measures of human capital. The results of economic growth model are given in table 5.8.

The values of R^2 and $R^2 - \text{adjusted}$ are 94.8% and 94.1% which shows goodness of fit. The Breusch-Godfrey LM Statistic is insignificant which shows non existence of autocorrelation in the model.

In order to examine the role of human capital in different forms of education in economic growth of Pakistan during 1971-2008, the economic growth model has been estimated with different levels of education keeping other variables of model the same. The elementary school enrollment, Gross school enrollment and enrollment at higher levels of education are used as proxies for education in different equation of economic growth. The results are displayed in table 5.8. The regression results of the equation with elementary school enrollment show that education affects economic growth positively. However, the result is not significant statistically. The other variables of the study health, labour, R&D and physical capital are significant at 10%, 1%, 1% and 1% respectively. The R^2 and $R^2 - \text{Adj}$ are 94.8% and 94.02 % which shows more than 94% variation in GDPPC Real is explained by these observed factors. The Breusch-Godfrey LM Statistic is 2.35 which is not significant. This rejects the claim of autocorrelation in the model.

The equation of economic growth is then estimated by taking gross school enrollment. All variables except gross school enrollment show significant effects on economic growth with expected signs. Education in form of gross school enrollment shows insignificant effect and unexpected negative sign. The economic growth model is then estimated by replacing the school enrollment by higher education enrollment. Gross enrollment at college and university level for the

observed period has been used as proxy for education in the economic growth model. The results obtained are more favourable and education appeared as significant variable. Other variables of the study, physical capital, labour, R&D, and health remain significant determinants of economic growth in Pakistan during the study period. The R^2 , R^2 -Adj, F-Statistic and Breusch-Godfrey LM Statistic are in the acceptable standard range.

Table 5.8 Results of Economic Growth Model

Results of equation with Secondary School Enrollment

Y = -15.2726 + 0.12873 LENRS+ 1.9065 LHealth+0.2255 LGFCF+0.8199 L+0.1199LRD
 S.E 4.5740 0.1165 1.03447 0.0710 0.2888 0.0288
 t-Stat (-3.3389)* (1.1050) (1.8429)*** (3.1751)* (2.8387)* (4.1563)*
 R-Sq = 94.8% R-Sq (Adj) = 94.1%
 F-statistic= 118.094
 Breusch-Godfrey LM Stat = 2.41

Results of equation with Elementary School Enrollment

Y = --15.402 + 0.12632 LENRE+ 1.9085 LHealth+0.2250 LGFCF+0.8330 L+0.1180 LRD
 S.E 4.5780 0.1241 1.0487 0.07137 0.2882 0.0291
 t-Sta (-3.3644)* (1.01739) (1.8198)*** (3.1519)* (2.8898)* (4.0567)*
 R-Sq = 94.8% R-Sq (Adj) = 94.02%
 F-statistic= 117.397 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Stat = 2.35

Results of equation with Gross School Enrollment

Y = -16.680 -0.0240 LENRG+ 2.4326 L Health+ 0.2054 LGFCF+0.8810 L+ 0.1200 LRD
 S.E 3.5808 0.0897 0.7961 0.07272 0.2689 0.0349
 t-Sta (-4.6581)* (-0.2682) (3.0556)* (2.8251)* (3.2758)* (3.4347)*
 R-Sq = 94.7 % R-Sq (Adj) = 93.8 %
 F-statistic= 113.76 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Stat = 1.78

Results of equation with Higher Education Enrollment

Y = -13.738 +0.2292 LENRHE+ 1.7288 LHealth+0.2275 LGFCF+0.69754 L+ 0.1157 LRD
 S.E 2.9225 0.1144 0.5678 0.0717 0.2441 0.03227
 t-Stat (-4.7008)* (2.0036)*** (3.0444)* (3.1731)** (2.8566)* (3.5880)*
 R-Sq = 95.07 % R-Sq (Adj) = 94.3%
 F-statistic= 123.494 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Stat = 1.77

5.5 Results from Simultaneous Equations Model

The simultaneous equation model has been used in the present study to examine interdependency of variables of the study. The effect of physical capital, human capital and labour force on economic growth of Pakistan has been analyzed by using the simultaneous equations model. The model included separate equations for economic growth, education, health, R&D, Physical capital and Labour. The econometric technique Two Stage Least Squares (TSLS) has been used for this purpose. The results are displayed in Table 5.9. The results of most of the models are satisfactory based on the statistical and economic criteria. The R^2 of all equations is very high showing validity of goodness of fit.

In economic growth equation, all variables have expected signs and most of variables are statistically significant. The physical capital which has been proxied by Gross fixed Capital is significant at 1% level of significance. The sign of education, an important measure of human capital is positive as expected which shows a positive impact of education on economic growth of Pakistan during the study period. The result is significant at 10% level of significance. Labour, another important variable of most of economic growth studies, appeared as highly significant with expected positive sign. It shows positive contribution of labour to economic growth in Pakistan. The third and MGTs variable R&D also remained significant with positive sign showing positive human capital-economic growth nexus in Pakistan during the study period. The results are satisfactory as the R-Sq is 94.5% which is good for time series data. These results are in line with the previous studies but the difference is that in the present study, the impact of human capital has been analyzed by using three different proxies which are hard to find in past studies in the study area.

Education is one of the most widely used measures for human capital in empirical literature of economic growth. It is introduced in Simultaneous equations model to avoid the simultaneity problem with other explanatory variables of economic growth equation. The variables included in the education model are Physical capital, the access to education institutions captured by number of educational institutions in Pakistan, the quality of institutions and health. The Results show that Real Gross Domestic Product per capita (RGDPPC) remained statistically significant with positive

sign at 5% level of significance. This shows that higher the GDPPC, the higher will be incentives for enrollment in education. The second factor which plays an important role in education is the availability or access to educational institutions. If people have easy access to schools, there are more chances that they will enroll their children in schools but if schools are not in their access or the access is difficult for them then school enrollment will be negatively affected. The results of education equation show that the easy access to educational institutions positively affects the school enrollment in Pakistan. The result is significant at 1% level of Significance. One of the unique features of the study in hand is that it has also taken into account the quality of educational institutions along with the number of institutions. The quality of educational institutions is measured by Pupil-Teacher Ratio (PTR). PTR is found to be positively affecting school enrollment and statistically significant. Similarly, health is also in positive relation with school enrollment but the result is not significant statistically. The R-squared and Adjusted R-sq are 97.7% and 97.5% respectively. This indicates the fact that more than 97% variation in educational enrollment is explained by RGDPPC, Educational institutions, the quality of educational institutions and health.

In equation for health, Real GDP Per Capita, Education, and the quality of health institutions are the explanatory variables. The Two Stage Least Squares Results show that education affects health positively and the result is statistically significant at 5% level of significance. The quality of health appeared as a significant determinant of health in simultaneous equation model. The Real GDP Per Capita also affects health but the result is statistically not significant.

In R&D equation, Real Gross Domestic Product Per Capita (RGDPPC), Education, educational institutions and the quality of educational institutions are kept explanatory variables. Following R&D and economic growth literature, these variables are expected to affect the R&D significantly. The signs of variables obtained from results of R&D equation in simultaneous equations model are as expected. The RGDP Per Capita is expected to positively affect R&D. It declares the fact with sustained economic growth, R&D is expected to flourish. The result is statistically significant at 10% level of significance. Education is regarded as one of the most influential variables, affecting major socio-economic variables. The results show that education affects R&D positively in Pakistan but the result is not statistically significant. The higher the

enrollment in education, the more are chances for R&D. An access to educational institutions is also an important factor for R&D. Access to education means, availability of higher number of institutions in country so that each and every person has access to it. The results show that access to educational institutions has significant positive effect on R&D. The quality of educational institutions is measured by the pupil-teacher Ratio. The higher ratio is taken lower quality and lower ratio is taken as higher quality of education. The results show that PTR significantly affect the R&D in Pakistan. The values of R-sq and Adjusted R-sq are 94.7 and 94.1% which points out the fact that more than 94% variation in R&D is explained by these observed factors. However the value of Breusch-Godfrey LM Statistic is significant which points towards the existence of lower order autocorrelation.

One of the objectives of the present study is to find the effects of human capital on physical capital accumulation. The physical capital, an explanatory variable in economic growth equation is expected to be affected by variation in RGDPPC, Education, health, Labour and R&D. A separate equation is therefore introduced for the determinants of the physical capital in the present study. In this equation Physical capital is dependent variable and RGDPPC, ENRS, Health, Labour and R&D are among the set of explanatory variables. The results show that Economic growth, Health, Labour and R&D play significant role in physical capital accumulation. These variables are significant at 10%, 1%, 1% and 1% level of significance respectively. All these variables have expected positive sign except RGDPPC. Education also affects the physical capital accumulation positively but the result is statistically insignificant. The R-squared and adjusted R-sq are 98.3 % and 98.03% respectively which indicate that more than 98% of variation in physical capital is explained by RGDPPC, Education, Health, Labour and R&D. The F-Statistic is also highly significant.

A separate equation has been introduced in simultaneous equations model for Labour Force Participation Rate (LFPR). The results of TSLS show that RGDP Per Capita, education, health and total labour force significantly affect the labour force participation in Pakistan. The coefficient of RGDP Per Capita is positive which indicate positive relationship between LFPR and RGDP Per Capita. The result is statistically significant at 10% level of significance. Health, an important variable of the equation also positively and significantly affects LFPR in Pakistan. The effect of education is also statistically significant but the the sign is unexpected. The R-Squared, Adjusted R-Sq, F-Statistic and LM Test, all show validity of the equation.

Table 5.9 Results of Simultaneous equations Model.

Economic Growth Model

$$\text{LGDPPCR} = -16.9816 + 0.2694 \text{LGFCF} + 0.1836 \text{LENRS} + 2.0384 \text{Health} + 0.9037 \text{L} + 0.1209 \text{LRD}$$

S.E	4.266474	0.071848	0.1018	1.0554	0.2597	0.0284
t. Stat	(-3.9802)*	(3.7498)*	(1.8036)***	(1.9312)***	(3.4803)*	(4.2562)*

R-Sq = 94.5% R-Sq (Adj) = 93.7 F-statistic= 106.10 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Test = 2.38

Education model

$$\text{LENRS} = -3.1827 + 0.7001 \text{LRGDPPC} + 0.5351 \text{LEdins} + 0.1926 \text{LPTR} + 1.8275 \text{LHealth}$$

S.E	3.4271	0.3073	0.149773	0.1112	1.2399
t-Stat	(-0.9287)	(2.2809)**	(3.573)*	(1.7309)***	(1.4739)

R-squared = 97.7% Adjusted R-sq = 97.5%
 F-statistic= 353.7024 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Test = 18.7*

Health Model

$$\text{LHealth} = 4.1722 + 0.0167 \text{LRGDPPC} + 0.0490 \text{LENRS} - 0.0917 \text{LDPR}$$

S.E	0.5752	0.0227	0.0222	0.0310
t-Stat	(7.2536)*	(0.7331)	(2.2078)**	(-2.9594)*

R-squared = 97.3% R-squared (adj) = 97%
 F-statistic= 293.369 Prob (F-Statistic) = 0.00000
 Breusch-Godfrey LM Statistic = 11.66

R&D Model

$$\text{LRD} = -8.8839 + 2.3083 \text{LRGDPPC} + 0.09575 \text{LENRS} + 1.77408 \text{LEdins} - 1.3642 \text{LPTR}$$

S.E	3.8468	1.2732	0.8617	0.80166	0.6385
t-Stat	(-2.3093)**	(1.8129)***	(0.1111)	(2.2129)**	(-2.1366)**

R-squared = 94.7% R-squared (adj) = 94.1%
 F-statistic= 142.37 Prob(F-statistic)= 0.0000
 Breusch-Godfrey LM Statistic = 1.16

Physical Capital Model

$$\text{LGFCF} = -67.071 - 3.210 \text{LRGDPPC} + 0.277 \text{LENRS} + 8.826 \text{LHealth} + 3.491 \text{L} + 0.4393 \text{LRD}$$

S.E	12.50186	1.339871	0.486434	3.723870	0.84623	0.133175
t-Stat	(-5.3649)*	(-2.3883)**	(0.5684)	(2.3702)*	(4.1258)*	(3.2986)*

R-squared = 98.3 % Adjusted R-sq = 98.03
 F-statistic = 374.358 Prob (F-statistic) = 0.00000
 Breusch-Godfrey LM Statistic = 1.88

Labour Force Participation Model

$$\text{LLFPR} = 3.19184 + 0.112185 \text{RGDPPC} + 1.23048 \text{Health} - 0.0867 \text{LENRHM} + 0.3464 \text{LTLF}$$

S.E	0.7158	0.0581	0.2993	0.0412	0.0561
t-stat	(4.4588)*	(1.9311)***	(4.1104)*	(-2.1042)**	(6.1703)*

R-Squared= 76.27 % Adjusted R-Sq= 73.3%
 F-Statistic= 18.3269 Prob F-Statistic= 0.0000
 Breusch-Godfrey LM Statistic = 2.89

5.6 Results for Unit Root Test

The stationarity of variables in the present study has been checked by using Augmented Dickey Fuller (ADF) test. The variables which are not stationary at level are made stationary after taking 1st difference as they are expected to be stationary of first order. But it is not necessary that all series for which null hypothesis of unit root is accepted may be integrated of first order. The stationarity of variables in log form was checked with intercept only and then with intercept and trend. The lag length was selected by Akaike Information Criteria (AIC)²⁹. The variables analyzed for stationarity are Gross Domestic Product Per Capita (LRGDPPC), Physical Capital (LGFCF), Labour (LLF), Secondary School Enrollment (LENRS), Elementary School Enrollment (LENRE), Gross School Enrollment (LENRG), Higher Education Enrollment (LENRHE), Health (LHealth), Research and Development (LRD), Labour Force Participation Rate (LLFPR), Educational Institutions (LEdins), Pupil- Teacher Ratio (LPTR), and Patient-Doctor Ratio (LDPR).

The results are derived by using Eviews 6. The test is conducted at level with the assumption of intercept but no trend. The results showed that when the test is conducted with intercept but no trend, all variables in log form remain non-stationary at least at 1%, 5% and 10% level of significance. Therefore, in order to make the variables stationary, their first difference was taken and again analyzed for unit root. All variables of the study became stationary at first difference. The results are shown in Table 5.10. The symbols I(0) and I(1) show results at level and first difference respectively.

The stationarity of the data is then checked with intercept and trend. Following the similar behavior, all variables of the study remain non-stationary at level with different lags and levels of significance. Therefore, they were converted to first difference and again tested for existence of unit root. The behaviour of variables in first difference was according to the expectations and all

²⁹ The lag length with Minimum Akaike Information Criteria was selected

the variables became stationary at first difference. The results indicate that variables Gross Domestic Product Per Capita (LRGDPPC), Physical Capital (LGFCF), Labour (LLF), Secondary School Enrollment (LENRS), Elementary School Enrollment (LENRE), Gross School Enrollment (LENRG), Higher Education Enrollment (ENRHE), Health (LHealth), Research and Development (LRD), Labour Force Participation Rate (LLFPR), Educational Institutions (LEdins), Pupil-Teacher Ratio (LPTR), and Patient-Doctor Ratio (LDPR) are stationary when first difference is taken. The Results are shown in Table 5.11.

Table: 5.10 ADF Test Results (With intercept but No Trend)

Variable	I(0)					I(1)					Results
	t-Statistic	Critical value			P-value	t-Statistic	Critical Value			P-Value	
		1%	5%	10%			1%	5%	10%		
LRGDP	-0.7820[0]	-3.6210	-2.9434	-2.6103	0.8125	-5.9552 [1]	-3.6329	-2.9484	-2.6129	0.0000*	I(1)
LGFCF	-1.1922 [1]	-3.6268	-2.9458	-2.6115	0.6672	-6.1723[0]	-3.6268	-2.9458	-2.6115	0.0000*	I(1)
LLF	0.7813[1]	-3.6268	-2.9458	-2.6115	0.9923	-7.7544 [0]	-3.6268	-2.9458	-2.6115	0.0000*	I(1)
LENRE	-0.6678[0]	-3.6210	-2.9434	-2.6102	0.8425	-5.8975 [0]	-3.6267	-2.9458	2.6115	0.0000*	I(1)
LENRG	-1.1900[0]	-3.6210	-2.9434	-2.6103	0.6685	-5.0206[0]	-3.6268	-2.9458	-2.6115	0.0002*	I(1)
LENRS	-0.5908 [0]	-3.6210	-2.9434	-2.6103	0.8607	-5.3518[0]	-3.6268	-2.9458	-2.6115	0.0001*	I(1)
LENRHE	-0.1939[0]	-3.6210	-2.9434	-2.6103	0.9305	-5.1899[0]	-3.6268	-2.9458	-2.6115	0.0001*	I(1)
LHealth	-0.6078[0]	-3.6210	-2.9434	-2.6103	0.8568	-6.3426[0]	-3.6268	-2.9458	-2.6115	0.0000*	I(1)
LRD	-1.3174 [0]	-3.6210	-2.9434	-2.6102	0.6112	-5.1376[0]	-3.6268	-2.9458	-2.611531	0.0002*	I(1)
LLFPR	-1.7086 [0]	-3.6210	-2.9434	-2.6103	0.4187	-8.0506[0]	-3.6268	-2.9458	-2.6115	0.0000*	I(1)
LEdins	-1.2304 [0]	-3.6210	-2.9434	-2.6103	0.6508	-4.8765[0]	-3.6268	-2.9458	-2.6115	0.0003*	I(1)
LPTR	-1.1162[0]	-3.6210	-2.9434	-2.6103	0.6991	-5.0338[0]	-3.6268	-2.94584	-2.6115	0.0002*	I(1)
LDPR	0.251550[0]	-3.62102	-2.9434	-2.61026	0.9226	-5.830657	-3.62678	-2.94584	-2.61153	0.0000*	I(1)

Source: Author's Calculations based on data from Economic Survey of Pakistan(Various Issues), State Bank of Pakistan (2005), World Development Indicators(Various Issues), Lag Selection has been made by Using Minimum AIC Criteria. * stands for 1% level of Significance.

Table 5.11 ADF Test Results (With Trend and Intercept)

Variable	I(0)					I(1)					Results
	t-Statistic	Critical value			p-value	t-Statistic	Critical Value			P-Value	
		1%	5%	10%			1%	5%	10%		
LRGDPPC	-2.1706[2]	-4.2436	-3.5443	-3.2047	0.4904	-5.9868[1]	-4.2436	-3.5443	-3.2047	0.0001*	I(1)
LGFCF	-2.9618[1]	-4.2349	-3.5403	-3.2024	0.1565	-6.1951[0]	-4.2350	-3.54032	-3.2024	0.0001*	I(1)
LTLF	-2.5563[0]	-4.2268	-3.5366	-3.2003	0.3012	-7.7943[0]	-4.2350	-3.5403	-3.2024	0.0000*	I(1)
ENRE	-1.6896[0]	-4.2268	-3.5366	-3.2003	0.7358	-5.8570[0]	-4.2349	-3.5403	-3.2024	0.0001*	I(1)
LENRG	-0.7837[0]	-4.2268	-3.5366	-3.2003	0.9581	-5.0886[0]	-4.2350	-3.5403	-3.2024	0.0011*	I(1)
LERNS	-1.5677[0]	-4.2268	-3.5366	-3.2003	0.7865	-5.2966[0]	-4.2305	-3.54032	-3.2024	0.0006*	I(1)
LENRHE	-2.0475[0]	-4.2268	-3.5366	-3.2003	0.5569	-5.1044[0]	-4.2350	-3.5403	-3.2024	0.0011*	I(1)
LHealth	-2.8782[0]	-4.2268	-3.5366	-3.2003	0.1808	-6.2637[0]	-4.2349	-3.54032	-3.2024	0.0000*	I(1)
LRD	-2.1337[0]	-4.2268	-3.5366	-3.2003	0.5109	-5.1302[0]	-4.2349	-3.54032	-3.2024	0.0010*	I(1)
LLFPR	-2.2964[0]	-4.2268	-3.5367	-3.2003	0.4254	-8.3986[0]	-4.2349	-3.5403	-3.2024	0.0000*	I(1)
LEdins	-0.6662[0]	-4.2268	-3.5366	-3.2003	0.9683	-4.8987[0]	-4.2349	-3.5403	-3.2024	0.0018*	I(1)
LPTR	-1.3646[0]	-4.2268	-3.5366	-3.2003	0.8549	-5.0523[0]	-4.2349	-3.54032	-3.2024	0.0012*	I(1)
LDPR	-2.4594 [0]	-4.2268	-3.5366	-3.2003	0.3451	-7.7424[0]	-4.2350	-3.5403	-3.2024	0.0002*	I(1)

Source: Author's Calculations based on dataset of Economic Survey of Pakistan (Various Issues), State Bank of Pakistan (2005), World Development Indicators(Various Issues). Lag Selection has been made by Using Minimum AIC Criteria. * Stands for 1% level of Significance.

5.7 Johansen Cointegration Test Results

As discussed in previous chapters, the major aim of the present study is to find out the role of human capital in economic growth of Pakistan during the period 1971-2008. It was aimed whether human capital in form of education, health and R&D has affected the economic growth of Pakistan. The ADF test results accepted the hypothesis of existence of unit root at level pointing out that all variables are non-stationary at level but stationary at I(1). Therefore, the approach of Cointegration becomes indispensable in such cases. In order to find out the long run relationship and avoid the existence of spurious regression in particular, Johansen Likelihood Ratio Test has been used. This test is used when all variables are stationary at I(1). The results have been displayed in Tables 5.12.1- 5.12.9.

First of all, the economic growth model has been analyzed for Cointegration. This model treats GDPPC in real form as dependent variable while Life expectancy (Health), Secondary School Enrollment (ENRS), Labour Force (LF), Physical Capital (GFCF) and R&D as explanatory variables. The results are exhibited in Table: 5.12.1. The Johansen Cointegration test results rejected the null hypothesis of no cointegration in the variables of the model. The results showed existence of two cointegrating equations at 5% level of significance. This means that the human capital affects economic growth in Pakistan in long run. Therefore, investments made in human capital can produce far-reaching outcome for the economy of Pakistan.

As the study in hand, also aims to find the impact of human capital in different forms of education on economic growth of Pakistan. Therefore, to find the existence of relationship in different levels of education and economic growth, the Johansen approach to Cointegration has been employed. Other variables in the model are kept the same, but three different equations consisting of different levels of education (Elementary School Enrollment, Gross School Enrollment and Higher Education Enrollment) has been tested for Cointegration.

Keeping, other variables of the model same, the Secondary School Enrollment has been substituted by Elementary Schools Enrollment (ENRE). The test is conducted by using similar conditions. The results show three cointegrating equations at 5% level of significance. This means that human capital in form education at elementary level also shows long run relationship

with economic growth. The result is presented in Table 5.12.2. In similar fashion, the test has been conducted for human capital captured by Gross School Enrollment in Pakistan by maintaining other variables of study the same. The results show 3 cointegrating equations with trace statistic at 5% level of significance.

Now to cover the role of higher education in long run economic growth of Pakistan, the enrollment at college and university level has been used. The secondary school enrollment has been now replaced by higher education enrollment. Physical capital, Health, R&D and Labour remained among the set of explanatory variables while GDP per Capita (Real) remains the dependent variable. The procedure of Johansen Cointegration test is repeated for the equation with higher education enrollment using the assumptions of intercept (no trend) in CE and no intercept in VAR. The results show two cointegrating equations at 5 % level of significance. This highlights the fact that results derived on the basis of non stationary data are not of spurious regression. This makes it clear that education is indispensable for economic growth in long run irrespective of its level. All levels of education are essential for economic growth. The results are displayed in Table 5.12.4

Education is one of the most important determinants of economic growth and keeping in view its significance, the factors which play a decisive role in its development needs to be explored. For this purpose, LEdins, LPTR, LRGDPPC, and LHealth have been used as explanatory variables in education model. Edins shows the number of educational institutions in Pakistan while Pupil-Teacher Ratio (PTR) measures the quality of institutions. The Johansen Cointegration results show that there are 2 cointegrating equations at 5% level of significance. This shows that all the explanatory variables in the model have significant long run relationship with the education. In other words the regression result derived from the non-stationary data is not spurious. The results are shown in Table 5.12.5.

Health is widely used as human capital in growth empirics. It is expected that health will affect economic growth in long run. Therefore, this becomes unavoidable to find its determinants. In equation for health, the log of life expectancy is treated as dependent variable while the log of Real GDP Per capita (LRGDPPC), Secondary School Enrollment (LENRS) and

the quality of health institutions captured by Doctor Patient ratio (LDPR) are the explanatory variables. The results show the existence of 2 cointegrating equation rejecting the null hypothesis of no cointegration. All the results are significant at 5 % level of significance. This confirms the claim that the economic growth, education and R&D affect health in long run. The result is shown in Table 5.12.6.

Research and development is another important determinant of economic growth in New Growth Theory (NGT). The Gross Domestic Product (GDP), Education (Measured by School Enrollment) and Educational Institutions positively affect the R&D in a country. Along with the quantity of educational institutions, the quality of educational institutions is equally important. The quality of institutions is mostly measured by the Pupil-Teacher Ratio. The Johansen Cointegration test results reject the null hypothesis of no Cointegration in R&D and its determinants. The test confirms the presence of 3 cointegrating equations at 5% level of significance. The Johansen Cointegration test is conducted with intercept (no trend) in CE and test VAR. The trace Statistic is used for the results. The test results discard the claim that the R&D model regression of non-stationary data is spurious. The results of Johansen-Cointegration test for R&D Model are shown in Table 5.12.7.

All the variables used in equation for physical capital are non-stationary at level but become stationary at I(1). These variables include Gross Domestic Product per capita (Y),Health(He), Secondary School Enrollment (ENRS) , Labour Force (Measured by Total Labour Force), and Research and Development (RD). The Johansen Cointegration test was conducted by using intercept (no trend) in CE and test VAR assumption. Using trace statistic for decision, the results illustrate 2 cointegrating equations in physical capital model. The results are given in Table 5.12.8. This indicates that the physical capital equation is cointegrating equation and the regression result based on non-stationary variables at level is not spurious.

The present study intends to find out the role of human capital in Labour Force Participation Rate (LFPR). The variables included in LFPR equation are Health, Secondary School Enrollment (ENR), Research and Development (R& D), Gross Domestic Product per Capita (GDPPC) and Educational Institutions (Edins). The Johansen Cointegration test for

Labour equation is conducted with intercept (no trend) in CE and test VAR assumption. As expected the results declined the claim of no Cointegration by rejecting the null hypothesis of no Cointegration. The hypothesis is rejected at 5% level of significance. The test confirms the existence of two cointegrating equations in labour model. This shows that human capital and GDPPC affect the Labour force participation rate in long run.

Table: 5.12.1 Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR.

The results are for economic growth model and the variables of the model are LRGDPPC LGFCF LENRS LHealth LLF LRD . The trend assumption is no deterministic trend. The lag interval is 1to 1.

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.6122	111.4710	103.84	0.0142
At most 1*	0.594273	77.37206	76.97277	0.0466
At most 2	0.456995	44.89740	54.07904	0.2534
At most 3	0.298794	22.91445	35.19275	0.5341
At most 4	0.185094	10.13611	20.26184	0.6265
At most 5	0.073996	2.767555	9.164546	0.6250

* shows the rejection of null Hypothesis at 5% level of significance.

Table:5.12.2 Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR

The results are for economic growth equation with Elementary School Enrollment. The equation is $LRGDP = F(LHealth, LGFCF, LLF, LRD, LENRE)$

Trend assumption: No deterministic trend (restricted constant)

Lags interval (in first differences): 1 to 3

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.8246	149.1755	95.7537	0.0000
At most 1*	0.6278	88.2401	69.8189	0.0009
At most 2*	0.5576	53.6440	47.8561	0.0130
At most 3	0.3806	25.0972	29.7970	0.1580
At most 4	0.2117	8.3297	15.4947	0.4308
At most 5	0.00009	0.0033	3.8415	0.9527

* shows the rejection of null Hypothesis at 5% level of significance

Table:5.12.3 Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VART

The results are for economic growth equation with Gross School Enrollment as measure for education. The equation is $LRGDPPC = f(LGFCF, LHealth, LRD, LTLF, LENRG)$

Trend assumption: No deterministic trend (restricted constant)

Lags interval (in first differences): 1 to 3

Hypthesis of CE(s)	No.	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*		0.822595	148.5627	95.75366	0.0000
At most 1*		0.629190	88.03652	69.81889	0.0009
At most 2*		0.558247	53.31423	47.85613	0.0141
At most 3		0.373237	24.71905	29.79707	0.1717
At most 4		0.212615	8.367516	15.49471	0.4270
At most 5		3.34E-05	0.001169	3.841466	0.9720

* shows the rejection of null Hypothesis at 5% level of significance.

Table:5.12.4. Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR

The results are for economic growth equation with Higher Education Enrollment as measure for education. The equation is $LRGDPPC = f(LGFCF, LHealth, LRD, LTLF, LENRHE)$

Trend assumption: No deterministic trend (restricted constant)

Lags interval (in first differences): 1 to 1

Hypthesis of CE(s)	No.	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*		0.628660	113.1098	103.8473	0.0106
At most 1*		0.576566	77.44688	76.97277	0.0460
At most 2		0.446756	46.51000	54.07904	0.1985
At most 3		0.310317	25.19958	35.19275	0.3882
At most 4		0.187704	11.82474	20.26184	0.4646
At most 5		0.113589	4.340691	9.164546	0.3637

* shows the rejection of null Hypothesis at 5% level of significance.

Table: 5.12.5. Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR

The results are for education equation and the equation is

LENRS= f(LRGDPPC, LEdins, LPTR, LHealth)

Trend assumption: No deterministic trend

Lags interval (in first differences): 1 to 3

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.730244	114.1798	76.97277	0.0000
At most 1*	0.667758	69.63175	54.07904	0.0011
At most 2	0.456677	32.16743	35.19275	0.1023
At most 3	0.244806	11.42568	20.26184	0.5016
At most 4	0.053769	1.879121	9.164546	0.8016

* shows the rejection of null Hypothesis at 5% level of significance.

Table: 5.12.6. Johansen Cointegration Test Result with intercept (no trend) in CE and test VAR

The results are for health equation and the equation is Health= f(LRGDPPC, LENRS, LDPR)

Trend assumption: No deterministic trend

Lags interval (in first differences): 1 to 1

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.536398	64.02248	54.07904	0.0051
At most 1*	0.439898	36.34822	35.19275	0.0374
At most 2	0.248469	15.48133	20.26184	0.2001
At most 3	0.134453	5.198190	9.164546	0.2624

* denotes rejection of the hypothesis at the 0.05 level

Table: 5.12.7. Johansen Cointegration Test Result with intercept (no trend) in CE and test VAR

The results are for R&D equation and the equation is

LRD= f(LRGDPPC, LENRS, LEdins, LPTR)

Trend assumption: No deterministic trend

Lags interval (in first differences): 1 to 2

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.706770	114.8476	76.97277	0.0000
At most 1*	0.646700	71.90962	54.07904	0.0006
At most 2	0.462267	35.49427	35.19275	0.0464
At most 3	0.193070	13.78051	20.26184	0.3048
At most 4	0.164071	6.272387	9.164546	0.1707

* shows the rejection of null Hypothesis at 5% level of significance.

Table: 5.12.8. Johansen Cointegration Test Result with intercept (no trend) in CE and no intercept in VAR

The results are for physical capital equation and the equation is
 $LGFCF = f(LRGDPPC, LHealth, LENRS, LRD, LTLF)$

Trend assumption: No deterministic trend

Lags interval (in first differences): 1 to 1

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.612172	111.4710	103.8473	0.0142
At most 1*	0.594273	77.37206	76.97277	0.0466
At most 2	0.456995	44.89740	54.07904	0.2534
At most 3	0.298794	22.91445	35.19275	0.5341
At most 4	0.185094	10.13611	20.26184	0.6265
At most 5	0.073996	2.767555	9.164546	0.6250

* denotes rejection of the hypothesis at the 0.05 level

Table: 5.12.9. Johansen Cointegration Test Result with no intercept or trend in CE or test VAR

The results are from LFPR equation and the equation is
 $LLFPR = f(LRGDPPC, LENRHM, LHealth, LTLF)$

Trend Assumption: No Deterministic Trend

Lags interval (in first differences): 1 to 1

Hypthesis No. of CE(s)	Eigen Value	Trace Statistic	Critical value (0.05)	Probability
None*	0.622552	78.49030	60.06141	0.0007
At most 1*	0.456686	43.41466	40.17493	0.0228
At most 2	0.326898	21.45224	24.27596	0.1089
At most 3	0.144871	7.201332	12.32090	0.3055
At most 4	0.042600	1.567215	4.129906	0.2471

* shows the rejection of null Hypothesis at 5% level of significance.

The results of the Johansen cointegration test are reliable because the Heteroscedasticity and Autocorrelation tests have been conducted for all equations in the model. The results are given in table: 5.12.10 and table: 5.12.13.

Table 5.12.10 VAR Residual Heteroscedasticity Tests

The results of the Heteroscedasticity have been displayed in table 5.12.10. The 1st column of the table shows the equation tested for heteroscedasticity. The value of the chi-square and probability of no heteroscedasticity have been given in the proceeding columns. The probability values show that for all equations the null hypothesis of no heteroscedasticity is accepted. Therefore no proof of heteroscedasticity is found in the equations tested for cointegration.

Equation	Chi-Sq	Prob
Economic Growth (ENRS as Education)	519.4350	0.3078
Economic Growth (ENRE as Education)	504.2132	0.4889
Economic Growth (ENRG as Education)	503.8627	0.4933
Economic Growth (ENRHE as Education)	525.4778	0.2457
Education	299.0049	0.5054
Health	158.5249	0.5181
R&D	307.4319	0.3714
Physical Capital	519.4350	0.3078
LFPR	296.5097	0.5461

Source: Author's Calculations by using Eviews 6 software

Table: 5.12. 11 VAR Residual Serial Correlation LM Test

Equation	LM-Statistic	Prob
Economic Growth (ENRS as Education)[2]	42.94903	0.1979
Economic Growth (ENRE as Education)[1]	45.95548	0.1237
Economic Growth (ENRG as Education)[1]	45.53053	0.1326
Economic Growth (ENRHE as Education)[1]	40.81173	0.2672
Education[1]	28.31174	0.2937
Health[1]	10.58295	0.8345
R&D[1]	26.24442	0.3946
Physical Capital[1]	42.94903	0.1979
LFPR[2]	27.44999	0.3338

Source: Author's Calculations

5.8 Results of Granger Causality Test

The results of Granger Causality Test confirm the presence of eleven significant causal relationships. All causal relationships are unilateral. As all variables are non-stationary in log level form, therefore, all variables are taken in log differenced form. The causality between the GDP per capita (Real) and ENRG (Gross School Enrollment) is unidirectional. The direction of causality is from GDP per Capita to ENRG. This highlights the fact that with increase in the GDP per Capita, the incentives for education increases. The people with increased resources are in better position to send their children to school. The state and public leave no stone unturned to educate the youth in the country. The relationship is statistically significant at 5% level of significance. The second significant causal relationship is Gross School Enrollment (ENRG)-Elementary School Enrollment (ENRP) relationship. The relationship is unilateral and the direction of the causality is from ENRG to ENRE. This indicates the fact that enrollment at all level of school is expected to push up the elementary school enrollment. The results are displayed in Table 5.13.

The human capital in form of education at elementary level is also found to have a causal relationship with Physical capital at 10% level of significance. The relationship means that human capital at elementary level increase the productivity of labour which through other channels leads to the accumulation of physical capital. The secondary education and higher education granger cause elementary education. The results are statistically significant at 1% level of significance. This highlights the facts that higher levels of education acts as incentives for lower level of education. A very important unilateral causal relationship is between higher education and R&D in Pakistan. The relationship is unidirectional and the direction of causality is from higher education to R&D. This means that higher education does play significant role in Research and Development in Pakistan.

The existence of causal relationship between R&D and GDP Per Capita is another significant relationship among the results of the GCT. The direction of the causality is from R&D to GDPPC (Real). This is one of the most important relationship which shows

the promotion of R&D in the economy leads to push up the GDPPC in the study area. This points out the significance of the development of R&D activities for economic growth. The R&D is also found in significant causal relationship with ENRG and ENRP. The Direction of causality is R&D →ENRG and R&D→ ENRHE. This means that the R&D is expected to promote the educational activities. This can be done by suggesting remedies to the educational problem or obstacles through promotion of R&D in the country.

The presence of causal relationship between the physical capital and economic growth is also a noteworthy. The direction in this case is from physical capital to economic growth. The means that being an important factor of production increase in physical capital leads to pushup the economic growth in Pakistan. The result is accordance with the conclusions drawn in economic growth literature. The primary education is found in causal relationship with labour force. The direction of the causality is from the primary education to labour force. This should be taken in senses that increase in the primary education increases the labour force participation.

The GCT results show no bilateral causal relationship among the selected set of variables. Although some independent type of the relationships are there like Enrollment at Secondary level (ENRS)- Real GDPPC, Secondary level (ENRS)- R&D, Health-GDPPC, Health- Enrollment at different school levels, R&D- Physical Capital, Physical Capital- R&D and Labour Force – GDPPC. All these relationships are statistically insignificant.

Table 5.13 Results of Granger Causality Test

Dependent Variable	RGDPG	ENRG	ENRE	ENRS	ENRHE	Health	R&D	GFCF	TLF
RGDPG	-	3.26573 (0.0366)** →	0.7978 (0.5063)	1.24484 (0.3129)	0.6781 (0.1952)	0.13710 (0.9370)	1.25203 (0.3105)	1.13597 (0.3522)	0.95894 (0.4263)
ENRG	3.26573 (0.1692)	-	4.3183 (0.0134)** →	1.92577 (0.1492)	0.8739 (0.4668)	0.18575 (0.9052)	0.97453 (0.4192)	0.12101 (0.9469)	2.01378 (0.1357)
ENRE	1.7012 (0.1913)	0.2864 (0.8348)	-	0.1052 (0.9563)	0.3107 (0.8174)	0.2065 (.8910)	1.7059 (0.1903)	2.5392 (0.0784)*** →	1.1758 (0.3380)
ENRS	2.02543 (0.1340)	0.25675 (0.8558)	315.089 (0.0000)* →	-	0.1516 (0.9278)	0.18936 (0.9027)	2.15998 (0.1160)	0.60167 (0.6195)	0.46856 (0.7067)
ENRHE	1.6622 (0.1986)	0.09435 (0.9625)	100.176 (0.0000)* →	0.3049 (0.8216)	-	0.3285 (0.8047)	2.5900 (0.0735)*** →	1.5765 (0.2180)	0.2945 (0.8289)
Health	0.75537 (0.5289)	0.83592 (0.4860)	2.4176 (0.0890)*** →	0.85488 (0.4763)	1.3357 (0.2835)	-	0.94621 (0.4321)	0.45674 (0.7147)	0.51339 (0.6765)
R&D	12.3834 (0.0000)* →	3.81097 (0.0213)** →	0.6782 (0.5733)	1.96825 (0.1425)	3.3965 (0.0321)** →	1.61781 (0.2084)	-	1.23498 (0.3163)	0.93392 (0.4379)
GFCF	2.81077 (0.0584)*** →	0.85495 (0.9469)	0.5792 (0.6339)	0.41935 (0.7406)	0.3224 (0.8091)	0.73581 (0.5398)	0.03184 (0.9922)	-	0.01357 (0.9978)
TLF	0.12814 (0.9426)	0.83108 (0.4885)	0.7140 (0.5525)	1.09169 (0.3695)	0.7435 (0.5355)	0.14118 (0.9344)	1.67775 (0.1953)	0.15279 (0.9270)	-

*, ** and *** shows 1%, 5% and 10% level of Significance respectively. The arrows (→ & ←) shows the direction of causal relationship between the variables

Chapter 6

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The present chapter consists of a brief discussion on the major findings of the study derived from data analysis. It will highlight conclusion of the study and present policy recommendations. The present study was based on some objectives and the study concludes with achievement of these objectives.

6.2 Findings of the Study

The present study was based on five major objectives. The first objective was to explore the status of human capital in the economy of Pakistan. The second objective of the study was to analyze the role of human capital in economic growth of Pakistan. It was also aimed to find-out the impact of institutions on human capital accumulation and resultantly on economic growth. The other objectives included, exploring the impact of human capital on physical capital and labour force participation, and checking the causal relationship between human capital and economic growth in Pakistan during the study period. The study started with chapter 1 which consisted of brief introduction of the study, Description of objectives of the study, statement of hypothesis of the study and description of the organization of the study.

A detailed review of theoretical and empirical literature has been discussed in chapter 2. The review of literature in chapter 2 shows that milestone in the theory of economic growth is the Solow-Swan Model in 1950s. The model is followed by a number of empirical and theoretical studies. This led to improvement of Solow model which resulted in endogenous growth theories and introduction of human capital in economic growth literature. The study in hand followed the path and introduced human capital in the form of health, education and R&D in economic growth model.

Chapter 3 describes a brief description of human capital, economic growth and characteristics of economy of Pakistan during the study period. The detailed discussion of human resources shows that Pakistan is endowed with huge human resource pool. The country is the 6th most populous country of the world. Population is mostly young and dependent. Due to population explosion, the country has higher population density than china, Iran and Nepal but lower than India.

The growth performance of Pakistan economy experienced ups and downs in different decades since the inception of Pakistan. In 1950, when Pakistan was infant, its growth performance was not exemplary and it grew at average rate of 3.14 % during 1951-1960. During 1960s, the growth performance remained very good and the economy grew at average rate of 6.8% per annually, due to import substitution, export promotion and effective industrialization policies.

The disintegration of Pakistan in the early 1970s affected the economy worsely, resultantly; high pace of growth fell to 4.6% in 1970s. The economy again started growing at average rate of 6.15% annually due to foreign aid and some economic reforms in 1980s. After a decade long military rule, the successive democratic governments in Pakistan failed to utilize its resources with any good economic performance. The economy of Pakistan grew at 4.41% in 1990s and 4.64% during 2000-2008. The description in chapter 3 further finds that agriculture and industry have been and are still the major contributors to GDP in Pakistan during the study period. Another finding of the chapter is that the share of agriculture in GDP of Pakistan is falling and share of industry is increasing but the process is very slow. Interestingly, the share of services is rapidly rising in economic growth of Pakistan.

The performance of Pakistan in education is good but the pace is still not upto the mark. Unfortunately Pakistan failed to achieve the target of Universalization of Primary Education, even after more than sixty years of its independence. It even remained unsuccessful to achieve higher literacy rate. The literacy rate in Pakistan was 16% at the time of independence and 57% in 2008-9, which is not a remarkable achievement. One of the reasons of low literacy rate is that government has not put education on its top priority yet. No government has taken education

seriously as a challenge as evident from the expenditures on education which is less than 2.5% annually showing negligence of education on the part of Government of Pakistan. The country spent less than 2% of its GDP on education till mid 1980s. The developmental expenditure in education is half of the non developmental expenditure. The school enrollment is increasing but is not up to the mark. The network of public sector schools needs further extension to ensure easy access to education.

Health is used as an important measure of human capital in empirical studies. The description of the study in chapter 3 shows that efficient efforts have not been carried out to improve health conditions in Pakistan. Unfortunately, a very meager percentage of GDP is spent on this basic need. Pakistan is spending 0.5% of its GDP on health sector, which shows that a meager percentage of GDP is spent on health sector in Pakistan. Health policies are not implemented practically, resultantly, these policies fail to achieve their objectives. This has entrapped Pakistan into a number of problems like limited access to health facilities, poor sanitation, lower life expectancy, malnutrition, high infant mortality rate and pitiable living conditions. The population per doctor is still very large in Pakistan and this points to lower quality of health in the country.

Pakistan has been able to cover up deficiencies in demographic indicators to some extent. It has controlled the Total Fertility Rate to a great extent by bringing it down from 7.0 in 1985 to 3.0 in 2008, which is a remarkable achievement. It is an achievement because before 1985, the same remained 7.0 for 15 years. The Infant Mortality Rate (IMR) was reduced from 106 in 1971 to 70.2 in 2008 but it is still very high. However, Pakistan controlled the birth rate and death rate by improved medical facilities and massive awareness. The life expectancy in Pakistan showed a continuous rise and it reached 67 years for both sexes in 2008.

Research and Development is considered a key to a number of social, economic and other problems. Unfortunately, this sector failed to attract the attention of government even after 4-5 decades. The work in science and technology remained negligible and this led to the failure of Industry, science and technology, agriculture and other sectors of economy. The establishment of Higher Education Commission (HEC) of Pakistan is a milestone in introducing Pakistan in to the

world of R&D. HEC worked on emergency basis and unexpectedly far-reaching results are being obtained. This is reflected in increase in number of universities in the study area. Interestingly, the number of publication increased from 1305 in 2000 to 7661 in 2008-9. Further more HEC has left no stone unturned in provision of all kinds of facilities for research within Pakistan and opportunities to educated youth for improvement in R&D abroad

Pakistan is endowed with rich human resources but unfortunately, the dependency ratio is very high in Pakistan. Major proportion of population consists of youth having less than 15 years of age while some percentage is more than 64 years of age. The female participation rate is still very low in Pakistan so the human resources are not utilized properly. Agriculture is still the major source of employment in Pakistan as it employed 45.1% of total labour force during 2008. However, the share of agriculture in total employment is gradually declining while the share of construction, trade and manufacturing sectors in total employment is growing.

The health and education institutions both increased in number during the period under analysis. However, there is room for further improvement to ensure easy access to education and health in Pakistan. The quality of institutions as measured in the present study by population per doctor and pupil-teacher ratio for health and education respectively, also needs improvement. The population per doctor was 4231 in 1971 and due to increased supply of doctors in the country; it reduced to 1225 in 2008. It further needs to be reduced to make sure the provision of best quality of health services. The Pupil-Teacher Ratio at school level is 20.44, which is good ratio, however, at college level the ratio is very poor, approximately 59.08 in 2008.

The empirical analysis started with Total Factor Productivity (TFP), which is an integral part of economic growth studies. The present study used Growth Accounting Method to find TFP in Pakistan. TFP was calculated by using education, health and R&D as measure of human capital separately. The results showed that TFP remained the 2nd major contributor to economic growth in Pakistan after physical capital. Physical capital and TFP contributed 43.09% and 38.47% to GDP per capita, when education is used as measure for human capital. The contribution of TFP to economic growth increased to 47.74%, when education is replaced by health in the TFP model. However, interestingly TFP adds only 18.27% to economic growth

when R&D is used as human capital. This shows that the share of TFP is sensitive to the measure used for human capital and its value lies in the range of 18.27% to 47.74%.

The calculation of TFP on five and ten yearly averages shows its sensitivity to time span. If the time periods are longer then the shocks are likely to be reduced. The present study has also addressed another aspect of TFP by using different shares of physical capital, labour and human capital. The literature shows the use of physical capital share with maximum share of physical capital as 0.50 and minimum share as 0.25. So the study in hand has used both these values in separate equation for calculation of TFP. The results show that when minimum share of physical capital is used, the contribution of TFP increases irrespective of measure for human capital. It increased to 46.72%, 57.08 and 24.14% in case of education, health and R&D respectively.

The TFP in Pakistan has been compared with seven Asian countries. A notable finding of the study is that the TFP share in economic growth in Pakistan is less than china, Iran, Indonesia and Sir Lanka while it is greater than Bangladesh and India. Physical capital appeared as 2nd major contributor along with TFP in all selected economies. Human capital (Health) showed a small contribution in all of the selected countries.

The results of economic growth models are satisfactory with most of variables appeared as significant with expected signs. The major economic growth model consisted of Real GDP per Capita, Education (Secondary school enrollment), health, physical capital, labour and R&D. The results indicate the fact that human capital in all forms showed positive impact on Real GDP Per Capita during the study period. Health³⁰ and R&D remained significant while Education remained statistically insignificant³¹. The results have been revised for Gross Enrollment, Elementary School Enrollment and Higher Education Enrollment. Human capital, when proxied with education remained insignificant contributor to economic growth except for higher education. However, its positive sign in most of cases show that education positively affects economic growth in Pakistan irrespective of its level. Health is significant contributor to

³⁰ The findings of the present study relevant to health and economic growth relationship contradicts the results derived by Knowles and Own (1995), Knowles and Own (1997) and McDonald and Roberts (2002) while support the findings of Rivera and Currais (1999a), Heshmati (2001), Rivera and Currais (2003) and Rivera and Currais (2004).

³¹

economic growth of Pakistan irrespective of levels of education introduced in the model. The coefficient of health is greater than coefficients of all other variables in all models. One year increase in life expectancy in Pakistan leads to 1.91% increase in RGDP per capita. The third measure of human capital R&D remained a positive and highly significant contributor to economic growth of Pakistan during the study period.

The present study has used Two Stage Least Squares (TSLS) for simultaneous equation model. The results are satisfactory on the basis of their signs and significance. The results of economic growth equation shows that Education (ENRS), Health, R&D, and Labour (L) all contribute positively to real GDP per capita and all the coefficients are highly significant. The LM statistic is insignificant which accepts the hypothesis of no serial auto correlation.

An important finding of the study is the macro determinants of education. This has been addressed in equation for education in simultaneous equations model. In order to achieve objective of impact of institutions on human capital, educational institutions have been introduced in education model. This included quantity as well as quality of educational institution. The finding of the present study in this connection is that both quality and quantity of educational institutions are significant determinants of education in Pakistan. Educational institutions positively affect school enrollments. As expected, health also proved as an important determinant of education. The Real GDP per capita also emerged among the positive and statistically significant determinants of education in Pakistan. The results further show that education and quality of health institutions are significant determinants of health. Real GDP Per Capita also affects health but not significantly.

The study also introduced a separate equation for the determinants of R&D. The study finds educational institutions and Real GDP per capita as major and significant determinants of R&D which is logical finding. Similarly, Education also affects R&D but the result is statistically insignificant. The results of equation for physical capital showed that human capital in form health and R&D significantly affected physical capital. Human capital in form of education also affects physical capital but the result is not significant statistically. Similarly,

health and Real GDP per capita are significant determinants of labour force participation in Pakistan.

Now, to find out the role of human capital in long run, Johansen approach to Cointegration has been used. The approach has been used because all variables of the study are stationary at first difference. When Johansen Cointegration applied to first model, the results confirmed existence of long run relationship among the human capital and economic growth during the study period. Results have been obtained by taking different levels of education separately as well as their combined effect was analyzed alongwith other determinants of economic growth. All equations of economic growth are found cointegrated with human capital. This shows that education, health and R&D affected economic growth in long run in Pakistan during 1971-2008.

The equation for education also rejected the null hypothesis of no Cointegration. The results showed that economic growth, educational institutions, quality of educational institutions and health affect education in form of school enrollment in long run. The equation for health also showed existence of cointegrating equations. Economic growth, education and quality of health institutions have been found affecting health in long run. Similarly, economic growth, education in form of school enrollment, educational institutions and quality of educational institutions affect R&D in long run.

The finding from Johansen Cointegration test of model for physical capital indicates that human capital, labour force and economic growth are the determinants of physical capital in long run in Pakistan. Similarly, human capital in form of education, and health emerged as macro determinants of labour force participation, which fulfilled the objective of the study of finding the impact of human capital on labour force participation rate in Pakistan.

The final objective of the study was to check the existence of causal relationship between human capital and economic growth in Pakistan during the study period. The Granger Causality Test (GCT) was used for this purpose. The findings of the GCT showed no bilateral causality. Some very important and logical unidirectional relationships were found. These included

relationships like RGDPCC causes Gross School Enrollment, Human Capital causes Physical Capital, Health causes School Enrollment and R&D while R&D causes Economic Growth and Enrollment at School as well as at College and University level. These relationships are significant statistically. Some other relationships found significant are Secondary school Enrollment causes elementary school enrollment and physical capital causes R&D.

6.3 Conclusion and Recommendations

The present study started with the objective of finding the role of human capital in economic growth of Pakistan during 1971-2008. The economy of Pakistan is found still mainly dependent on agriculture. The share of industry and services is rising in GDP of Pakistan. Unfortunately, Pakistan failed to in getting any remarkable achievement in field of education since independence. The achievement at university enrollment in recent decade is appreciable but at school level still huge population of school age children is out of schools. The achievement in health is comparatively better but the expenditure on health is very low. It succeeded in bringing down the Total Fertility Rate and population growth rate but still mortality rate is to be controlled. The R&D sector is found neglected in Pakistan but the establishment of HEC opened a new era in this field.

It is concluded on the basis of results from empirical analysis that TFP contributes on average 38.47% to the GDP growth rate in Pakistan. The contribution of TFP to GDP growth rate is highly sensitive to the human capital measure, length of period and value of the share of factor inputs. Its contribution varied from 18.27% to 47.74% depending upon the measure used for human capital. The human capital affect economic growth irrespective of measure of human capital but health and R&D are found statistically significant determinants of economic growth in Pakistan. Real GDPPC, educational institutions and quality of educational institutions are significant determinants of education in Pakistan. Similarly, education and quality of health institutions are significant determinants of health in Pakistan.

Education, Real GDPPC and educational institutions mainly set the quality and quantity of R&D in Pakistan. It is concluded on the basis johansen Cointegration test results that physical

capital, labour and human capital inform of education, health and R&D affected economic growth in Pakistan in long run. Similarly, RGDPPC, educational institutions and health are the macro determinants of education in longrun. Following the same pattern, RGDPPC, Health and R&D affect the labour force participation rate in the study area in long run. Interestingly, RGDPPC-ENRG, Human Capital-Physical capital, Health-School enrollment, Health-R&D, R&D-RGDPPC and R&D-School Enrollment are significant uni-directional relationships in economy of Pakistan.

The following recommendations are herby made on the basis of the present study

1. TFP emerged as the second major contributor to RGDPPC, therefore, it is recommended to find the major sources affecting TFP in Pakistan. Appropriate measures through fiscal policies can be effective tool for this purpose. This will help in enhancing the pace of economic growth in Pakistan.
2. Education is an important determinant of economic growth in Pakistan and it should be kept on top priority in economic policies. The resources allocated to education should be increased to ensure access to education for each and every individual in the country. As a first step measures should be taken for Universalization of Primary Education.
3. The education system in Pakistan needs to be linked with market. The trend of general education should be diverted to scientific, technical and vocational education in accordance with individual needs and resource potential of Pakistan.
4. Health in form of life expectancy appeared as statistically significant determinant of economic growth in Pakistan, which makes strong case for more investment in health. Health affects education and labour force participation rate. Therefore, it is strongly recommended that investment in health should be enhanced both on economic as well as humanitarian basis.

5. Research affects economic growth positively but the sector is neglected so far in Pakistan. The expenditures on R&D are lower than other developing countries of the region. Research in agriculture and industry is needed to increase productivity. The gap between university and industry should be bridged up to materialize the research in industrial output. It is therefore, recommended to increase investment in R&D to put the economy on path of sustained growth.
6. It is also recommended to collect and analyze quality R&D data for effective policy making in the field of science and technology, and social sectors in Pakistan.
7. The institutions for health and education affect human capital, therefore, it is recommended to take proper measures for the improvement of the quality as well as quantity of the health and educational institutions.
8. Labour in Pakistan positively affect economic growth, therefore to increase the productivity of labour, it should be equipped with appropriate skills. Skilled labour will accelerate economic growth more than the unskilled labour by adding more to productivity. Pre-job training and on the Job training can be an effective tool for this purpose.

REFERENCES

- Abbas, Q., (2001), "Endogenous Growth and Human Capital: A Comparative Study of Pakistan and Sri Lanka" ,*The Pakistan Development Review*, Vol. 40, No. 4, Part II, pp. 987–1007
- Acemoglu, D., S. Johnson., J. Robinson., and Y. Thaicharoend., (2003), "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth", *Journal of Monetary Economics*, Vol. 50, pp. 49–123
- Adams, S. J. (2002), "Educational Attainment and Health: Evidence from a Sample of Older Adults", *Education Economics*, Vol. 10, No. 1
- Afza, T., and M. S. Nazir., (2007). "Economic Competitiveness and Human Resource Development: An FDI Perspective". *Political Economy and Social Review*, Vol. 45, No. 2, pp. 167-180.
- Aghion, P. and P. Howitt., (1992), "A Model of Growth Through Creative Destruction" *Econometrica*, Vol. 60, No. 2, pp. 323-351
- Ahking,F,W., (2002), "Model Mis-specification and Johansen's Cointegration Analysis: An Application to US Money demand". *Journal of Macroeconomics*, Vol.24, pp.51-66
- Ahmad, K., (2007), "Sources of Growth and Total factor Productivity: A \Case Study of Pakistan", Ph. D in Economics, Dissertation, Department of Economics, University of Punjab.
- Ahmad, K., M. A. Choudary and M. Ilyas., (2008), "Trends in Total factor Productivity in Pakistan Agriculture Sector", *Pakistan Economic and Social Review*, Vo.46, No.2, pp.117-132
- Ahmed, Q.M., and H. Kalim., (2007), "Determinants of Total Factor Productivity in Pakistan", Paper No.16253, *Munich Personal RePEc Archive*
- Aiyer, S., and C.J. Dalgaard., (2005), "Total Factor Productivity Revisited: A Dual Approach to Development Accounting", *Staff Papers, International Monetary Fund*, Vol. 52, No. 1, pp. 82- 102

- Akintoye, I. R., and F. A. Adidu., (2008), “Optimizing National Growth through Human Resource Investment”, *European Journal of Scientific Research* Vol. 22, No. 3, pp. 433-443.
- Albatel, A. H., (2004), “Human Resource Development and Economic Growth in Saudi Arabia”. *J. King Saud University*, Vol.16, pp. 35-59.
- Anwer, S., (2008), “Foreign investment, human capital and manufacturing sector growth in Singapore” *Journal of Policy Modelling*. Vol.30, pp.447-453.
- Arrow, K. J., (1962). “The Economic Implications of Learning by Doing”, *The Review of Economic Studies*. Vol. 29, No. 3, pp. 155-173.
- Asian Productivity Organization., (2004), “Total Factor Productivity Growth: Survey Report”, Hirakawacho, Chiyoda-ku, Tokyo 102-0093, Japan
- Asteriou, D., and G. M. Agiomirgianakis., (2001) “Human Capital and Economic Growth Time series Evidence from Greece”, *Journal of Policy Modeling*, Vol.23, pp. 481–489
- Asteriou, D., and S.G.Hall., (2007), “*Applied Econometrics: A Modern Approach Using Eviews and Microfit (Revised Edition)*”, Palgrave Mcmillan, New York,1000
- Bader, S.A., and .S.A.Qarn., (2003),” Government Expenditures, Military Spending and Economic Growth: Causality Evidence from Egypt, Israel and Syria”, *Journal of Policy Modelling*, Vol.25, pp.567-583
- Bair,S., G.P.Dwyer and R.Tamura., (2002), “ How Important are Capital and Total Factor Productivity for Economic Growth”, *Working Paper 2002-2a*, Federal Reserve Bank of Atlanta
- Barro, R. J., (1991), “Economic Growth in Cross-Section of Countries”, *The Quarterly Journal of Economics*, Vol.106, No.2, pp.407-443
- Barro, R. J., (1996), “Determinants of Economic Growth: A Cross-Country Empirical Study”, Working Paper Series, *Working Paper No.5698*, National Bureau of Economic Research, Massachusetts
- Barro, R. J., (1999), “Notes on Growth Accounting”, *Journal of Economic Growth*, Vol.4, pp. 119-137.
- Barro, R. J., G. N. Mankiw and X. Sala-i-Martin., (1995); “Capital Mobility in Neoclassical Growth Models”, *American Economic Review*, Vol.85, pp.103-115.

- Barro, R.J., and J.W.Lee., (1994), “Sources of Economic Growth”, *Carnegie-Rochester Conference Series on Public Policy*, Vol.40, pp.1-46
- Barro, R.J., and J.W.Lee., (2000), “ International Data on Educational Attainment, Updates and Implications”, *Working Paper* No.7911, National Bureau of National Research, Massachusetts, Cambridge
- Barro, R.J., and X.Sala-i-Martin., (2004), “*Economic Growth*”, Second Edition, The Massachusetts Institute of Technology Press, Massachusetts
- Ballot,G., F.Fakhfakh and E.Taymaz., (2001), “Firms’ human capital, R&D and performance: a study on French and Swedish firms”, *Labour Economics*, No. 8, pp. 443–462
- Bazo, E.L and R. Moreno., (2008), “Does Human Capital Stimulate Investment in Physical Capital? Evidence from a Cost System Framework”, *Economic Modelling*, Vol. 25, pp. 1295– 1305
- Becker, Gary S., (1964), “*Human Capital*”, National Bureau of Economic Research, New York
- Becker, G. S., K. M. Murphy and R. Tamura., (1990). “Human capital, Fertility and Economic Growth”, *Journal of Political Economy*, Vol. 98, No.5, part 2, pp. S12-S37.
- Becker, G. S., (1993). *Human Capital-A theoretical and Empirical Analysis, with Special References to Education (3rd edition)*, The University of Chicago Press, Chicago and London.
- Bedard, K., (2001), “Human Capital versus Signaling Models: University Access and High School Dropouts”,*The Journal of Political Economy*, Vol. 109, No. 4, pp. 749-775
- Berger, M. C., and J.P. Leigh., (1989) “Schooling, Self-Selection, and Health” , *The Journal of Human Resources*, Vol. 24, No. 3, pp. 433-455
- Behram, J.R and N. Birdsall., (1983), “ The Quality of Schooling: Quantity alone is Misleading”, *The American Economic Review*, Vol.73, No.5, pp.928-946
- Besudeb, G,K., and Bari.F., (2000), “Sources of Economic Growth in Asian Countries”., *Global Research Project*, World Bank
- Bhargava,A, D. T. Jamison., L.J. Lau., and C.J.L.Murray., (2001) “Modeling the Effects of Health on Economic Growth”, *Journal of Health Economics*, Vol. 20, pp. 423–440
- Bhattacharayya, S., (2009), “Unbundled institutions, human capital and growth” *Journal of Comparative Economics*, Vol. 37, pp. 106–120
- Blackburn, K., and M . Ravn., (1993), “Growth, Human Capital Spillovers and International

- Policy Coordination ”, *Scandinavian Journal of Economics*, Vol. 95, pp. 495-515
- Blackburn, K., V. T. Y. Huang and A. F. Pozzolo., (2000), “ Research, Development and Human Capital Accumulation”, *Journal of Monetary Economics*, Vol.22. pp.189-206
- Bloom, D. E., D. Canning., and P. N. Malaney., (2000), “Population Dynamics and Economic Growth in Asia”, *Population and Development Review*, Vol.26, pp.257-290
- Bloom, D., and P. Malaney., (1998), “ Macroeconomic Consequences of Russian Mortality Crisis”, *World Development*, Vol. 26, No.11, pp.2073-2085
- Bloom, D. E., D. Canning and J. Sevilla., (2004). “The Effect of Health on Economic Growth: A Production Function Approach”. *World Development*, Vol.32, No.1, pp. 1-13.
- Borensztein E, J. D. Gregorio and J-W. Lee., (1998), “How does foreign direct investment affect Economic Growth”, *Journal of International Economics*, Vol. 45, pp. 115–135
- Bosworth, B., S.M.Collins., and Y. C. Chen., (1995). “ Accounting for Differences in Economic Growth”, *Conference on "Structural Adjustment Policies in the 1990s: Experience and Prospects"*, Institute of Developing Economies, Tokyo, Japan
- Bosworth, B.P., and S. M. Collins., (2003), “The Empirics of Growth: An Update”, *Brookings Papers on Economic Activity*, Vol. 2003, No. 2 , pp. 113-179
- Bound, J., M. Schoenbaum , T.N. Stinebrickner and T. Waidmann., (1999), “The dynamic effects of health on the labor force transitions of older workers”, *Labour Economics*, Vol. 6, pp.179–202
- Bratti, M., (2003), “ Labour Force Participation and Marital Fertility of Italian Women: The Role of Education”, *Journal of Population Economics*, Vol.16, No.3, pp.525-554
- Brempong, K. G and M. Wilson., (2004) “Health human capital and economic growth in Sub-Saharan African and OECD countries”, *The Quarterly Review of Economics and Finance* Vo. 44, pp. 296–320
- Butkiewicz J. L and H. Yanikkaya., (2006) “Institutional quality and economic growth: Maintenance of the rule of law or democratic institutions, or both?” *Economic Modelling*, Vol. 23, pp. 648–661
- Cai, L., (2010), “The relationship between health and labour force participation: Evidence from a panel data simultaneous equation model”, *Labour Economics*, Vol. 17, pp. 77–90
- Canlas, D.B., (2003) “Economic growth in the Philippines: theory and evidence” *Journal of Asian Economics* Vol.14, pp.759-769

- Cass, D., (1965), “ Optimum Growth in an Aggregative Model of Capital Accumulation”, *Review of Economic Studies*, No.32, pp.233-240
- Coe, D.T and E. Helpman., (1995), “International R & D spillovers”, *European Economic Review*, Vol. 39, pp. 859-887
- Collins, S.M. and Bosworth, B.P., (1996), “Economic Growth in East Asia: Accumulation versus Assimilation”, *Brookings Papers on Economic Activity*, No. 2, pp. 135-203
- Collins, S.M., B.P.Bosworth., and D.Roderick., (1996), “ Economic Growth in East Asia: Accumulation versus Assimilation”, *Brookings Papers on Economic Activity*, Vol. 1996, No. 2, pp. 135-203
- Comilla, J., and L.Schon., (2002), (Determinants of Total Factor Productivity and Phases in Economic Growth: Swedish Manufacturing Industry 1950-1994” *XIII Congress of the International Economic History Association*, Buenos Aires 22-26 July 2002
- Caselli, F., G. Esquivel, and F. Lefort., (1996), “Reopening the Governance Debate: A New Look at Cross Country Growth Empirics”, *Journal of Economic Growth*, Issue.1, no.13, pp. 363-389
- Chen, E,K,Y., (1997), “The Total factor Productivity Debate: Determinants of Economic growth In East asia”, *Asian Pacific Economic Literature*, Vol.11, Issue.1, pp.18-39
- Chen, G., and S. Hamori., (2009), “Economic Returns to Schooling in Urban China: OLS and Instrumental Variables Approach”, *China Economic Review*, Vol. 20, pp.143-152
- Chuang, Y.C., “Human Capital, Exports and Economic Growth: A Causality Analysis for Taiwan, 1952-1995”, *Review of International Economics*, Vol.8, No.4, pp.712-720
- Chuang,A., and C. Calderonb (2000), “Causality and Feedback between Institutional Measures and Economic Growth”, *Economics and Policies*, Vol.12, No.1, pp.69-81
- Chou, Y. K. (2002). “The Australian Growth Experience (1960-2000), R & D based, Human Capital-Based or Just Steady State Growth? *Research Paper No. 855* ISSN 0819-2642, Department of Economics, University of Melbourne.
- Conceicao, P, M.V.Heitor, and F. Veloso(2003), “Infrastructures, incentives, and institutions: Fostering distributed knowledge bases for the learning society” *Technological Forecasting & Social Change*, Vol.70, pp. 583–617

- Diabolt,C., and J.Litago (1997), “ Education and Economic Growth in Germany before the Second World War: An Econometric Analysis of Dynamic Relations”, *Historical Social Research*, Vol.22, No.2, pp.132-149
- Dias, J. and J. McDermott(2006) “Institutions, education, and development: The role of entrepreneurs “ *Journal of Development Economics*, Vol. 80, pp. 299– 328
- Durham, J. B. (2004). “Economic Growth and Institutions: Some Sensitivity Analysis, 1961-2000” *International Organization*, Vol. 58, No. 3, pp. 485-529.
- Easterlin, R.A (2001), “Review of Simon Kuznets *Modern Economic Growth: Rate, Structure and Spread*’Economic History Services”
- Easterly, W., and S.Rebelo (1993), “ Fiscal Policy and Economic Growth: An Empirical Investigation”, *Journal of Monetary Economics*, Vol.32, Issue.No.3, pp.417-458
- Enders, W (2004), *Applied Econometric Time Series*, Second Edition, John Willey& Sons.Inc., River Street, Hoboken, New jersey
- Engle, R,F., and C.W.J.Granger (1987), “Co-Integration and Error Correction: Representation, Estimation and Testing”, *Econometrica*, Vol.55, No.2, pp.251-276
- Echevaria, C.A and A.Iza. (2006) “Life expectancy, human capital, social security and growth”, *Journal of Public Economics*, Vol. 90, pp. 2323–2349
- Engelbrecht, H. J., (1997) “International R &D spillovers, human capital and productivity in OECD economies: An empirical investigation”, *European Economic Review*, Vol. 41,pp. 1479-1488
- Evans, P. (1998), “ Using Panel Data to Evaluate Growth Theories”, *International Economic Review*, Vol. 39, No. 2 , pp. 295-306
- Fagerberg, J., B. Verspagen and M. Caniee (1997), “Technology, Growth and Unemployment across European Regions”, *Regional Studies*, Vol. 31, No.5, pp. 457-466
- Falk, M. (2007), “R&D spending in the high-tech sector and economic growth” *Research in Economics*, Vol. 61, pp. 140–147
- Frantzen,D(2000), “ R&D, Human Capital and International Technology Spillovers: A Cross-Country Analysis “ *The Scandinavian Journal of Economics*, Vol. 102, No. 1, pp. 57-75
- Gameren, E,V.,(2008), “ Labor Force Participation of Mexican Elderly: The Importance of Health”, *Estudios Económicos*, Vol. 23, No. 1 (45), pp. 89-127

- Ghali, K.H.,(1997), “Government Spending and Economic Growth in Saudi Arabia”, *Journal of Economic Development*, Vol.22, No.2, pp.165-172
- Ghani, E., and V. Suri (2001), “Productivity Growth, Capital Accumulation, and the Banking Sector:Some Lessons from Malaysia”, *Policy Research Working Paper*, No.2252, Poverty Reduction and Management Sector Unit, The World Bank
- Gilleskie,D,B., and A.L.Harrison (1998), “The Effect of Endogenous Health Inputs on the Relationship Between Health and Education”, *Economics of Education Review*, Vol.17, No.3, pp279-297
- Glewwe, P., and H.G.Jacoby (2004), “Economic growth and the demand for education: is there a wealth effect?” *Journal of Development Economics*, Vol. 74, pp.33– 51
- Gokcekus, O., A.Ntow, Kwabena., and T.R.Richmond (2001), “Human Capital and Efficiency: The Role of Education and Efficiency”, *Journal of Economic Development*, Vol.26, 103-113.
- Goel, R. K., J. E. Payne, and R. Ram (2008), “R&D expenditures and U.S. economic growth: A disaggregated approach” *Journal of Policy Modeling* 30, 237–250
- Gollin, D (2002), “Getting Income Shares Right”, *Journal of Political Economy*, Vol.110, pp.458-474
- Gollop, F. M., and D.W. Jorgenson (1980), “ *U.S. Productivity Growth by Industry 1947-73 in New Developmentism Productivity Measurement Analysis*”, J. W. Kendrick and B. N. Vaccara (edition), University of Chicago Press
- Gonzolo, J (1994), “Five alternative methods of estimating long-run equilibrium relationships”, *Journal of Econometrics*, Vol. 60, Issues 1-2, pp. 203-233
- Government of Pakistan. (2005). *The State of Education in Pakistan*, Policy and Planning Wing, Ministry of Education, Islamabad.
- Government of Pakistan, *Economic Survey of Pakistan* (various issues), Economic Advisors wing, Ministry of Finance, Islamabad.
- Government of Pakistan, *Population Census Report* (Various Issues), Population Census Organization, Pakistan
- Government of Pakistan, “*Pakistan Education Statistics*”, Academy of Educational Planning and Management National Educational Management Information System, Ministry of Education

- Government of Pakistan (Various Issues), “*Social Indicators of Pakistan*”, Federal Bureau of Statistics, Statistics Division, Government of Pakistan.
- Government of Pakistan (Various Issues), “*Pakistan Social & Living Standards Measurement Survey*”, Federal Bureau of Statistics, Statistics Division, Government of Pakistan.
- Government of Pakistan, “*Pakistan Integrated Household Survey (PIHS)*”, Federal Bureau of Statistics, Statistics Division, Government of Pakistan.
- Granger, C.W.J., and P. Newbold (1974), “Spurious Regression in Econometrics”, *Journal of Econometrics*, Vol.2, No.2, pp.111-120.
- Granger, C.W.J (1986), Development in The Study of Cointegrated Economic Variables”, *Oxford Bulletin of Economics and Statistics*, Vol.48, No.3, pp.213-228
- Grilliches, Z.(1979) “Issues in Assessing the Contribution of Research and Development to Productivity Growth” *The Bell Journal of Economics*, Vol. 10, No. 1, pp. 92-116.
- Grossmann, V.,(2007), “How to promote R&D-based growth? Public education expenditure on scientists and engineers versus R&D subsidies” *Journal of Macroeconomics*, Vol. 29, pp. 891–911
- Grossman, G.M., and E. Helpman (1989), “Growth and Welfare in a Small Economy”, *Working Paper No. 2970*, National Bureau of Economic Research, Massachusetts
- Grossman, G.M., and E. Helpman (1991), “Endogenous growth, Trade, knowledge spillovers, and growth” *European Economic Review*, Volume 35, Issues 2-3, pp. 517-526
- Gujrati, D.N (2003), “Basic Econometrics”, 4th Edition, pp.822, McGraw Hill, New York
- Gundlach, E (2001), “Education and Economic Development: An Empirical Perspective”, *Journal of Economic Development*, Vol. 26, No. 1, pp.1-24
- Hall, R.E (1978), Stochastic Implications of Life Cycle Permanent Income Hypothesis: Theory and Evidence”, *The Journal of Political Economy*, Vol.86. No6, pp.971-987
- Hall, R.E., and C.I. Jones., (1996), “The Productivity of Nations”, *Working Paper No.5812*, National Bureau of Economic Research, Massachusetts
- He, Z., and K. Maekawa (2001), “On Spurious Granger Causality”, *Economics Letters*, Vol.73, pp.307-313
- Harmon, C., H. Oosterbeek., and I. Walker (2003), “The returns to education: Microeconomics”. *Journal of Economic Surveys*, Vol. 17, No. 2, pp.115-155

- Hartwig, J.,(2009) “Is health capital formation good for long-term economic growth? – Panel Granger-causality evidence for OECD countries”, *Journal of Macroeconomics*, Vol. xxx
- Hartog, J., and H. Oosterbeek (1998), “Health, Wealth and Happiness: Why Pursue a Higher Education?” , *Economics of Education Review*, Vol.17, No.3, pp.246-256
- Heshmati, A (2001), “On the Causality between GDP and Health Care Expenditure in Augmented Solow Model”, *Working Paper Series in Economics and Finance*, No.423, Stockholm School of Economics
- Hsieh, E., and K.S.Lai (1994), “ Government Spending and Economic Growth: The G-7 Experience”, *Applied Economics*, Vol.26, pp.535-542
- Human Development Report*. (2008). United Nations Development Programme (UNDP), United Nations Organization.
- International Labour Organization (2011), *LABORSTA Labour Statistics Database 1998-2011*, Geneva
- Iwata,S., M.S.Khan and H.Murao (2002),”Sources of Economic growth in East Asia: A Non-Parametric Assessment” *International Monetary Fund Working Paper*, Wp/02/13
- Jacobsen, J.P (1999) “Labor force participation”, *The Quarterly Review of Economics and Finance* Vol. 39, pp. 597–610
- Jbili, A., V. Karamrenko and J. Bailen (2007), “ *Islamic Republic of Iran: Managing the Transition to a Market Economy*”, International Monetary Fund, Washington DC
- Jerzmanowski, M (2007), “Total factor productivity differences: Appropriate technology vs. efficiency”, *European Economic Review*, Vol. 51,pp. 2080–2110
- Jin,J.C., (2009) “Economic research and economic growth: Evidence from East Asian Economies”, *Journal of Asian Economics*, Vol. No. 20, pp. 150–155
- Johansen, S (1988), "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254
- Johansen, S.,(1991), “ Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models”, *Econometrica*, Vol. 59, No. 6, pp. 1551-1580
- Johansen , S (1995), “Identifying restrictions of linear equations with applications to simultaneous equations and cointegration”, *Journal of Econometrics*, Vol. 69, pp. 111- 132
- Jones C.I (1995), “ Time Series Tests of Endogenous Growth Models”, *The Quarterly Journal of Economics*, Vol.110, No.2, pp.495-525

- Jones C.I (2002), “Sources of U.S. Economic Growth in a World of Ideas”, *The American Economic Review*, Vol. 92, No. 1, pp. 220-239
- Jones, L. E and R.Manueli (1990). “A Convex Model of Equilibrium Growth: Theory and Policy Implications” *The Journal of Political Economy*, Vol. 98, No. 5, Part 1 , pp. 1008-1038
- Jorgenson, D. W. and B. M. Frauwani. (1992). “Proceedings of Symposium on Productivity Concepts and Measurement Problems in Service Industries”. *The Scandinavian Journal of Economics*, Vol. 94, pp. S51-S70.
- Jorgenson, D. W., and Z. Griliches (1967), “The Explanation of Productivity Change”, *The Review of Economic Studies*, Vol. 34, No. 3, pp. 249-283
- Josephson (2002), Determinants of Total factor Productivity and Phases of Economic Growth: Swedish Manufacturing Industry 1950-1994” \, Technology and Human Capital in Historical Perspective, *XIII Congress of the International Economic History Association*, Buenos Aires.
- Kendrick, J. W. (1961), “*Productivity Trends in the United States*”, Princeton University Press for National Bureau of Economic Research.
- Khalil, K., S. Ellaboudy, and A. Denzau. (2007). “Institutions and Economic Development in OECD”. *International Research Journal of Finance and Economics*, ISSN. 1450-2887, Issue. 12.
- Khan, M., C.M. Reinhart (1990), “ Private Investment and Economic Growth in Developing Countries”, *World Development*, Vol. 18, No. 1, pp. 19-27
- Kingdon, G (1996), “The Quality and Efficiency of Private and Public Education: A Case Study of Urban India”, *Oxford Bulletin of Economics and Statistics*, Vo. 58, No. 1, pp.57-82
- Khan, M. S. (2005). “Human Capital and Economic Growth in Pakistan”, *Pakistan Development Reviews*, Vol. 44, No. 4, Part 2, pp. 455-478.
- Khan, S (2006), “*Macro Determinants of Total Factor Productivity in Pakistan*”, State Bank of Pakistan Research Bulletin, vol2, No.2
- Kim, J.I., and L. J. Lau., (1994), “The Sources of Economic Growth of The East Asian Newly Industrialized Countries”, *Journal of Japanese and International Economies*, Vol.8, pp.235-271
- Klenow, P. J., and A. R. Clare., (1997), “The Neoclassical Revival in Growth Economics: Has it Gone Too Far? *National Bureau of Economic Research Macroeconomics Annual*, Vol.12

- Knab, S. D and C. Stoddard., (2005), “The Quality of Education, Educational Institutions, and Cross-Country Differences in Human Capital Accumulation”, *Growth and Change*, Vol. 36 No. 3, pp. 354–373
- Knowles, S., and P. D. Owen., (1995), “Health Capital and Cross Country variation in Income Per Capita in Mankiw-Romer-Weil Model”, *Economic Letters*, vol.48, pp.99-106
- Knowles, S., and P. D. Owen., (1997), “Education and Health in an Effective-Labour Empirical Growth Model”, *The Economic Record*, Vol. 73, NO. 223, pp. 314-328
- Kocherlakota, N. R, and Kei. M. Y., (1995) “ Can Convergence Regression Distinguish Between Exogenous and Endogenous Growth Models? ” *Economic Letters*, Vol.49, pp.211-215
- Koopmans, T. C., (1965), “On the Concept of Optimal Economic Growth”, *Econometric Approach to Development Planning*, chap. 4, pp. 225–87
- Kuo, C. C and C. H. Yang (2008) “Knowledge Capital and Spillover on Regional Economic Growth: Evidence from China”, *China Economic Review*, Vol. 19, pp. 594–604
- Kwack, S.U and Y. S. Lee (2006) , “Analyzing the Korea’s growth experience: The application Of R&D and human capital based growth models with demography”, *Journal of Asian Economics*, Vol. 17, pp. 818–831
- Lee, J.W., (2005), “Human capital and productivity for Korea’s sustained economic growth”, *Journal of Asian Economics*, Vol. 16, pp. 663–687
- Li,H., and L.Hunang., (2008), “ Health, Education, and Economic Growth in China: Empirical findings and implications”, *China Economic Review* , Vol.. XXX
- Limam,Y. R, and S. M. Miller., (2004), “Explaining Economic Growth: Factor Accumulation, Total Factor Productivity Growth, and Production Efficiency Improvement” Department of Economics Working Paper Series, *Working Paper No. 20*, University of Connecticut.
- Lin, T.C., (2004), “The role of higher education in economic development: an empirical study of Taiwan case”, *Journal of Asian Economics*, Vol. 15, pp. 355–371
- Lin. T. C., (2006). “Alternative Measure for Education Variable in an Empirical Growth Model. Is Primary education less important?” *Economics bulletin*, Vol.15,No.15, pp.1-6.
- Lucas, R., Jr., (1988). “On the Mechanics of Economic Erowth”, *Journal of Monetary Economics*, vol. 22, pp. 3-22, North Holland.
- Maddison, A.,(2006), “*Historical Statistics of the World Economy: 1-2008*”, University of Groningen. <http://www.ggdc.net/MADDISON/oriindex.htm>

- Mankiw, N. G., D. Romer and D. N. Weil., (1992). “The Empirics of Economic Growth” *Quarterly Journal of Economics*, Vol.107, No. 2, pp. 407-435.
- Mayer, D (2001), “The Long Term Impact of Health on Economic Growth in Latin America”, *World Development*, Vol.29, No.6, pp.1025-1033
- McDonald, S., and J. Roberts., (2002), “Growth and multiple forms of human capital in an augmented Solow model: a panel data investigation”, *Economics Letters*, Vol. 74, pp. 271–276
- McMahan, W. W., (1998), “Education and Growth in East Asia” *Economics of Education Review*, Vol. 17, No. 2, pp.159-172
- Meulemeester, J. L. D., and D. Rochit., (1995), “A Causality Analysis of the Link between Education and Economic Development”, *Economics of Education Review*, Vol.14, No.4, pp-351-361
- Mincer, J., (1962). “ On The Job Training: Costs, Returns and Some Implications”. *The Journal of Political Economy*, Vol. 70, No. 5, Part-II, pp. 50-79.
- Murphy, N. R. V., and I. S. Chien., (1997), “The Empirics of Economic Growth for OECD Countries: Some New Findings”, *Economic Letters*, Vol.55, pp. 425-429
- Nadiri, M.I., (1993), “Innovations and Technological Spillovers”, *Working Papers Series*, No.4423, National Bureau of Economic Research, Massachusetts, Cambridge
- Naidoo, R., (2004). “Economic Growth and Liquidation of Natural Capital: The Case of Forest Clearance” *Land Economics*, Vol. 80, No. 2, pp. 194-208
- Nakamura, J, I., (1981), “Human Capital Accumulation in Premodern Rural Japan”, *The Journal of Economic History*, Vol. 41, No. 2, pp. 263-281
- Nam, S., (1991), “Determinants of Female Labor Force Participation: A Study of Seoul, South Korea, 1970-1980”, *Sociological Forum*, Vol. 6, No. 4, pp. 641-659
- Narayan, P. K., and R. Smyth (2004), “Temporal Causality and The Dynamics of Human Capital and Real Income in China”, *International Journal of Applied Economics*, Vol.1, Issue.1, pp. 24-45
- Nehru, V., and A. Dhareshwar., (1993), “ A New Database of Physical Capital Stock: Sources, Methodology and Results”, *Revista De Analisis Economico*, Vol.8, No.1, pp. 37-59
- Nehru,V., and A. Dhareshwar., (1994), “New Estimates of Total Factor Productivity for

- Developing and Industrial countries”, *Policy Research Working Paper* 1313, International Economics Department, World Bank
- Nelson, C. R., and C. R. Plosser., (1982), “Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications”, *Journal of Monetary Economics*, Vol. 10, Issue 2, pp. 139-162
- Nelson, R.R., and H. Pack., (1999), “ The Asian Miracle and Modern Growth Theory”, *The Economic Journal*, vol.109, No.457, pp.416-436
- Ohanian, L. E., (1988), “The Spurious Effects of Unit Roots on Vector Autoregressions : A Monte Carlo study”, *Journal of Econometrics*, Vol.39, Issue. 3, pp. 251-266
- Oketch, M.O., (2006). “Determinants of Human Capital Formation and Economic Growth of African Countries”, *Economics of Education Review*, Vol.25, pp.554-564
- Ornaghi,C., (2006), “Spillovers in Product and Process Innovation: Evidence from Manufacturing Firms”, *International Journal of Industrial Organization*, Vol.24 pp. 349–380
- Ozkan, S. K., H. E. Ryder and D. N. Weil., (2000). “Mortality Decline, Human Capital Investment and Economic Growth”. *Journal of Development Economics*, Vol. 62, pp. 1-23.
- Park, J., (2006), “Dispersion of human capital and economic growth”, *Journal of Macroeconomics*, Vol. 28, pp. 520–539
- Park, J., (2010), “Projection of Long-Term Total Factor Productivity Growth for 12 Asian Economies”, *Economics Working Paper Series*, Asian Development Bank, No. 227,
- Philps, P.C.B., (1986), “Understanding Spurious Regressions in Econometrics”, *Journal of Econometrics*, Vol.33, No.3, pp.311-340
- Pelkowski, J.M and M. C. Berger., ((2004), “The impact of health on employment, wages, and hours worked over the life cycle”, *The Quarterly Review of Economics and Finance*, Vol.44 , pp. 102–121
- Petrakis, P.E and D. Stamatakis., {2002) “Growth and educational levels: a comparative analysis”, *Economics of Education Review*, Vol. 21, pp. 513–521
- Pritchett, L.,(1996), “Where Has All the Education Gone?” *Policy Research Working Paper 1581* The World Bank,Policy Research Department, Poverty and Human Resources Division

- Qayyum, A., I. Khwaja and A. Hyder., (2008), “Growth Diagnostics in Pakistan”, *European Journal of Scientific Research*, Vol.24 No.3, pp.433-450
- Rebelo, S., (1991) “Long-Run Policy Analysis and Long-Run Growth” *The Journal of Political Economy*, Vol. 99, No. 3, pp. 500-521
- Rico, A. A. and I. A. Guerra-Turrubiate., (2005). “Empirical Evidence of the Impact of Health on Economic Growth”, *Issues in Political Economy*, Vol.14.
- Rodrik, D., and Subramanian. A., (2004), “From “Hindu Growth” to Productivity Surge: The Mystery of the Indian Growth Transition”, *International Monetary Fund Working Paper*, No. WP/04/77, International Monetary Fund
- Rivera, B., and Currais. L., (1999), “Income Variation and Health Expenditures: Evidence for OECD Countries”, *Review of Development Economics*, Vol.3, No.3, pp.258-267
- Rivera, B., and Currais. L., (2003), “The Effect of Health Investment on Growth: A Causality Analysis”, *International Advances in Economic Research*, Vol.9, No.3, pp.312-324
- Rivera, B., and Currais. L., (2004), “Public Health Capital and Productivity in the Spanish Regions: A Dynamic Panel Data Model”, *World Development*, Vol. 32, No. 5, pp. 871–885
- Roderick, D., (1997), “TFPG Controversies, Institutions and Economic Performance in East Asia”, *Working Paper No.5914*, National Bureau of Economic Research
- Romer. P. M., (1986). “Increasing Returns and Long-Run Growth” *The journal of Political Economy*, Vol. 94, No. 5, pp. 1002-1037. The University of Chicago Press.
- Romer. P. M., (1990). “Endogenous Technological change” *The journal of Political Economy*, Vol. 98, No. 5, Part.2 pp. S71-S102. The University of Chicago Press.
- Romer, P. M., (1994). “Economic Growth and Investment in Children” *Duodalus*, Vol.123, No. 4, *Health and Wealth*, pp.141-154.
- Sachs, J.D., and A.M. Warner (1996), “Sources of Slow Growth in African Economies”, *Journal of African Economics*, Vol. 6, No. 3, PP. 335-76
- Sarel, M., (1997), Growth and Productivity in Asian Countries”, Working Paper No.ww/97/97, *International Monetary Fund*,
- Schultz, T. W., (1961), “Investment in Human Capital”, *The American Economic Review*, Vol. 51, No. 1, pp. 1-17

- Schultz, T. W., (1962). "Investment in Human Beings", *Journal of Political Economy*, Vol. 70, No. 5, part. 2, pp. 1-8.
- Schultz, T. P., (2003). "Human Capital, Schooling and Health". *Economics and Human Biology*, No.1, pp. 207-221.
- Seers, D., (1969), "The Meaning of Development", *International Development Review*, Vol. 11, No.4, pp. 3-4.
- Self, S., and R, Grabowski., (2004), Does Education at all Levels Cause Growth" India a Case Study", *Economics of Education Review*, Vol. 23, pp. 47-55
- Seren, M. J. F., (2001) "Human Capital Accumulation and Economic Growth" *Investigaciones Economicas*, Vol. XXV, No.3, pp.285-602
- Sheran, M., (2007), "The Career and Family Choices of Women: A Dynamic Analysis of Labor Force Participation, Schooling, Marriage, and Fertility Decisions", *Review of Economic Dynamics*, Vol. 10. pp. 367–399
- Siddiqui, R., (2009), "Human Capital vs. Physical Capital: A Cross-Country Analysis of Human Development Strategies" *PIDE Working Papers 51*, Pakistan Institute of Development Economics, Islamabad
- Sinhadji, A., (1999), "Sources of Economic Growth: An Extensive Growth Accounting Exercise", Working Paper No. WP/99/77, *International Monetary Fund*
- Solow. R. M., (1956). "A Contribution to the Theory of Economic Growth", *The Quarterly Journal of Economics*, Vol. 70 No. 1, Feb 1956, pp. 65-94, MIT Press.
- Solow, M., (1957), "Technical Change and the Aggregate Production Function ", *The Review of Economics and Statistics*, Vol. 39, No. 3, pp. 312-320
- Spohr, C.A., (2003), "Formal Schooling and Workforce Participation in a Rapidly Developing Economy: Evidence from "Compulsory" Junior High School in Taiwan", *Journal of Development Economics*, Vol. 70, pp. 291– 327
- State Bank of Pakistan (2005), *A Handbook of Statistics on Pakistan Economy*, Statistics and Data Warehouse Department.
- Sterlacchini.,A., (2008), "R&D, higher education and regional growth: Uneven linkages among European regions", *Research Policy*, Vol. 37, pp. 1096–1107
- Stevens, M., (1999), "Human Capital theory and UK Vocational Training Policy", *Oxford Review of Economic Policy*, V ol.15, No.1, pp16-32

- Street, J. H., (1987), “The Institutionalist Theory of Economic Development”, *Journal of Economic Issues*, Vol. 21, No. 4, Evolutionary Economics II: Institutional Theory and Policy, pp. 1861-1887
- Sundararajan, V., and S. Thakur., (1980), “Public Investment, Crowdingout and Growth: A Dynamic Model Applied to India and Korea”, *Staff papers, International Monetary Fund*, Vol.27, pp.814-856
- Swan, Trevor. W., (1956), “Economic Growth and Capital Accumulation”, *Economic Record*, Vol. 32, No.2, pp.334-361
- Tallman, E.W and Wang, P., (1994), “Human capital and endogenous growth evidence from Taiwan”, *Journal of Monetary Economics*, Vol. 34, Issue 1
- Tamura, R., (2001), “Teachers, Growth, and Convergence”, *The Journal of Political Economy*, Vol. 109, No. 5, pp. 1021-1059
- Temple, J., (1999), “A positive effect of human capital on growth”, *Economics Letters*, No. 65, pp. 131–134
- United Nations Educational Scientific and Cultural Organization, *UNESCO Statistical Year Book (various Issues)*, UNESCO Institute for Statistics
- Uzawa, H., (1965). “Technical Change in Aggregative Model of Economic Growth”, *International Economic Review*, Vol. 6, No.1, pp. 18-31.
- Vanhoudt, P., (1998), “A Fallacy in Research on Growth and Capital Accumulation”, *Economic Letters*, Vol.60, pp.77-81
- Vuori, J., P. Koivisto., P. Mutanen., M. Jokisaari and K. S. Aro., (2008), “Towards Working Life: Effects of an intervention on mental health and transition to post-basic education”, *Journal of Vocational Behavior*, Vol. 72, pp. 67–80
- Wang, Y., and Y. Yao., (2003), “Sources of China’s Economic Growth 1952–1999: Incorporating Human Capital Accumulation”, *China Economic Review*, Vol. 14, pp. 32– 52
- Weisbrod, B. A., (1962). “Education and Investment in Human Capital”, *Investment in Human Beings*, Vol. 70, No. 5 Part 2, pp. 106-123.
- Wolfe, B.L., (1985) “The Influence of Health on School Outcomes: A Multivariate Approach”, *Medical Care*, Vol. 23, No. 10, pp. 1127-1138
- World Development Indicators (various Issues), World Bank
- Wu, Y., (1995), “The Productive Efficiency of Chinese Iron and Steel Firms : A Stochastic Frontier Analysis”, *Research Policy*, Vol.21, No.3, pp.215-222

- Young, A., (1989), “*Hong kong and the Art of Landing on Ons’s Feet: A Case Study of a Structurally Flexible Economy*”, Ph.D Dissertation, Fletcher School, Tufts University
- Young, A., (1992), “A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore”, *NBER Macroeconomics*, Volume 7, pp.13-64
- Young, A., (1993), “Innovation and Bounded Learning by Doing”, *Journal of Political Economy*, Vol.101, pp.443-473
- Young, A., (1995), “The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience”, *The Quarterly Journal of Economics*, Vol.110, pp.641-680, MIT press
- Zeng , J.,(2001) “Innovative vs. imitative R&D and economic Growth”, *Journal of Development Economics*, Vol. 64, pp.499–528

Appendix- A
Gross Domestic Product, Population and GDP Per Capita

Year	Gross Domestic Product (Million Rs.)	Population (Millions)	GDP Per Capita (Rs)	Gross Fixed Capital Formation
1971	49784	63.74	781.048	7050000000.00
1972	61414	65.89	932.0686	6810000000.00
1973	81690	67.9	1203.093	7650000000.00
1974	103557	69.98	1479.809	10600000000.00
1975	119736	72.12	1660.233	12200000000.00
1976	135982	74.33	1829.436	22800000000.00
1977	159840	76.6	2086.684	26400000000.00
1978	177140	78.94	2243.983	29000000000.00
1979	210253	81.36	2584.231	31600000000.00
1980	247029	83.84	2946.434	39400000000.00
1981	289788	86.44	3352.476	47700000000.00
1982	327909	89.12	3679.41	54600000000.00
1983	375772	91.88	4089.813	61800000000.00
1984	435015	94.73	4592.157	69200000000.00
1985	489378	97.67	5010.525	77900000000.00
1986	545888	100.7	5420.933	87500000000.00
1987	618036	103.82	5952.957	100000000000.00
1988	683138	107.04	6382.081	111000000000.00
1989	759854	110.36	6885.23	133000000000.00
1990	908374	113.78	7983.6	148000000000.00
1991	1077943	117.31	9188.842	178000000000.00
1992	1200129	120.83	9932.376	225000000000.00
1993	1412858	124.45	11352.82	257000000000.00
1994	1688126	128.01	13187.45	281000000000.00
1995	1957218	125.38	15610.29	318000000000.00
1996	2255649	128.42	17564.62	368000000000.00
1997	2540147	131.51	19315.24	397000000000.00
1998	2735943	134.51	20340.07	403000000000.00
1999	2951680	136.69	21593.97	409000000000.00
2000	3923244	139.76	28071.29	607000000000.00
2001	3377100	142.86	23639.23	659000000000.00
2002	3709700	145.96	25415.87	680000000000.00
2003	5250527	149.03	35231.34	736000000000.00
2004	6122568	150.47	40689.63	865000000000.00
2005	7158527	153.96	46496.02	999000000000.00
2006	8235099	158.2	52054.99	1570000000000.00
2007	9962247	161	61877.3	1810000000000.00
2008	12081956	163.8	73760.42	2100000000000.00

Source: Economic Survey of Pakistan (Various Issues), Government of Pakistan, State Bank of Pakistan (2005)

Appendix-B
Enrollment in Institutions of Education in Pakistan

Year	School Enrollment (Elementary)	Secondary school Enrollment	School Enrollment (Gross)	Higher Education Enrollment	Literacy Rate(%)
1971	4941000	373500	5314500	996935	21.6
1972	5173000	405900	5578900	1016689	21.7
1973	5501000	448700	5949700	1096372	21.5
1974	5910000	458300	6368300	1158570	21.6
1975	6176000	504400	6680400	1261832	21.00
1976	6966000	524000	7490000	1325912	21.8
1977	6909000	548000	7457000	1388643	22.3
1978	6319000	538000	6857000	1407243	23.1
1979	6431000	513000	6944000	1405919	24.00
1980	6604000	511000	7115000	1505289	26.2
1981	6886000	549000	7435000	1532023	26.2
1982	7208000	588000	7796000	1624069	27.1
1983	7673000	627000	8300000	1627242	27.9
1984	8590000	659000	9249000	1836694	28.8
1985	8633000	702000	9335000	1924060	29.8
1986	9004000	726000	9730000	2038218	30.8
1987	9662000	776000	10438000	2149229	31.7
1988	10012000	834000	10846000	2191942	32.7
1989	11648000	943000	12591000	2538209	33.8
1990	13006000	1021000	14027000	2749113	34.9
1991	13658000	1094000	14752000	2958643	36
1992	13717000	1169000	14886000	3123193	37.2
1993	15766000	1261000	17027000	3185027	38.4
1994	16593000	1399000	17992000	3481316	39.6
1995	18080000	1611000	19691000	3997620	39
1996	18132000	1533000	19665000	3816576	42.2
1997	19121000	1613000	20734000	3958386	43.6
1998	21095000	1748000	22843000	4288019	45
1999	22267000	1777000	24044000	4353082	47.1
2000	23260000	1817000	25077000	4386995	49
2001	20894000	1648000	22542000	4042772	50.5
2002	21350000	1657000	23007000	4100212	50.5
2003	22138000	1683000	23821000	4208722	54
2004	20528000	1800000	22328000	4868282	53
2005	21808000	1880000	23688000	5475239	54
2006	22096000	2133000	24229000	6139178	55
2007	22410000	2315000	24725000	6353897	56
2008	22601000	2436000	25037000	6492902	57

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (various Issues), Pakistan Education Statistics, Pakistan Standard Living survey, Pakistan Integrated Household Survey, Population Census Organization

Appendix-C
Health and Education Institutions in Pakistan

Year	Health Institutions ³²	Educational Institutions ³³	Teachers in Schools
1971	3635	52494	181900
1972	3644	56881	191800
1973	4094	58204	205500
1974	4439	59651	222600
1975	4629	60630	235300
1976	5012	61591	241600
1977	5304	62442	246000
1978	5344	63893	252100
1979	5545	66029	258900
1980	5833	68171	271300
1981	5918	70327	283900
1982	6762	80773	297200
1983	7055	83699	317200
1984	7491	84860	319300
1985	7826	88433	323500
1986	8135	105751	346000
1987	8523	118920	364300
1988	9210	126779	459100
1989	9690	134759	506900
1990	10178	131835	521800
1991	10705	130398	544700
1992	10924	151722	503300
1993	11002	155953	573200
1994	11353	162315	596200
1995	11423	166577	585300
1996	11872	174848	568300
1997	11875	185374	610200
1998	11944	190380	601600
1999	12032	194112	613600
2000	12069	188630	878900
2001	12182	191607	914200
2002	12216	194985	947800
2003	12209	199800	948500
2004	12259	204200	978900
2005	12348	219800	1117000
2006	12438	218100	1125900
2007	12514	222200	1191200
2008	12521	221900	1225100

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues)

³² Health institutions include Hospitals, Dispensaries, Basic Health Units

³³ Educational Institutions include all primary, middle and secondary schools of Pakistan

Appendix-D
Population Per Doctor and Pupil-Teacher Ratio in Pakistan

Year	Population Per Doctor (DPR)	PTR(Primary)	PTR (Sec)	PTR (Gross)	PTR (Middle)
1971	4231	37.75	9.29104478	29.2166025	26.4166667
1972	4137	38.62	9.80434783	29.0870699	23.2608696
1973	4012	38.55	9.36743215	28.9523114	24.8448687
1974	3997	38.35	8.55037313	28.6087152	25.2183908
1975	3949	38.22	8.60750853	28.3909902	25.7758621
1976	3912	42.90	8.41091493	31.0016556	27.1086957
1977	3845	41.75	8.72611465	30.3130081	26.5983607
1978	3742	36.66	8.22629969	27.199524	26.1322645
1979	3660	36.42	7.7027027	26.8211665	25.2918288
1980	3598	34.75	7.39507959	26.2255805	26.6475096
1981	3448	34.41	7.72151899	26.1887989	26.2942272
1982	3144	33.99	7.94594595	26.2314939	27.1143376
1983	2888	34.85	7.63702801	26.1664565	25.8477509
1984	2654	38.32	7.96856106	28.9664892	30.0347222
1985	4696	37.81	8.18181818	28.8562597	31.6112084
1986	2315	37.45	7.37804878	28.1213873	32.8178694
1987	2176	38.93	7.28638498	28.6522097	32.8409091
1988	2623	32.02	6.15498155	23.6244827	27.3733333
1989	2426	32.94	6.33310947	24.8392188	31.0505837
1990	2259	37.44	6.38524078	26.8819471	30.9869203
1991	2082	36.92	6.68295663	27.0827979	32.24
1992	1993	35.91	8.82264151	29.5767932	41.5181058
1993	1892	39.52	7.38290398	29.705164	37.8109453
1994	1848	39.78	7.95790671	30.1777927	38.2523148
1995	1803	43.09	10.06875	33.6425765	40.466596
1996	1755	44.99	9.53951462	34.6032025	42.5619835
1997	1689	45.29	8.87238724	33.9790233	42.1016949
1998	1636	47.50	11.4472823	37.9704122	44.9498328
1999	1590	49.59	11.4129737	39.1851369	44.7868852
2000	1578	46.83	6.98040722	28.5322562	19.6089652
2001	1529	41.40	6.09918579	24.6576242	16.3363755
2002	1516	40.44	5.96043165	24.2741085	16.1701227
2003	1466	42.16	6.0780065	25.1143911	16.3659148
2004	1404	36.01	6.38071606	22.8092757	17.5152006
2005	1359	38.87	5.19050248	21.2068039	14.6396396
2006	1274	37.76	5.81833061	21.5196732	16.784689
2007	1251	37.37	5.48968461	20.7563801	17.122807
2008	1225	37.04	5.54518552	20.436699	16.74883

Source: State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues), and Author's Calculations from the data obtained from State Bank of Pakistan (2005), Economic Survey of Pakistan (Various Issues)

Appendix-E
Research and Development Expenditure and Publications in Pakistan during 1971-2008

Year	R&D (Expenditure on higher Education) Million Rupees	Publications
1971	69	-
1972	81.8	-
1973	107.9	-
1974	124	-
1975	174.3	271
1976	210.7	293
1977	258	359
1978	324.2	393
1979	426.2	408
1980	459.2	422
1981	611.3	436
1982	507.82	446
1983	701.7	455
1984	871	512
1985	1159.2	615
1986	1317.4	783
1987	1497.3	841
1988	1831	846
1989	2536	874
1990	2989	944
1991	3164	975
1992	3900	1017
1993	4373	1076
1994	5271	1154
1995	6113	1262
1996	6838	1191
1997	7291	1263
1998	2119.67	1357
1999	2403.72	1328
2000	2946	1305
2001	2947	1425
2002	7723.402	1680
2003	10273.097	1957
2004	15935.684	2347
2005	21384.289	2988
2006	28741.677	3855
2007	27926.953	5798
2008	18415.936	7661

Source: Economic Survey of Pakistan, UNESCO

Appendix-F
Population and Labour Force in Pakistan

Year	Population Density	Total Labour Force (Millions)	Labour Force (Employed) in Millions	Crude Activity Rate	Rate of Unemployment (Percentage)
1971	78.621	18.7	18370000	30.85452175	2.05
1972	81.127	19.54	18550000	31.24419768	1.89
1973	83.745	19.62	19240000	30.39141352	1.79
1974	86.46	20.42	20070000	30.63677502	1.65
1975	89.26	20.64	20300000	29.99422785	2.13
1976	92.14	21.54	21080000	30.32393395	2.62
1977	95.09	22.48	21890000	30.66631351	3.11
1978	98.10	22.93	22540000	30.3200742	3.55
1979	101.16	23.68	23130000	30.36585417	3.67
1980	104.23	24.45	23810000	30.42781735	3.72
1981	107.32	25.24	24500000	30.50876336	3.81
1982	110.39	26.6	25200000	31.25881358	3.91
1983	113.42	26.91	25850000	30.77674606	3.82
1984	116.53	26.95	25920000	30.00048268	3.72
1985	119.71	28	26960000	30.34102094	3.66
1986	122.97	28.05	27020000	29.59034556	3.05
1987	126.29	28.92	27860000	29.70605794	3.13
1988	129.66	29.42	27610000	29.43376558	3.13
1989	133.12	32.81	29900000	31.97170696	3.13
1990	136.56	32.81	31780000	31.16758307	6.38
1991	140.07	32.81	30750000	30.38664557	5.85
1992	143.67	33.68	32080000	30.41083082	4.73
1993	147.31	34.68	33040000	30.53839508	4.84
1994	151.05	35.68	33990000	30.64129412	5.41
1995	154.89	34.42	32500000	28.82702452	5.41
1996	158.75	36.84	34590000	30.10419975	6.12
1997	162.68	37.73	35420000	30.08535661	6.12
1998	166.64	38.59	36230000	30.04110813	6.12
1999	170.69	40.4	38020000	30.70328768	6
2000	174.85	41.2	38800000	30.56606573	6
2001	179.12	41.5	38300000	30.05504056	7.8
2002	183.49	43.22	39640000	30.55493186	7.8
2003	187.97	45.5	38370000	31.40044263	8.3
2004	192.55	45.95	42420000	30.95552504	7.8
2005	197.25	50.5	46950000	33.21029871	7.6
2006	206	53.21	47650000	33.43493171	6.2
2007	211	54.42	49090000	33.47050726	5.2
2008	215	55.84	49520000	33.61597744	5.2

Source: Economic Survey of Pakistan (Various Issues), World Development indicators

Appendix-G
Total Factor Productivity Estimates of Selected Asian Countries

Year	Bangladesh	China	Iran	India	Indonesia	Nepal	Srilanka
1970	0.04	0.00	0.13	0.00	0.03	-0.03	0.02
1971	0.02	-0.01	0.07	0.01	0.12	0.08	0.01
1972	-0.08	0.02	0.27	0.14	0.27	-0.09	0.19
1973	0.42	-0.04	0.50	0.07	0.35	0.23	0.09
1974	0.53	-0.01	-0.18	-0.03	0.08	0.23	0.05
1975	-0.30	-0.04	0.11	-0.01	0.10	-0.02	0.04
1976	-0.09	0.05	0.07	0.05	0.12	-0.05	0.15
1977	0.18	0.06	-0.05	0.02	0.09	0.01	-0.07
1978	0.09	0.06	0.21	0.01	0.24	0.09	0.01
1979	-0.04	0.05	-0.08	0.08	0.25	-0.02	0.02
1980	-0.02	0.05	0.12	0.07	0.09	0.07	0.24
1981	0.03	0.02	0.18	0.04	0.01	0.01	0.04
1982	0.06	0.04	-0.02	0.09	0.12	-0.02	0.15
1983	0.12	0.10	0.00	0.03	0.08	0.12	0.20
1984	0.04	0.14	0.05	0.03	0.02	0.01	0.04
1985	0.03	0.06	0.00	0.04	0.01	0.14	0.05
1986	0.08	0.08	0.14	0.05	0.11	0.04	0.05
1987	0.02	0.14	0.06	0.08	0.10	0.09	0.07
1988	0.03	0.13	0.11	0.05	0.10	0.11	0.09
1989	0.04	0.05	0.13	0.07	0.08	0.11	0.15
1990	0.03	0.06	0.08	0.09	0.10	0.03	0.07
1991	0.01	0.08	0.21	0.06	0.06	0.10	0.05
1992	-0.02	0.11	0.38	0.09	0.09	0.02	0.08
1993	0.01	0.25	0.21	0.08	0.08	0.05	0.07
1994	0.03	0.17	0.27	0.04	0.10	0.01	0.10
1995	0.01	0.10	0.08	0.10	0.09	0.04	0.11
1996	0.01	0.07	0.05	0.05	0.09	0.06	0.09
1997	0.02	0.02	0.04	0.07	0.32	0.01	0.07
1998	0.02	0.03	0.19	0.04	0.07	0.10	0.02
1999	0.01	0.06	0.22	0.04	0.15	0.03	0.07
2000	0.01	0.05	0.05	0.01	0.10	0.03	0.15
2001	0.02	0.03	0.21	0.02	0.05	0.03	0.09
2002	0.04	0.04	0.10	0.04	0.05	0.01	0.06
2003	0.03	0.09	0.15	0.04	0.07	0.02	0.03
2004	0.04	0.09	0.14	0.03	0.11	0.04	0.06
2005	0.05	0.10	0.11	0.07	0.12	0.02	0.10
2006	0.06	0.16	0.19	0.08	0.10	0.05	0.14
2007	0.08	0.10	0.15	0.07	0.15	0.04	0.15
2008	0.04	0.07	0.12	0.05	0.11	0.05	0.08

Source: Author's Calculations from the data obtained from World Development Indicators, International Labour Organization, and Maddison (2006)

Appendix-H
Life Expectancy in Selected Asian Countries

Year	Bangladesh	China	Iran	India	Indonesia	Nepal	Srilanka
1970	44.00	62.00	54.00	49.00	48.00	43.00	63
1971	44.00	63.00	54.00	49.00	48.00	43.00	63
1972	45.00	63.00	55.00	50.00	49.00	44.00	64
1973	45.00	64.00	56.00	51.00	50.00	44.00	64
1974	45.00	64.00	56.00	52.00	50.00	45.00	65
1975	45.00	64.00	57.00	52.00	51.00	45.00	65
1976	46.00	65.00	57.00	53.00	52.00	46.00	66
1977	46.00	65.00	57.00	54.00	52.00	46.00	66
1978	47.00	65.00	58.00	54.00	53.00	47.00	67
1979	47.00	66.00	58.00	55.00	54.00	48.00	67
1980	48.00	66.00	59.00	55.00	54.00	48.00	68
1981	48.00	66.00	59.00	56.00	55.00	49.00	68
1982	49.00	66.00	60.00	56.00	56.00	49.00	69
1983	50.00	67.00	60.00	56.00	57.00	50.00	69
1984	50.00	67.00	61.00	57.00	57.00	50.00	69
1985	51.00	67.00	61.00	57.00	58.00	51.00	69
1986	52.00	67.00	62.00	57.00	59.00	52.00	69
1987	52.00	67.00	63.00	57.00	60.00	52.00	69
1988	53.00	68.00	63.00	58.00	60.00	53.00	69
1989	53.00	68.00	64.00	58.00	61.00	53.00	69
1990	54.00	68.00	65.00	58.00	62.00	54.00	70
1991	55.00	68.00	65.00	58.00	62.00	55.00	70
1992	55.00	69.00	66.00	59.00	63.00	55.00	70
1993	56.00	69.00	66.00	59.00	63.00	56.00	70
1994	57.00	69.00	67.00	59.00	64.00	57.00	70
1995	58.00	70.00	67.00	60.00	64.00	57.00	70
1996	58.00	70.00	67.00	60.00	65.00	58.00	69
1997	59.00	70.00	68.00	60.00	66.00	59.00	70
1998	60.00	71.00	68.00	61.00	66.00	60.00	70
1999	61.00	71.00	69.00	61.00	67.00	61.00	70
2000	61.00	71.00	69.00	61.00	67.00	62.00	71
2001	62.00	72.00	69.00	62.00	68.00	62.00	72
2002	63.00	72.00	70.00	62.00	68.00	63.00	72
2003	63.00	72.00	70.00	62.00	69.00	64.00	73
2004	64.00	72.00	70.00	62.00	69.00	65.00	73
2005	65.00	73.00	71.00	63.00	70.00	65.00	74
2006	65.00	73.00	71.00	63.00	70.00	66.00	74
2007	66.00	73.00	71.00	63.00	70.00	66.00	74
2008	66.00	73.00	71.00	64.00	71.00	67.00	74

Source: World Development Indicators (Various Issues), UNESCO