ESSAYS ON EDUCATION IN PAKISTAN

By

Faiza Hassan
07/PHD/PIDE/2013

Supervisor

Dr. Hafsa Hina
Prof. Dr. Abdul Qayyum

PIDE School of Economics
Pakistan Institute of Development Economics,
Islamabad
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Student Name: Ms. Faiza Hassan
07/PhD/PIDE/2013

Signature: _____

Examination Committee:

a) **External Examiner: Dr. Faisal Mehmood Mirza**
Associate Professor
Department of Economics
Hafiz Hayat Campus, University of Gujrat
Gujrat

Signature: _____

b) **Internal Examiner: Dr. Abdul Jalil**
Professor
PIDE, Islamabad

Signature: _____

Supervisor: Dr. Hafsa Hina
Assistant Professor
PIDE, Islamabad

Signature: _____

Co-Supervisor: Dr. Abdul Qayyum
Ex-Joint Director
PIDE, Islamabad

Signature: _____

Dr. Shujaat Farooq
Head, PIDE School of Economics
PIDE, Islamabad

Signature: _____

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Faiza Hassan

This dissertation is Dedicated to

My Parents & my sister Farhana

Their Love, Concern and Understanding
is source of strength for me

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ABSTRACT

The dissertation is aimed to analyze the role of education in Pakistan's economy. It is composed of three essays. The first essay is based on microeconometric analysis and explores the role of education in the life satisfaction of individuals in Pakistan. The second essay analyzes the impact of education on agriculture, industrial and services sector separately as well as on the overall economy. The third essay is about the comparison of Pakistan economy's educational statistics with the 10 selected better-performing countries. The essay is aimed to find the gap between the existing and required levels of educational requirements based on the comparison with high performing countries. This essay is also dedicated to define the roadmap for the next two decades for the educational sector of Pakistan in terms of enrollments, number of teachers and government expenditure composition on different levels of education.

The first essay is 'Education and life satisfaction: A Marginal Mediation Analysis'. The purpose of the analysis is to find the direct and indirect impact of education on life satisfaction of individuals in Pakistan. Six mediators that are health, employment status, marital status, number of children, the scale of income and freedom of choice are used in the study. Multiple Mediation Model suggested by Powdthavee et al. (2015) is used. The marginal mediation technique by Barrett (2018) is used for estimation. It is specially designed to deal with the interpretability issues in mediation analysis due to the inclusion of binary mediators in the model. The differences based on gender, marital status and the scale of income in the impact of education on life satisfaction are also analyzed. The data from Wave 6 (2010-2014) of the World Values Survey is used. The analysis identified and tested the direct and indirect effects of education on the life satisfaction of individuals in Pakistan for the first time. It helped in identifying the channels that are operative between education and life satisfaction and ones that are broken. The analysis enabled us to know, how outcomes of education affect life satisfaction in a developing country and how these are different in their behaviour in comparison with a developed country observed in the study of Powdthavee et al. (2015). The study also investigates whether education is contributing factor to life satisfaction for all social classes; poor, middle class and higher class or it is only important in the life of poor in Pakistan. Furthermore, the study includes freedom of choice and control over life as a mediating factor in education and life satisfaction model for the first time. The results show that education plays a significant role in affecting the life satisfaction of individuals in Pakistan. The results of analyzing the indirect effect in the full sample show that health, freedom and scale of

income are the significant mediators through which education is positively effecting the life satisfaction. The direct effect is also found positive and significant. The channel of employment status is found insignificant between education and life satisfaction in the full sample. The deeper look in the matter shows that the path from education to employment status is significant and positive. But the path from employment status to life satisfaction is broken. The employment status is found insignificant mediator in all other sub-samples based on gender, marital status and scale of income. The analysis is also performed for men and women separately to identify the possible differences. Different paths are found operative. For men, the channels of health, scale of income and marital status while for women channels of health and freedom of choice are found to be functional. The direct effects of education are also statistically significant and positive for both men and women. It is observed that for women all the paths from education to mediators are significant and operative but most of the paths from these mediators to life satisfaction are found insignificant. As a result, only the channels of health and freedom of choice are found significant for them. The broken paths must be mended to fully reap the benefits of education. For single persons, freedom of choice and scale of income while for married person health, freedom of choice and scale of income are significant mediators. For married persons, the total indirect effect is higher than single persons. The direct path is significant and has a positive coefficient value for married persons while for single persons it is found insignificant. The analysis of the impact of education on life satisfaction based on the scale of income illustrates that as compared to rich and poor more channels are effective for the middle class. It is found that all indirect effects, as well as a direct effect, are insignificant in case of the rich class, that means the role of education in defining and affecting the life satisfaction of rich is not supported by the data and is found insignificant. On the other hand, for the middle class, all of the indirect effects are significant except employment status. It indicates that the level of education is playing a crucial role in improving life satisfaction of persons belonging to the middle class. The direct path between education and life satisfaction for the middle class is also effective. For poor class, although only health and marital status are significant mediating effects, the coefficient of direct effect is much higher as compared to the direct path of the middle class. It means that although most of the indirect effects are insignificant for poor still education can affect the life satisfaction of the poor through its direct effect. It proclaims the policy of increased level of education for the poor and middle class to increase the level of life satisfaction in the country. Furthermore, the health channel is found significant in most of the models, it entails that the good of education is effectively translating to

health and then to the life satisfaction of individuals. So the policy of increased education will also lead to increased health in the country. Although, the current study is first in its nature for Pakistan and identified the broken links between education and life satisfaction the research gap remains to find the reasons for broken paths.

The second essay is particularly aimed to analyze the impact of different levels of education (i.e. Primary, Secondary and Tertiary) of employed persons on level and growth of national output in Pakistan. Moreover, it is an attempt to find the possible differences in the impact of education in different sectors of the economy i.e. Agriculture, Industry and Services Sector. From the review of studies with reference to Pakistan, it is clear that while attempts have been made to analyze the impact of different levels of education on economic growth e.g Jalil & Idrees (2013), still there is a gap in the literature to find its effect on the growth of agriculture, industry and services sector separately. Another distinct feature of this study is the use of output per employed person as a dependent variable, as most of the growth models when solved have dependent variable as Y/L denoted by y. Although per capita output is the most widely proxy used for Y/L, it is more appropriate to measure it as output per worker or employee, if there are no data issues. Benhabib & Spiegel (1994), Pritchett (1997), Hall & Jones(1999), Klenow-Rodriquez(1997), de la Fuente & Domenech(2000) and Barro & Lee(1994) used output per worker as a dependent variable. This study is distinct in considering the education of employed persons instead of overall enrollment rates. If the dependent variable is output per worker then it is more appropriate to analyze the educational level of those who are employed and participating in the production of GDP rather than to consider the education of all the people living in the economy. Hence although like all the previous studies this essay aims to find the impact of education on overall economic growth it is distinct in using different variables for the analysis. Moreover, it is a first attempt in finding the impact of education for different major sectors of the economy. This study is based on the time series analysis over the period of 1985-2018. The method of analysis used is the autoregressive distributed lag model (ARDL). The analysis of the impact of different levels of education of employed persons shows that each level of education whether its primary, secondary or tertiary have a positive effect on the output per employed person both in the short-run as well as in the long-run. It is true for the overall economy, industrial and services sector but the agriculture sector gives somewhat different results. In the agriculture sector, it is found that each level of education is negatively associated with the output per employed person. The deeper analysis showed us that the greater negative effect

of employment evades the positive effect of education in the agriculture sector. However, when the effect of education is considered on output, controlling for the effect of employment in the model, the coefficients turned to be positive. The comparison of different sectors for each level of education shows that primary education contributes more to the industrial sector. While the contribution of the secondary and tertiary level of education is highest in the case of the services sector. It implies that primary education is best utilized in the industrial sector as compared to other sectors. While secondary and tertiary education is more efficiently used in the services sector as compared to the industrial and agriculture sector. It is true both for short-run and the long-run.

The third essay is "Forecasting educational requirements for the economy of Pakistan: A Normed Planning Approach". Pakistan lies in the list of medium human development countries with an HDI rank of 150 in the list of 189 countries in the year 2017 (Human Development Report, 2018). Pakistan's HDI value for the year 2017 is 0.562 that lies below the average value of 0.638 for the South Asia region (Human Development Indices and Indicators: 2018 Statistical Update). The education system in Pakistan lacks uniformity, accessibility and quality. The current study is aimed to compare some of basic and important educational statistics of Pakistan with a group of 10 better performing countries and then to define a road map for the educational sector in Pakistan for the next two decades. The projections for the following variables are made for each level of education i.e. primary, secondary and tertiary level of education. 1. The required levels of Gross enrollment ratios and the number of enrollments. 2. The required levels of student-teacher ratios and the number of teachers. 3. The required composition of government expenditure among different levels of education. 4. Comparison of actual and required levels of all above-mentioned variables in the current time-period 2017. The integration of country by country planning and cross country comparisons is done by Cohen (2015) to forecast the educational requirements. We have followed the same approach to define a road map for the educational sector in Pakistan. Based on the panel data of 10 selected countries, estimations are made for finding the relationship between representative statistics of the education sector and GDP per capita of these countries. Then these estimated regressions are solved by inculcating the GDP of Pakistan in current as well as estimated values for future years to get the required level of educational statistics for the economy of Pakistan. The gap between existing and required levels are also reported. Hence, the third essay contributes to the literature by comparing the existing situation of Pakistan's educational sector with 10 selected better-performing countries by means of

some basic statistics of the education sector. It identifies the gap between the existing and required level of educational statistics to perform better in terms of educational statistics. The following conclusions are drawn on the analysis performed in the third essay. Gross enrollment ratios in Pakistan is below the required level for all levels of education i.e. primary, secondary and tertiary level of education. It is found that the numbers of enrollments are far below the required level of enrollments at each level of education. Wide differences exist between actual and required student-teacher ratios in primary and tertiary level of education. The actual value of the student-teacher ratio is closer for the secondary level of education, however, this is at the cost of low enrollments at the secondary level. Huge differences exist between the actual and required number of teachers in the system of each level of education. Analysis of the distribution of the government's recurrent expenditure on different levels of education shows that Pakistan is spending more than the required proportion of its spending on education to the primary and secondary level of education. It results in spending less than the required proportion, to tertiary education. It is also deduced from the analysis that the proportion of capital expenditure in overall government expenditure on education is less than required.

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ESSAY 1

INTRODUCTION

The recognition of education in economics as an element in the prosperity of individuals and society is as old as the subject itself. Adam Smith known as the father of economics elaborates the importance of education and its effects on society in his books “Theory of Moral Sentiments” and “The Wealth of Nations”. In his view, the basic aim of education is the prosperity of society and is attained not only by formal educational institutions but from parents, friends and other social interactions. The role of education in explaining wage differentials are also discussed in detail. Education is also considered important to nullify the adverse effects of the division of labour. According to him, the expenses of education should be borne by governments and individuals. It should not be treated as an ordinary commodity whose prices are determined by the forces of demand and supply. The following excerpt is from the writings of Adam Smith;

> “The expence of the institutions for education and religious instruction, is likewise, no doubt, beneficial to the whole society, and may, therefore, without injustice, be defrayed by the general contribution of the whole society.” (Wealth of Nations, p-815)

The literature of economics can be divided into three broad categories with regard to analyzing returns to education. The studies that attempted to find the role of education as a component of human capital in overall economic growth. There are hundreds of studies in this regard that attempted to explain the role of education theoretically as well as empirically in explaining the economic growth of an economy (Holland et al.,

2013; Sianesi & Reeenen, 2003; Temple, 2001; Topel, 1999; Renelt, 1991). The neoclassical and endogenous growth theories and all the empirical work done in this regard falls into this strand of literature. The second broad category is one that analyzes the impact of education on the earnings of individuals. Mincerian equation by Mincer (1974) and hundreds of empirical studies in this regard are the examples of this type of research. The third category deals with the studies that are interested in finding the role of education in increasing life satisfaction of individuals and wellbeing of nations. For example, Botha (2014), Chen (2012), Castriota (2006), Blanchflower and Oswald (2004), Hayo and Seifert (2003), Frey and Stutzer (2000) and many others explored the role of education in explaining higher life satisfaction. This is a relatively recent aspect of analyzing the role of education and relates to 'Economics of Happiness'.

The current research is about analyzing the role of education in Pakistan's economy. The dissertation is composed of three essays. The first essay deals with the role of education in the life satisfaction of individuals in Pakistan. The second essay analyzes the impact of education on agriculture, industrial and services sector separately as well as on the overall economy. The third essay is about the comparison of Pakistan economy's educational statistics with the 10 selected better-performing countries. The essay is aimed to find the gap between the existing and required levels of educational requirements based on the comparison with high performing countries. This essay is also dedicated to define the roadmap for the next two decades for the educational sector in terms of enrollments, number of teachers and government expenditure composition on different levels of education.

The first essay is 'Education and life satisfaction: A Marginal Mediation Analysis'. The purpose of the analysis is to find the direct and indirect impact of education on life satisfaction of individuals in Pakistan. Six mediators that are health, employment status,

marital status, number of children, the scale of income and freedom of choice are used in the study. Although the literature acknowledges that education has the ability to affect health, employability, marital status, family size and income of an individual and all these factors are also reported as determinants of life satisfaction. However, in most of the studies, the effect of education on all these factors are analyzed separately from the effect of these factors on life satisfaction. While analyzing the impact of education on life satisfaction all these factors that are known to be affected by education are taken as control variables. It means that the indirect impact of education on life satisfaction through these factors are ignored. Powdthavee et al. (2015) is the only study that attempted to analyze the indirect effect of education on life satisfaction in Australia by suggesting the use of multiple mediation analysis. This study also uses multiple mediation analysis to examine the relationship between education and life satisfaction. The marginal mediation technique by Barrett (2018) is used for estimation that is specially designed to deal with the interpretability issues in mediation analysis due to the inclusion of binary mediators in the model. The differences based on gender, marital status and the scale of income in the impact of education on life satisfaction are also analyzed. The data from Wave 6 (2010-2014) of the World Values Survey is used. This analysis is important for the following reasons. It empirically evaluates the general perception that education enhances life satisfaction in a particular economy or segment of the economy. The study of the indirect effect of education on life satisfaction addresses the question; why education is important and what are the channels through which it increases life satisfaction. It's worthwhile to know the effective paths and to know the broken ones that are unable to translate the good of education to life satisfaction. The analysis of differences based on gender and scale of income in the impact of education on life satisfaction will help policymakers to decide if a special

focus is required to a particular segment of society. This essay will contribute to the literature by adding the analysis of education and life satisfaction for developing countries like Pakistan. It will enable to know, how outcomes of education will affect life satisfaction in a developing country and how these are different in their behaviour in comparison with a developed country observed in the study of Powdthavee et al. (2015). This study will also investigate whether education is contributing factor to life satisfaction for all social classes; poor, middle class and higher class or it is only important in the life of poor in Pakistan. Furthermore, the study will include freedom of choice and control over life as a mediating factor in education and life satisfaction model for the first time.

The second essay is particularly aimed to analyze the impact of different levels of education (i.e. Primary, Secondary and Tertiary) of employed persons on level and growth of national output in Pakistan. Moreover, it is an attempt to find the possible differences in the impact of education in different sectors of the economy i.e. Agriculture, Industry and Services Sector. From the review of studies with reference to Pakistan, it is clear that while attempts have been made to analyze the impact of different levels of education on economic growth e.g Jalil & Idrees (2013), still there is a gap in the literature to find its effect on the growth of agriculture, industry and services sector separately. Another distinct feature of this study is the use of output per employed person as a dependent variable, as most of the growth models when solved have dependent variable as Y/L denoted by y. Although per capita output is the most widely proxy used for Y/L, it is more appropriate to measure it as output per worker or employee, if there are no data issues. Benhabib and Spiegel (1994), Pritchett (1997), and Bils and Klenow (1997), Hall and Jones (1999), Klenow-Rodriquez (1997), de la Fuente and Domenech (2000) and Barro and Lee (1994) used output per worker as a

dependent variable. This study is distinct in considering the education of employed persons instead of overall enrollment rates. The number of employed persons with a particular level of education i.e. primary, secondary and tertiary education in each year for the overall economy, agriculture, industrial and services sector is derived from labour force survey of Pakistan. If the dependent variable is output per worker then it is more appropriate to analyze the educational level of those who are employed and participating in the production of GDP rather than to consider the education of all the people living in the economy. Hence although like all the previous studies this essay aims to find the impact of education on overall economic growth it is distinct in using different variables for the analysis. Moreover, it is a first attempt in finding the impact of education for different major sectors of the economy. This study is based on the time series analysis over the period of 1985-2018. The method of analysis used is the autoregressive distributed lag model (ARDL).

The third essay is "Forecasting educational requirements for the economy of Pakistan: A Normed Planning Approach". Pakistan lies in the list of medium human development countries with an HDI rank of 150 in the list of 189 countries in the year 2017 (Human Development Report, 2018). Pakistan's HDI value for the year 2017 is 0.562 that lies below the average value of 0.638 for the South Asia region (Human Development Indices and Indicators: 2018 Statistical Update). The review of Pakistan's educational policies shows that while higher targets are set in each educational policy, they lack the proper quantitative targets and the strategy to achieve them. The education system in Pakistan lacks uniformity, accessibility and quality. The vast differences in private and public schooling, high numbers of out of school children, low personal investments in education due to poverty, poor policy formulation and implementation, lack of adequate teachers training, lack of proper infrastructure at all levels of education, low

participation and poor quality of higher education and low learning outcomes in terms of personal development & productivity are few of the challenges. These facts indicate the need for focusing on educational planning and human development in Pakistan. The current study is aimed to compare some of basic and important educational statistics of Pakistan with a group of 10 better performing countries and then to define a road map for the educational sector in Pakistan for the next two decades. The projections for the following variables are made for each level of education i.e. primary, secondary and tertiary level of education. 1. The required levels of Gross enrollment ratios and the number of enrollments. 2. The required levels of student-teacher ratios and the number of teachers. 3. The required composition of government expenditure among different levels of education. 4. Comparison of actual and required levels of all above-mentioned variables in the current time-period 2017. The advancement in data availability on education and human resource development for all countries by the international agencies like UNESCO, World Bank and UNDP made it possible to base the educational planning on the cross country/ international comparisons (Cohen, 2015). The integration of country by country planning and cross country comparisons is done by Cohen (2015) to forecast the educational requirements. We have followed the same approach to define a road map for the educational sector in Pakistan. Based on the panel data of 10 selected countries, estimations are made for finding the relationship between representative statistics of the education sector and GDP per capita of these countries. Then these estimated regressions are solved by inculcating the GDP of Pakistan in current as well as estimated values for future years to get the required level of educational statistics for the economy of Pakistan. The gap between existing and required levels are also reported. Hence, the third essay contributes to the literature by comparing the existing situation of Pakistan's educational sector with 10 selected

better-performing countries by means of some basic statistics of the education sector. It identifies the gap between the existing and required level of educational statistics to perform better in terms of educational statistics. It provides useful information about Pakistan's educational sector statistics. The current statistics are compared with what is required to be better performing in terms of education keeping in view the GDP per capita of the country. The required levels of the educational statistics for the coming two decades are also calculated and reported in the study.

After presenting all the three essays as distinct sections, this dissertation will be concluded in a separate section at the end.

EDUCATION AND LIFE SATISFACTION: A MARGINAL MEDIATION ANALYSIS

1.1.1 Introduction

The concept of wellbeing, life satisfaction and happiness remained in the philosophy of economics since its inception as a subject. Although the distinction between wealth and happiness was recognized by classical economists, the subject remained and became more focused on utility (from the use of goods and services), increasing wealth, GDP and its growth. It was believed that more money, wealth and consumption means more wellbeing and happiness to individuals and nations. The concept that promoting income and growth means wellbeing overshadowed the realization that merely higher incomes and growth are not enough for the wellbeing of individuals and nations, until the recent past.

The seminal work of Easterlin(1974) and Scitovsky(1976) changed the focus of economists from wealth to happiness. Easterlin paradox could be considered as a basis of a paradigm shift in the field of economics. Easterlin attempted to analyze the relationship between income and happiness. In contrast to Pigou's dictum, the study concluded that richer countries were not happier than poor countries. Also, the data from 1946 to 1970 for the US showed that despite the rapid increase in income there was not much increase in happiness of the US over time. The Easterlin paradox and Sctovsky(1976) could not draw the interest of many researchers and the subject remained dormant until 1990. These two eminent researchers made further contributions in 1995 and 1992 respectively, that grabbed the attention of many economists, and as a result, a new branch of economics emerged with the name 'Economics of Happiness'.

Education is a much-recognized factor in improving quality of life and thereby increasing life satisfaction. Many educationists and economists are in favour of public expenditure on education because education increases the overall quality of life. Education enhances life satisfaction not only through its monetary rewards but also because of its positive impact on almost every aspect of life.

The literature on education and life satisfaction, happiness and subjective wellbeing can be divided into two distinct categories. One group of researchers found that education is positively associated with life satisfaction because of its positive economic, social and psychological impacts on individuals (Blanchflower and Oswald, 2004; Di Tella et al., 2001; Hayo and Seifert, 2003; Chen, 2012). The second cluster of studies revealed no or a negative association between the two, particularly after some threshold level of education (Clark &Oswald, 1996; Helliwell, 2003; Inglehart & Klingemann, 2000).

In literature, income is the most acknowledged return of education. The pioneering work to establish the relationship between education and income is of Mincer(1974) and popularly known as mincerian equation. Moreover, Angrist and Krueger (1991), Harmon and Walker (1995) and Leigh and Ryan (2008) and many other studies concluded that an additional year of schooling results in increased income. On the other hand, many studies establish a significant and positive association between income and subjective wellbeing or life satisfaction (Blanchflower & Oswald, 2004; Yang, 2008; Headey et al. 2008; Selim, 2008).

However, many studies have recognized that it is not only the monetary rewards through which education leads to higher life satisfaction but there are some other

significant mediating factors (Brighouse,2006; Michalos, 2008). It is explored that in addition to income, education has a significant impact on one's health, marital life,

family size, and chances of getting employment (Oreopoulos and Salvanes, 2011).

Education and mental & physical health are observed to be positively and significantly associated (Siles, 2009; Powdthavee, 2010b). Mincer (1991) and Kettunen (1997) recorded that individuals with higher education have comparatively fewer chances of being unemployed and if unemployed they do not remain unemployed for longer periods. Furthermore, educated individuals with prestigious jobs seem more attractive for marriage and have better marital choices (Chiappori et al., 2009; LaFortune, 2013). It is also witnessed that educated people have more stable marriages and hence less divorce rate (Oreopoulos & Salvanes,2011). Furthermore, there is empirical evidence that education has a negative impact on family size (Sander, 1992; Martin, 1995). As educated women have a greater opportunity cost of being out of the labour market for the child-rearing period that discourages them to have a large family.

On the other hand, a vast literature about defining the determinants of happiness or life satisfaction in economics illustrates that income, education, health, employment, marital status, number of children and freedom of choice are the important predictors of life satisfaction (Oswald, 1997; Layard, 2005; Yang, 2008; Verme, 2009; Layard et al. 2013).

Verme (2009) observed that freedom of choice and control over life is the dominant predictor of life satisfaction rather than any other factor such as income, health, employment, marital status or religion. However, in literature, the mediating effect of freedom of choice and control over life in relation to education and life satisfaction has not yet studied.

Although the relationship between education and life satisfaction is analyzed and well-recognized in the economics of happiness literature, only the direct effects are considered and quantified ignoring the indirect effects. All previous studies except Powdthavee et al. (2015) analyzed the relationship by using a single equation model. The use of single-equation model shows the impact of education on life satisfaction by taking other factors like health, employment, marital status, number of children and income as control variables. Powdthavee et al. (2015) contributed to the literature by pointing out that the use of single-equation model ignores the fact that the factors which are taken as control variables are the function of education themselves. It implies that these studies ignore the indirect effect of education on life satisfaction. As health, freedom of choice and control over life, marital status, number of children, employment status and scale of income are themselves a function of education. Therefore, Multiple mediation model is proposed to properly know the role of intermediating variables through which education affects life satisfaction.

The purpose of the current study is to find the direct and indirect impact of education on life satisfaction in the context of Pakistan. The indirect effect of education on life satisfaction will be analyzed through six mediating factors namely health, freedom of choice and control over life, marital status, number of children, employment status and scale of income. This analysis will also be repeated for different categories based on gender, marital status and scale of income.

1.1.2 Significance of Study

This study is the first attempt with reference to Pakistan that aims to investigate the relationship between education and life satisfaction and try to specify the channels through which education indirectly affects life satisfaction. This analysis is important

for various reasons. Firstly, it empirically evaluates the general perception that education enhances life satisfaction in a particular economy or segment of the economy. Secondly, the study of the indirect effect of education on life satisfaction has important policy implications such as if education increases life satisfaction via health as a mediating factor between the two, then increasing education will not only be the aim of educational policy but also the aim of health policy, same applies to employment status and scale of income. Thirdly, this micro-level study is important for educational policy because it is an integral part of a worthy education policy to address the questions of why education is important and what good it is bringing to individuals. Fourthly, it's worthwhile to know the effective paths and the ones that are broken and unable to translate the good of education into life satisfaction. Fifthly, the analysis of differences in the impact of education on life satisfaction based on gender, the scale of income and marital status will help policymakers to decide if special attention is required by a particular segment of society.

1.1.3 Objectives of Study

The objectives of this essay are to:

- Analyze the impact of education on life satisfaction via six mediators; income, health, employment, marriage, children and freedom of choice and control over life.
- Explore whether the impact of education on life satisfaction is the same for male and female or differences exist on the bases of gender.
- Identify the role of education in life satisfaction across different income groups Rich, middle class and poor.
- Investigate differences if any in the impact of education on life satisfaction for married vs single.

1.1.4 Organization of Study

The essay is organized in several sections in the following manner. The literature review is presented in section 1.2. Section 1.3 is about model and estimation methodology. Section 1.4 explains the estimation results. Section 1.5 is devoted to report conclusions and section 1.6 is about policy implications and ideas for future research.

1.2 Literature Review

This section reviews the literature on education and life satisfaction. In section 1.2.1, the concept of happiness and life satisfaction in economics is explained very briefly. Then the impact of education on life satisfaction is reviewed in section 1.2.2, which is further divided into two sections regarding the impact of education on life satisfaction.

1.2.1 The Concept of Happiness, Life Satisfaction & Subjective Wellbeing in Economics

The philosophy of economics since its inception recognizes the concept of wellbeing, life satisfaction and happiness, however, the realization that merely higher incomes and growth are not enough for the wellbeing of nations and individuals is relatively new as compared to the concept that promoting income and growth means wellbeing. Even the work of Adam Smith which is considered to promote competition and self-interest contemplates the idea of wellbeing and happiness. In the book, 'The Theory of Moral Sentiments' Smith(1759, p.100) explained the purpose of government in the following words "All constitutions of government, however, are valued only in proportion as they tend to promote the happiness of those who live under them. This is their sole use and end." Similarly, in his book The Wealth of Nations he postulated that individuals by pursuing their interest promote the interest of the society. Furthermore, he described that "No society can surely be flourishing and happy, of which the far greater part of

the members are poor and miserable. It is but equity, besides, that they who feed, cloath and lodge the whole body of the people, should have such a share of the produce of their own labour as to be themselves tolerably well fed, cloathed and lodged." Likewise, the following words of Malthus (1798) show the understanding of the distinction between wealth and happiness among the classical economists

> "The professed object of Dr Adam Smith's inquiry is the nature and causes of the wealth of nations. There is another inquiry however perhaps even more interesting, which he occasionally includes in his studies and that is the inquiry into the causes which affect the happiness of nations . . . I am sufficiently aware of the near connection of these two subjects and that the causes which tend to increase the wealth of a state tend also, generally speaking, to increase happiness. But perhaps Dr Adam Smith has considered these two inquiries as still more nearly connected than they really are." (Malthus 1798, pp. 303–4)

Even though the distinction between wealth and happiness was recognized by classical economists, the subject remained and became more focused on utility (from use of goods and services), increasing wealth, GDP and its growth as it was believed that more money, wealth and consumption means more wellbeing and happiness to individuals and nations.

The seminal work of Easterlin(1974) and Scitovsky(1976) changed the focus of economists from wealth to happiness. Easterlin paradox could be considered as a basis of a paradigm shift in the field of economics. Easterlin attempted to analyze the relationship between income and happiness. In contrast to the Pigou's dictum, the study concluded that richer countries were not happier than poor countries and also the data from 1946 to 1970 for the US showed that despite the rapid increase in income there was not much increase in happiness of US over time. The Easterlin paradox and Sctovsky(1976) could not draw the interest of many researchers and the subject remained dormant until 1990. These two eminent researchers made further

contributions in 1995 and 1992 respectively, that grabbed the attention of many economists, and as a result, a new branch of economics emerged with the name 'Economics of Happiness'.

In economics, happiness, life satisfaction and subjective wellbeing are the words that are used synonymously. Veenhoven (1996) presented detail insight into definition, measurement, reliability and validity of data about life satisfaction. Similarly, Veenhoven (2012) provided detail discussion about definition and measurement of happiness, life satisfaction and subjective wellbeing. Further, it is explained in the study that in 1950s morale and adjustment and in 1960s word 'life satisfaction' is used in the meaning of 'overall happiness'. While in 1984, Denier introduced the word 'subjective wellbeing' as a synonym of happiness. Layard (2005) in his book 'Happiness: Lessons from a New Science' discussed the slight differences among the words happiness, life satisfaction, wellbeing and subjective wellbeing. It is maintained that these words are used interchangeably in the literature of economics while the field of psychology uses them in different meanings and implications. Stevenson and Wolfers (2008) stated that "the economics literature has tended to treat measures of happiness and life satisfaction as largely interchangeable". In the same way, Easterlin one of the founders of Economics of Happiness used these words synonymously in his article Easterlin(2001) "Throughout this article, I use the term happiness, subjective wellbeing, satisfaction, utility, wellbeing, and welfare interchangeably".

1.2.2 Education and Life Satisfaction in Literature of Economics

The economics literature on education and life satisfaction, happiness and subjective wellbeing can be divided into two distinct categories. One group of researchers found that education is positively associated with life satisfaction because of its positive

economic, social and psychological impacts on individuals. The second cluster of studies revealed no or a negative association between the two, particularly after some specific level of education (threshold level).

1.2.2.1 Positive Impact of Education on Life Satisfaction

There are numerous studies in the literature that describe the positive association between education and life satisfaction. Blanchflower and Oswald (2004) established that education affects happiness independently of income while studying happiness in the US and UK. Rojas (2004) following the domains-of-life approach attempted to study the wellbeing of individuals. It was established that education is important and contributing positively in almost every domain of life, seven main domains were identified i.e. health, economic, job, personal, family, friendship and community environment. In the study of Bukenya et al. (2003) education is found to have a significantly positive effect on the quality of life in a sample of 2000 individuals of West Virginia. Furthermore, individuals with higher education have a higher probability of having a better quality of life as compared to individuals with a low level of education. Similarly, empirical studies of Di Tella et al. (2001), Hayo and Seifert(2003), Castriota (2006), Chen(2012), Botha(2014), Ferrer-i-Carbonell (2005), Graham and Pettinato (2002), Frey and Stutzer (2000) and many others concluded the same that education is a significant factor in explaining higher life satisfaction. Some of these studies are briefly summarized in the following passages.

Di Tella et al (2001) utilizing microdata for twelve European countries and the US over more than 25 years attempted to find the impact of macroeconomic movements on wellbeing. To know the structure of happiness function micro econometric model was fitted. The Ordered Probit equations revealed that, in general, different countries have

a similar form of the happiness equation. Macroeconomic variable (GDP and lagged GDP) were found correlated with the nation's happiness also happiness equations were found monotonically increasing in terms of income.

Botha(2013) affirmed a positive association between education and self-reported life satisfaction. The study was based on cross-sectional data for South Africa. The econometric technique for analysis was ordered probit regression. It was concluded that higher education is associated with higher life satisfaction while people with a low level of education were found comparatively less satisfied in their lives. Although the study could not report the significant differences in life satisfaction on the bases of gender, however, the study reported male to be more satisfied as compared to female regardless of education. The study tested the hypothesis of education being positional good and it is found that people who have an education higher than the mean level of education are more satisfied as compared to those who have less than the average level of education and supported the claim that education is positional good.

Hayo and Seifert (2003) established a significant impact of economic well-being on life satisfaction by using an ordered logit model. Data from 11 Eastern European countries over time span 1991-1995 was used. Education is found to be important and significant determinant of economic wellbeing which leads to higher life satisfaction.

Castriota (2006) used the World Values survey of the years 1995 and 2000 using data of 81 countries and 118000 individuals. The study showed that individuals with higher education attach less importance to GDP (used as a proxy for income along with data on income deciles) in life satisfaction model, holding other things constant. Multinomial ordered-logit regressions were used for the analysis of the effect of education on life satisfaction by segregating data into three income classes (lower,

middle and high), taking into consideration effect of gender, employment status, marital status, age and dummies for year and country.

1.2.2.1a Education and Income

In literature, income is the most acknowledged return of education. Mincer(1974) attempted to model the effect of investment in human capital (education) on earnings. As a result, the most widely used mincerian equation emerged that links earnings with years of schooling and experience. Mincerian equation is used by numerous studies for a large number of countries and different demographic groups. Card(1999) reviewed the empirical work of the link between education and earnings. The studies are categorized into two groups; studies that used OLS and those that used the instrumental variable technique, estimates of all studies are listed in the paper. The review concluded that the added year of schooling results in a 7-12% increase in income, keeping in view the other affecting factors like; ability, family background and intelligence. The recent study of Psacharopoulos and Patrinos (2018) reviewed studies on returns of investment in education. The review covers studies from 1950 to 2014, 139 countries and 1120 estimates. The two main methods discussed in the review were Mincerian earnings equation which describes education-earnings/income relationship, we are interested in, and full discounting method. It is concluded based on 705 estimates of Mincerian function that every added year of schooling means 8.8 percent higher earnings. It is also summarized that private returns to education for female are 2% higher than male. Angrist & Krueger (1991) illustrated that extra schooling has a positive impact on earnings, interestingly they found that even small differences in schooling have significant differences in earnings. They found the impact of schooling by differences in a quarter of birth. They found that individuals who have to attend more schooling because of their quarter of birth and the compulsory schooling laws have greater

earnings. It has interesting implications that even the small differences in education (i.e. of a quarter or few quarters) results in significant differences in earnings. Similarly, Harmon &Walker (1995) and Leigh & Ryan (2008) also supports the positive relationship between income and years of schooling both by OLS and instrumental variable estimation technique. It is also a well-established fact that income is significantly and positively associated with subjective wellbeing or life satisfaction or happiness (Blanchflower & Oswald, 2004; Yang, 2008; Headey et al. 2008; Selim, 2008). While Cun˜ado & de Gracia (2012), Castriota (2006), Checchi (2006), Powdthavee et al. (2015), Cambell (1981) and Witter et al. (1984) shows that part of the relationship between education and social wellbeing exists because of the covariance of education and income.

1.2.2.1b Non- Monetary rewards of Education and their role in Life Satisfaction

However, many studies established that in addition to monetary rewards through which education leads to higher life satisfaction there are some other mediating factors (Brighouse, 2006; Michalos, 2008). This argument is augmented by the empirical research in which education is shown to be positively associated with life satisfaction even after controlling for income (Blanchflower & Oswald, 2004; Gerdtham & Johannesson, 2001; Selim, 2008; Shin & Inoguchi, 2009; Tsou and Liu, 2001). It is observed that it is not only income but also effect of education on health, marital life, family size, and chances of getting employment that leads to higher life satisfaction (Layard,2005; Yang, 2008). It is established in the literature that differences exist in health, unemployment rate and divorce rate based on education. Individuals with better education on average have better health, fewer chances of remaining unemployed and better marital life resulting in less divorce rate. Mostly income together with health, employment and marital status are attributed as factors that mediate between education

and subjective wellbeing (Chen, 2012). However, most of the studies analyzed the impact of education on the above-mentioned factors separately than the effect of these factors on life satisfaction or subjective wellbeing.

Siles (2009) and Powdthavee (2010b) observed that education and mental and physical health are positively and significantly associated. Cutler and Lleras-Muney(2006) discussed and reviewed different existing theories and possibilities about the link between education and health. Accordingly, some of the explanations for a link between education and health are that better education means increased income, better occupational status and environment that helps in preserving better health. Educated persons can get quick access to new information and technology to prevent or treat a disease and they are also quick to respond to health campaigns or new guidelines. Moreover, individuals with higher education have peer recognition for good habits regarding health e.g. exercise, routine checkups, blood pressure and sugar controls while face disapproval for bad habits e.g. smoking, drinking and drugs etc. which helps them to maintain better health. Another hypothesis regarding education and health is that more educated persons are more risk-averse and therefore maintain better health. Similarly it is also explained with references in literature that education increases the rank in society which means that they have more control over their lives and less influenced by negative emotions which people at lower ranks face e.g. depression, anxiety and hostility. Another explanation of the link between education and health is that education increases the ability to think differently and to make better decisions due to better information and cognition. Whereas Easterlin(2004) described the relationship between health and life satisfaction. Based on his work and a large survey results by sociologists, psychologists and American survey data, the study termed health an important factor in defining life satisfaction and rejects the setpoint theory by

psychologists and concluded that adverse changes in health have lasting negative impacts on happiness. Similarly, Appleton & Song (2008) based on survey data of 7000 individuals from China reported that ill-health adversely affects subjective wellbeing and people who are satisfied with their health status are more chances of being satisfied with their life as compared to those who are less satisfied with their health.

Blanchflower and Oswald (1994) and Albert and Davia (2005) proposed that education increases subjective wellbeing because of job quality and opportunity of getting interesting jobs. Mincer (1991) and Kettunen(1997) recorded that individuals with higher education have comparatively fewer chances of being unemployed and if unemployed they do not remain unemployed for longer periods. On the other hand, it is also established in the literature that employment status affects life satisfaction. For example, Grün, Hauser & Rhein (2010) attempted to compare the life satisfaction of persons in two different periods; when they were unemployed and after they get employment with consideration of job quality. The analysis was carried out using panel data of West Germany and estimation was done through conditional logit technique. Job quality was measured by different factors e.g. wages, job satisfaction of worker, contract type, qualification of worker and job requirement and comparison of before and after unemployment jobs. It was found that people without a job are less satisfied with their lives as compared to the situation when they get jobs, in addition to this people even with bad job quality were found more satisfied than unemployment period. it was also found that job quality has less relevance when persons are unemployed and life satisfaction increases even if they get a job of low quality. The study could not found a single factor or combination of characteristics that make a job, less preferable than remaining unemployed. However good quality jobs increase life satisfaction more

than the increase in life satisfaction due to a bad quality job. Similarly, Hassall et al. (2004) also concluded the same that low wage earners are better off than unemployed in terms of life satisfaction. The study was based on a case study in Australia including 193 unemployed persons and 206 low wage workers. Layard (2004) reported that "human happiness is more affected by whether or not one has a job than by what kind of job it is". On the contrary, Dockery (2003) reported based on Australian household panel data that remaining in a job that has less job satisfaction is more unfavourable for life satisfaction as compared to remaining without a job.

It is observed by many studies that individuals with higher education and prestigious jobs seem more attractive for marriage and have better choices (Chiappori et al., 2009; LaFortune, 2013). It is also witnessed that educated people have more stable marriages and hence have less divorce rate (Oreopoulos & Salvanes, 2011). Blanchflower and Oswald (2000) illustrated that self-reported wellbeing is greater who are married as compared to those who are unmarried and also it is greater for highly educated people and low among less educated. The analysis was based on 100,000 individuals from the US and UK. Heliwell (2003) reported the same that married individual on average report higher life satisfaction than unmarried.

With relation to the impact of family size, there is empirical evidence that education has a negative impact on family size (Sander, 1992; Martin,1995) and the reason is that more educated women have a greater opportunity cost of being out of the labour market for a period of child-rearing. Haller and Hadler (2006) reported children as positively contributing factor of life satisfaction. While studies of Di Tella et al. (2003) and Smith (2003) observed that in the UK and US children have a negative impact on life satisfaction.

Verme(2009) states that " A variable that measures freedom of choice and the locus of control is found to predict life satisfaction better than *any* other known factor such as health, employment, income, marriage or religion, across countries and within countries". Although the importance of freedom and control over life is recognized as an important factor in determining life satisfaction it is not studied as a mediating factor in relation to education and life satisfaction.

Salinas-Jime´nez et al. (2011) and Cuñado &Pérez-de-Gracia (2011) found the non-linear relationship of education and life satisfaction and they concluded that education is more contributing to the happiness or life satisfaction of poor as compared to rich income groups.

1.2.2.2 Studies showing no or negative impact of education on Life satisfaction

However, many studies also reported no effect or negative effect of education on subjective well-being or life satisfaction. For example, Heady &Wooden (2004), Inglehart & Klingemann (2000), Clark &Oswald (1996) and others observed that no significant relationship exists between education and wellbeing. Inglehart & Klingemann (2000) performed a cross-national analysis consisting of 64 societies, the study concluded that society's education does not have a significant impact on its overall wellbeing. Similarly, Helliwell(2003) found no impact of increasing level of education on wellbeing both on a national and individual level when perceived trust, income and health are considered in the model; based on data of 50 countries from three successive WVS. While the results of Clark &Oswald (1996) showed a strong negative relationship between education and life satisfaction of workers when income is held constant, and higher aspirations due to higher education might be the reason for the negative relationship.

Ferrante (2009) reported a negative relationship between education and life satisfaction. Accordingly, higher education leads to higher aspirations which may decrease life satisfaction if aspirations are higher than the real opportunities available. The study utilizing cross-sectional data for Italy and ordered probit regressions supported the argument that education through increased aspirations could cause regret that affects life satisfaction adversely.

1.2.3 Conclusion

Although literature acknowledges that education has the ability to affect individuals health, employability, marital status, family size and income and these factors are all reported as determinants of life satisfaction along with education. However, in most of the studies the above-mentioned factors i.e. health, employability, marital status, family size, income and education are included in a single equation model of life satisfaction. The problem with using a single equation model for finding the relationship between education and life satisfaction is that it ignores the ability of education to effect the control variables like health, employment status and others. So the indirect effect of education through these channels are not properly analyzed. Powdthavee et al. (2015) is the only study that attempted to analyze the indirect effect of education on life satisfaction in Australia by utilizing structural equation model in contrast to all previous studies which used a single equation model.

The current study will contribute to the literature with reference to developing countries like Pakistan. It will enable us to know how outcomes of education will affect life satisfaction in a developing country and how these are different in their behaviour in comparison with a developed country observed in the study of Powdthavee et al. (2015). This study will also investigate whether education is contributing factor to life

satisfaction for all social classes; poor, middle class and higher class or it is only important in the life of the poor in Pakistan. Furthermore, the study will include freedom of choice and control over life as a mediating factor in the education and life satisfaction model for the first time.

1.2.4. Review of Literature on Mediation Analysis

This section reviews the literature on mediation analysis to understand the pros and cons of each method available and to single out the appropriate technique for analyzing our model.

Mediation analysis investigates the relationship of the exogenous variable and the dependent variable keeping in consideration the third variable i.e. the mediator. So mediator is an intervening variable that is expected to affect the dependent variable and get affected by the changes in the independent variable. M variable is said to be a Mediator in X and Y relationship if the impact of X on Y variable get affected by its introduction in the model as well as if it is established that X significantly affects M and M significantly impact Y variable in the presence of X variable (Judd & Kenny, 1981; Barron and Kenny,1986). The following figure shows a simple mediation model.

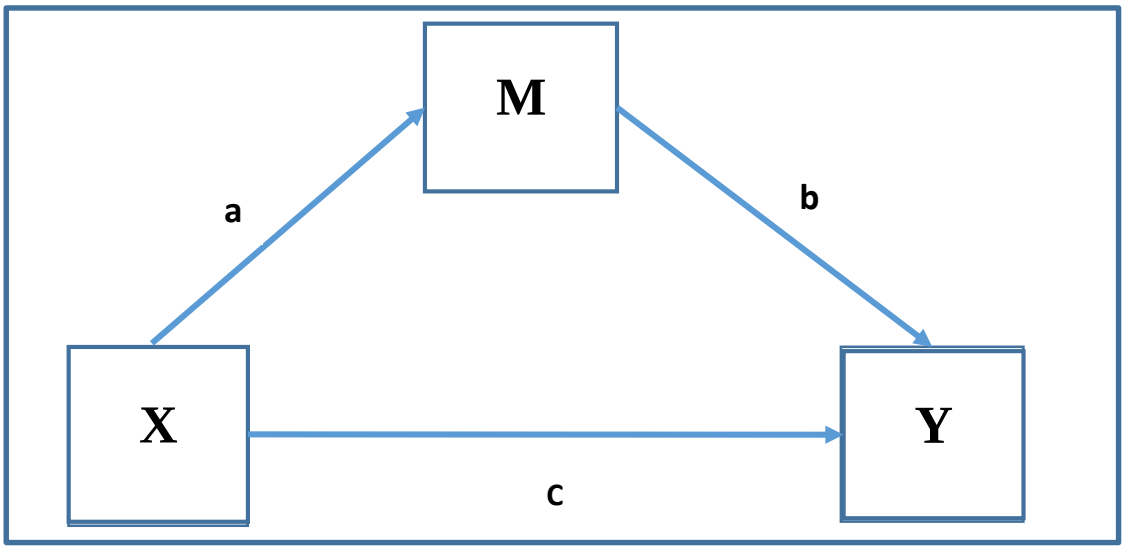

Figure 1.1: Simple Mediation Model

Introduction of intervening variable splits the effect of X on Y into two parts the direct and indirect effect. The indirect effect is the effect of X variable which is transferred into Y variable through the intermediating variable M (X → M → Y); because changes in X variable brings changes into variable M and when M changes it impact Y variable. So M provides a path through which X variable transfer its impact to variable Y.

Mediation model is called a simple mediation model when there is a single mediator in the model while it is called a multiple mediation model when there are more than one intermediating factors in the model. Full mediation is when the introduction of mediating factor or factors makes the direct path insignificant. It means that in full mediation model all of the effect of X to Y is through mediator M. Partial mediation is when the mediating factor(s) reduces the direct impact of X on Y but the direct path remains non-zero and significant.

Preacher and Hayes (2008) recommended using a multiple mediation model when there are more than one mediating factor between X and Y variable instead of using a simple mediation model for each intermediate factor separately. It helps in reducing omitted variable bias, comparison of different indirect effects becomes possible, testing the significance of total indirect effect helps in concluding whether the mediators included in the model are jointly mediating the effect of X on Y or not.

1.2.4.1 Methods of Estimation

This section will illustrate different techniques available for estimating and testing mediation along with their pros and cons. The focus will be on strategies available for performing multiple mediation analysis as all the models in the current study contains more than one mediating factor. Methods which are more applicable to the analysis of the model used in the current study are discussed more thoroughly while others are

described briefly. Besides, this section facilitates the justification of the method chosen for estimation in the current study. The following general model and coefficient names are used to discuss the methods of estimation.

$$\hat{Y} = k_1 + c X \quad \text{(a)}$$

$$M\square_i = k_2 + a_i X_i \quad \text{(b)}$$

$$\hat{Y} = k_3 + c' X + \Sigma b_i M_i \quad \text{(c)}$$

Where X is the independent variable, Y is the dependent variable and M_i represents mediators, subscript i is indicating several mediators e.g. (M_1 is the first mediator, M_2 is a second mediator and so on). Similarly, a_1 a_2 a_3 are representing the paths from X to respective mediators while b_1 b_2 b_3 are denoting coefficients of respective mediators in an equation containing all mediators and X variable as predictors of Y.

(a) The causal Steps Approach

Causal steps approach follows the steps prescribed by Baron and Kenny (1986) and Judd and Kenny (1981) which are the basis of mediation analysis. This method derives information from the estimation of equations mentioned at the start of this section. This criterion requires for a variable to be the mediator that the path coefficients a, b and c are all significant and introduction of the mediator(s) significantly reduces the direct effect of X on Y. So this approach basically investigates whether the difference between c and c' is significant after the introduction of the mediator(s) holding that paths from X to M and M to Y are significant. The flaw with causal step approach is that it does not directly test the mediation effect or could not tell how stronger the impact of the mediator is or how large the indirect effect is and whether the indirect effect is significantly different from zero or not. It is discussed in MacKinnon et al. (2002) this approach is not powerful enough to discover an indirect effect. While

Holmbeck (2002) reported that the causal approach may have inconsistencies in its results, for example, a and b paths may turn significant but it does not reduce the direct effect of X to Y, which will lead to an inconclusive result. Moreover, this approach also does not provide standard errors and confidence intervals for indirect effect and in the case of multiple mediators, it could not split the effects of mediators. Preacher and Hayes (2008) concluded regarding causal step approach that it is of less utility, especially in multiple mediation analysis.

(b) Product of Coefficients Method

Product of coefficient approach is an extension and substantial improvement of the causal step approach nullifying most of the flaws in it. This method ascertained that the product of paths from X to M and then from M to Y represents, the indirect effect. In terms of notations in the above-mentioned model, the indirect effect is the product of a and b in a simple mediation model. While in case of multiple mediators the specific indirect effects are represented by respective a and b paths and total indirect effect is $\Sigma a_i b_i$. This method also provides tools for testing these mediation effects, in case of simple mediation the most popular method for testing the significance of the indirect effect is the Sobel test. **Sobel test** assumes that ab follows the normal distribution and the significance of this indirect effect can be tested by the following formula

$$z = \frac{a * b}{\sqrt{b^2 \sigma_a{}^2 + a^2 \sigma_b{}^2}} \qquad \text{(a)}$$

Where denominator shows the standard error of indirect effect (ab) which is based on the work of Aroian(1947) and also illustrated by Mood, Graybill and Boes (1974) using the 2nd order Taylor approximation of product of coefficients ab. The formula of Standard error of ab by Taylor approximation also includes the cross product of variance of 'a' and variance of 'b'. It is dropped in Sobel test formula knowing that this

cross product is too small to be included (MacKinnon & Dwyer, 1993) and Sobel (1982) mentioned that this cross product of variances are not required to be included because it does not appear if standard error of ab is derived through delta method. Preacher and Hayes (2008) discuss the Sobel test and delta method for specific indirect effect in case of multiple mediator models. It is proposed that these methods can be extended to find indirect effects and their standard errors to test the mediation effect of each mediator. For example the indirect effect of the third mediator in the model M_3 will be equals to $a_3 b_3$. Test of significance will be performed by the formula given below where the term in the denominator is a standard error of indirect effect.

$$z = \frac{a_3 b_3}{\sqrt{{b_3}^2 {\sigma_{a_3}}^2 + {a_3}^2 {\sigma_{b_3}}^2}} \qquad \text{(b)}$$

The main shortcoming of the product of coefficient method is that it assumes the product of coefficients distribution to be normally distributed which is contradicted by studies of Aroian (1947); Goodman (1960); Mackinnon et al. (2007) stating that the paths a and b even if individually follow normal distribution their products are not normal and are skewed.

(c) Use of Structural Equation Modelling (SEM) for Mediation Analysis

Structural Equation modelling for estimation of parameters in the mediation model is usually preferred for a variety of reasons. SEM is theoretically stronger than OLS technique because it estimates all the related variable coefficients simultaneously. It makes the estimation and interpretation of complex models easy. It deals easily the multiple exogenous variables, mediators and outcome variable. Handling of missing data is also easy in SEM. It is also preferred for its information given on model fit. It is especially more useable in complex mediation models where there are multilevel mediation processes, when the effect of X transmits to Y through many in-between

nodes, when there is a mix of latent and observed variables or when all or most of variables are latent variables.

However, SEM although preferable for all the reasons mentioned above is less applicable in case of binary mediators or outcomes as it assumes that all the variables are continuous and have a multivariate normal distribution.

(d) Bootstrapping Technique

Bootstrapping technique is preferable and recommended particularly in small and moderate samples because it does not assume the distribution of indirect effects (ab) to be normal; these methods do not require to make any assumptions about the distribution of parameter estimates to be tested (Shrout & Bolger, 2002; Preacher & Hayes, 2008). Bollen and Stine (1990) and Stone and Sobel (1990) using bootstrapping and simulation studies respectively found that distribution of the product of 'a' and 'b' paths i.e. of indirect effect is skewed, they used small sample sizes of less than 400 observations. So it is more appropriate to utilize non-parametric test instead of the conventional tests for testing mediation e.g. Sobel test which assumes the distribution of indirect effect to be normal. As not only it does not make assumptions about the distribution of the test but also has a higher power of the test.

Bootstrapping in its general sense means a self-executing process that does not require external input. In a statistical view, it is a resampling method to re-estimate a required summary statistics some large numbers of time (usually thousands). The method of bootstrapping is equally applicable to calculate Standard errors, p-values, and confidence interval of direct, total indirect and specific indirect effects in mediation analysis. Bootstrapping method do resampling based on the original sample some thousands of time. From each generated sample the required statistics is calculated e.g.

specific indirect effect. In this manner, there are thousands of estimated values for the required parameter to be tested. Based on these estimated values then standard errors, p-values and confidence interval are calculated. Furthermore, point estimates can be calculated by averaging all the estimated values of a parameter.

1.2.4.2 Discussion on some complexities involved in mediation analysis

This section will discuss some of the complexities involved in the model of the current study and the proposed methods in literature to deal with it.

- ***Categorical Variables***

Iacobucci (2012) in the article "mediation analysis and categorical variables: the final frontier" discussed the definition of a categorical variable in the mediation analysis context. It is clearly stated in the study that 5, 7 and 9 point scale variables are treated as continuous and the variables with binary outcomes e.g yes or no and nominal categories like ethnicity groups and brands like A, B or C will be considered as categorical variables.

- ***Estimation of the mediation model with categorical variables***

It is illustrated in Iacobucci (2012) that if mediator (M) or outcome Y is binary then it is not optimal to use traditional approaches to estimate mediation model equations. It is stated that "OLS regression is better suited for continuous response variables and logit model are better suited for discrete response variables". It is also indicated that SEM is difficult to implement in case if the mediator or dependent variable is binary. It is described in the following words "It seems daunting to ask that Eqs. (1)–(3) could be reformulated such that all parameter estimates be estimated simultaneously when they comprise a mix of regression and logistic regressions, with their variant requisite assumptions". Similarly, it is quoted that "For our purposes, this issue means that we

cannot fit the equivalent of a structural equation model wherein one path is a logit link and another is OLS regression".

1.2.4.2a Method proposed by Iacobucci (2012)

It is advocated to use Structural Equation modelling, if all X, M and Y variables are continuous. However, if the Mediator or Y is categorical, after comparing and listing shortcomings of different techniques available e.g. Neural Networks, generalized least squares and using R^2 instead of β, the following procedure is recommended to test the mediation.

Step 1: If the dependent variable Y is continuous then equation 1 presented into mediation model given in the start of this section will be estimated through OLS otherwise logistic regression will be used for estimation

Step 2: If Mediator is continuous equation 2 will be estimated by OLS and if it is categorical then estimations will be done by logistic. This will give parameter estimate of 'a' and its standard error

Step 3: If Y is continuous then the 3rd equation will be estimated by OLS otherwise logistic regression will be used. This will give the parameter estimate of 'b path' and its standard error.

Step 4: Using information collected in step 2 and 3, the standardized elements can be found.

$$z_a = \frac{\hat{a}}{\hat{s}_a} \quad \text{(a)}$$

$$z_b = \frac{b\square}{\hat{s}_b} \quad \text{(b)}$$

their product will be $z_{a\ x\ b} = z_a z_b$ (c)

and standard error is given by $\sqrt{z_a{}^2 + z_b{}^2 + 1}$ (d)

Step 5: Finally the test of mediation proposed in the study is given by the following formula which is equally applicable to whether a and b both are from OLS or 'a' is from logistic and 'b' is from OLS or whether both are from logistic.

$$z_{Mediation} = \frac{z_a z_b}{\sqrt{z_a{}^2 + z_b{}^2 + 1}} = \frac{\frac{a}{s_a} X \frac{b}{s_b}}{\sqrt{z_a{}^2 + z_b{}^2 + 1}} \quad \text{(e)}$$

A mediator is significant at α = 0.05 if its value exceeds 1.96 in absolute terms. The critical values at a different level of significance in a normal distribution.

1.2.4.2b Method of standardization of coefficients from the logit model

In this method, the indirect effect is found a byproduct of standardized coefficients. Indirect effects are calculated by standardized 'a' and 'b' because both are coming from different regressions one from logistic and other from OLS if M or Y is binary. When mediator (M) is a binary variable a path will be standardized by formula proposed by MacKinnon and Dwyer (1993) that is given by

$$a^* = \frac{\hat{a}\, S_x}{S_M} \quad \text{(a)}$$

But if M is binary its standard error will be equal to $S_M = \sqrt{a^2\, s_x{}^2 + \frac{\pi^2}{3}}$ while b path will also be standardized if Y is also binary.

1.2.4.2c Method proposed by Li et. al (2007)

Li, Schneider and Bennett (2007) by performing Monte Carlo study claimed that the method proposed by them for finding mediation effect is consistent as compared to four other estimates that turned to be inconsistent in presence of a binary mediator. The following model is used for the analysis to capture the effect of X variable through binary mediator M on dependent variable Y where z represents covariate.

$$M = I\,(\,c_M + \alpha_o \mathrm{X} + \gamma_{zM}\mathrm{Z} + \varepsilon_M > 0) \qquad \text{(a)}$$

Where *I (·)* is representing binary mediator in terms of the indicator function. Whereas the equation for Y is given by

$$Y = c_y + \tau\,\mathrm{X} + \beta_o \mathrm{M} + \gamma_{zy}\mathrm{Z} + \varepsilon_y \qquad \text{(b)}$$

Error terms in both models are assumed to be mean zero random variables. The subscripts of coefficients are providing information about variable with which it is associated and about whether it is from the equation of mediator or dependent variable Y. For example γ_{zy} is the coefficient of variable Z in the equation of Y.

Taking the definition of mediation effect, that it is changed in the mean value of Y which is transferred through M due to change in X variable, it could be summarized as

$$\frac{\partial\,\{E\,(Y \mid X, Z) - E(Y \mid X, M, Z)\,\}}{\partial X} = \delta_o \qquad (c)$$

where $E\,(Y \mid X, Z)$ denotes the conditional mean of Y given X and **Z** while $E(Y \mid X, M, Z)$ is conditional mean of Y given X, Z and M. Utilizing equation (b) $E\,(Y \mid X, Z)$ can be written as

$$E\,(Y \mid X, Z) = c_y + \tau\,\mathrm{X} + \beta_o E(Y \mid X, M, Z) + \gamma_{zy}\mathrm{Z} \qquad \text{(d)}$$

$$E\,(Y \mid X, M,\ Z) = c_y + \tau\,\mathrm{X} + \beta_o M + \gamma_{zy}\mathrm{Z} \qquad \text{(e)}$$

Plugging equation 'd' and 'e' in equation 'c' will give the following equation

$$\delta_o = \beta_o\,\frac{\partial\,\{E\,(M \mid X, Y)\}}{\partial X} = \beta_o\,\frac{\partial\,\{\Pr(\,c_M + \alpha_o \mathrm{X} + \gamma_{zM}\mathrm{Z} + \varepsilon_M > 0) \mid X, Z\,\}}{\partial X} \qquad (f)$$

It could be seen that equation (f) is representing the mediation effect which is also equivalent to the product of coefficients.

- ***Estimation***

For estimation of mediation effect through utilizing the above theoretical derivation, equation 'a' could be estimated through logit or probit regression and equation 'b' will be estimated through Ordinary Least Squares (OLS). When ε_M follows a logistic distribution, the mediation effect presented by equation (f) can be written as

$$\delta_{AL} = \alpha_o \beta_o \frac{e^{c_M + \alpha_o \mathrm{X} + \gamma_{zM} \mathrm{Z}}}{(1+e^{c_M + \alpha_o \mathrm{X} + \gamma_{zM} \mathrm{Z}})^2} \quad \text{(g)}$$

The estimated $\hat{\delta}_{AL}$ can be calculated by plugging the estimated values of the coefficient given in eq (g). Getting from following equations

$$logit\left(\widehat{M}\right) = \hat{c}_{M.XY} + \hat{\alpha}_{XM.Z}\mathrm{X} + \gamma_{zM.X}\mathrm{Z} \quad \text{(h)}$$

$$\hat{Y} = \hat{c}_{Y.XMZ} + \hat{\tau}_{XY.MZ}\mathrm{X} + \hat{\beta}_{MY.XZ}\mathrm{X} + \hat{\gamma}_{ZY.XM}\mathrm{Z} \quad \text{(i)}$$

Finally

$$\hat{\delta}_{AL} = \hat{\alpha}_{XM.Z}\hat{\beta}_{MY.XZ} \frac{\exp(\hat{c}_{Y.XMZ} + \hat{\alpha}_{XM.Z}\mathrm{X} + \hat{\gamma}_{ZY.XM}\mathrm{Z})}{\{(1+\exp(\hat{c}_{Y.XMZ} + \hat{\alpha}_{XM.Z}\mathrm{X} + \hat{\gamma}_{ZY.XM}\mathrm{Z})\}^2} \quad \text{(j)}$$

Estimated mediation will be the average of $\hat{\delta}_{AL}$ for each observation in the sample. Bootstrapping could be used to construct the C-I and test its significance.

1.2.4.2d Karlson, Holm and Breen (KHB) method

Karlson, Holm and Breen (2012, 2013) addressed the problem of comparing coefficients of non-linear regression e.g. logit and probit models with coefficients of linear regression models. They proposed and justified a new method to deal with a binary outcome variable or binary mediator. The method is briefly discussed as follows. The article uses y to denote continuous outcome variable, x for predictor variable and

z for mediating variable(s) and y* is used to represent a binary outcome. The following two models are specified

$$H_R : y^* = \beta_{yx}x + e \quad \text{(a)}$$

$$H_F : y^* = \beta_{yx}x + \beta_{yz.x}z + v \quad \text{(b)}$$

Where R stands for reduced model and F for the full model.

Moreover, let x is linearly related to z and could be presented as

$$z = \theta_{zx} + w \quad \text{(c)}$$

They introduced a new method that utilized the residual term from z on x regression represented by $\tilde{z}$. Equation 'c' given below is the full model with $\tilde{z}$ while equation 'b' is a full model with z

$$H_F^* : \ y^* = \beta_{yx.\tilde{z}}x + \beta_{y\tilde{z}.x}\tilde{z} + k, \qquad sd(k) = \sigma_F \frac{\pi}{\sqrt{3}} \quad \text{(d)}$$

They proved that

$$\beta_{yx} = \beta_{yx.\tilde{z}} \quad \text{(e)}$$

They proposed the following three measures to capture the mediating effect (confounding effect) holding rescaling effect constant

The difference measure

$$b_{yx.\tilde{z}} - b_{yx.z} = \frac{\beta_{yx.\tilde{z}}}{\sigma_F^*} - \frac{\beta_{yx.z}}{\sigma_F} = \frac{\beta_{yx}}{\sigma_F} - \frac{\beta_{yx.z}}{\sigma_F} = \frac{\beta_{yx} - \beta_{yx.z}}{\sigma_F} \quad \text{(f)}$$

Ratio measure

$$\frac{b_{yx.z}}{b_{yx.\tilde{z}}} = \frac{\frac{\beta_{yx.z}}{\sigma_F^*}}{\frac{\beta_{yx.\tilde{z}}}{\sigma_F}} = \frac{\frac{\beta_{yx.z}}{\sigma_F}}{\frac{\beta_{yx}}{\sigma_F}} = \frac{\beta_{yx.z}}{\beta_{yx.\tilde{z}}} = \frac{\beta_{yx.z}}{\beta_{yx}} \quad \text{(g)}$$

Percentage measure

$$\frac{b_{yx.\tilde{z}} - b_{yx.z}}{b_{yx.\tilde{z}}} \times 100\% = \frac{\frac{\beta_{yx.\tilde{z}} - \beta_{yx.z}}{\sigma_F}}{\frac{\beta_{yx.\tilde{z}}}{\sigma_F^*}} \times 100\% = \frac{\beta_{yx.\tilde{z}} - \beta_{yx.z}}{\beta_{x|\tilde{z}}} \times 100$$

$$= \frac{\beta_{yx} - \beta_{yx.z}}{\beta_{yx}} \times 100\% \quad \text{(h)}$$

- Implementation of KHB method to the binary mediator and continuous outcome

Karlson, Holm and Breen (2013) discussed the case of a binary mediator and continuous outcome variable and summarized it by equations 26a, 26b and 26c in their article

$$y^* = \gamma_{yx.z} x + \gamma_{yz^*.x} z^* + \sigma_n \omega \quad (i)$$

Where z^* is representing mediator with a binary outcome.

$$z^* = \theta_{z^* x} x + m \quad (j)$$

The total effect β_{yx} for the binary mediator and the continuous outcome is transcribed in the following way

$$\beta_{yx} = \gamma_{yx.z^*} + \theta_{z^*.x} \gamma_{yz^*.x} \quad \text{(k)}$$

Karlson, Holm and Breen (2012, 2013) not only proposed a new method but also provided a KHB package for STATA. This package has the ability not only to implement the method proposed but also to calculate Average Partial effects (APE).

1.2.4.2e Latest Approach: Marginal Mediation

Marginal mediation is the latest approach to deal with binary mediators and/ or binary outcomes and to get effect size of each mediator without any interpretability issues. Barrett (2018) discussed the existing methods and their limitations to deal with categorical outcomes and mediation. The study discussed five current approaches i.e.

estimation of each path by logistic regression which lacks estimation of indirect effect size, polychoric correlation in SEM, the method proposed by Iacobucci (2012), the sequence of logistic regression models and the fifth one is ignoring the distribution of outcomes. The pros and cons of each method are discussed in detail and the conclusion is drawn in the following words

> " In the end, none of these approaches can flexibly handle categorical variables of various kinds (e.g., binary, multinomial) or other non-normal distributions (e.g., costs, counts); none can produce intuitive and meaningful effect sizes and confidence intervals across these variable types; and none can consistently combine two different types of estimates (e.g., binary mediator with continuous outcome, count mediator with binary outcome). Although the current approaches are useful in some situations—particularly the SEM approach—a more complete framework is needed" (Barrett, 2018, p.14).

Barrett (2018) proposed a new technique named "Marginal Mediation Analysis" by the integration of Average Marginal Effects (AMEs) proposed by Bartus(2005)in mediation analysis. It is illustrated in the study that the marginal mediation analysis makes the interpretation of indirect effects more meaningful and simple in the models which were previously considered problematic (models with categorical mediators and outcomes). This method takes into account the marginal effect of each variable for each unit in the sample and then this marginal effects for every observation are averaged to get the meaningful number called Average Marginal Effect (AME). It is elaborated that AMEs are robust in case of model misspecification and unobserved heterogeneity and generally applicable to any type and mix of models.

The process of marginal mediation analysis follows the following steps that integrate AME method to mediation analysis. First, the following equations are estimated, the same notations are used as in Barrett (2018).

$$\boldsymbol{M_{ij}} \;=\; \boldsymbol{a_0} \;+\; \sum_{k=1}^{p} \;\boldsymbol{a_k}\, \boldsymbol{x_{ki}} + \;\boldsymbol{\varepsilon_i} \qquad \textbf{for j= 1 , ……..m mediators} \qquad \textbf{(a)}$$

$$\boldsymbol{Y_i} \;=\; \boldsymbol{\beta_0} \;+\; \sum_{j=1}^{m} \;\boldsymbol{b_j}\, \boldsymbol{M_{ij}} + \sum_{k=1}^{p} \;\boldsymbol{c'_k}\, \boldsymbol{x_{ki}} \;+\; \boldsymbol{\varepsilon_i} \qquad \textbf{(b)}$$

Where there are k= 1, 2 ….p predictors, 1 to m mediators, and a, b and c′ paths are the same as in the usual mediation analysis. These equations are representing mediation model as it is in practice, and estimation can be done keeping in view the type of outcome in each equation. The novelty of marginal mediation method is in post-estimation steps and integration of AME with above-mentioned equations. For continuous predictor, AME of path a for the kth variable is presented by the equation given below

$$AME_k^a = \boldsymbol{a_k}\, \tfrac{1}{n} \sum_{i=1}^{n} \;\; f(aX) \qquad \text{(c)}$$

Where f is denoting the probability density function, linear combination of X variables (predictors) is represented by aX in the above equation. The above mention equation is identical to the equation given below.

$$AME_k^a = \tfrac{1}{n} \sum_{i=1}^{n} \;\; \frac{f(a\boldsymbol{X_1}) - f(a\boldsymbol{X_2})}{2h} \qquad \text{(d)}$$

Where aX_1 and aX_2 are given by the following matrices

$$\boldsymbol{aX_1} = \begin{bmatrix} \boldsymbol{ax_{11}} & \boldsymbol{ax_{12}} & \dots & \boldsymbol{ax_{1k}+h} & \dots & \boldsymbol{ax_{1p}} \\ \boldsymbol{ax_{21}} & \boldsymbol{ax_{22}} & \dots & \boldsymbol{ax_{2k}+h} & \dots & \boldsymbol{ax_{2p}} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \boldsymbol{ax_{n1}} & \boldsymbol{ax_{n2}} & \dots & \boldsymbol{ax_{nk}+h} & \dots & \boldsymbol{ax_{np}} \end{bmatrix} \qquad \text{(e)}$$

$$\boldsymbol{aX_2} = \begin{bmatrix} \boldsymbol{ax_{11}} & \boldsymbol{ax_{12}} & \dots & \boldsymbol{ax_{1k}-h} & \dots & \boldsymbol{ax_{1p}} \\ \boldsymbol{ax_{21}} & \boldsymbol{ax_{22}} & \dots & \boldsymbol{ax_{2k}-h} & \dots & \boldsymbol{ax_{2p}} \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots & \dots & \vdots \\ \boldsymbol{ax_{n1}} & \boldsymbol{ax_{n2}} & \dots & \boldsymbol{ax_{nk}-h} & \dots & \boldsymbol{ax_{np}} \end{bmatrix} \quad \text{(f)}$$

Matrices given above are the predicted changes in outcome due to very small changes h, where h = 1×10^{-7}.

While for dummy variable in "a" path, AME is

$$AME_k^a = \frac{1}{n}\sum_{i=1}^{n} [F(aX|\boldsymbol{x_{ki}} = 1) - F(aX|\boldsymbol{x_{ki}} = 0)] \quad \text{(g)}$$

Where the $F(aX|\boldsymbol{x_{ki}} = 1)$ is ith observation's predicted value when the dummy is one and $F(aX|\boldsymbol{x_{ki}} = 0)$ is predicted value at value 0. Same equations can be applied to calculate AME for b and c´ paths.

By following the above-mentioned procedure and reporting indirect effect sizes in the form of AMEs makes the results more interpretable. It is explained in the study that the results of individual paths e.g. path 'a' are in metric of the dependent variable in the equation. For example, if a path for a mediator in the binary form will represent risk or probability while if the mediator is continuous then it will be interpreted as the results in ordinary regression are interpreted. The indirect effects are based on both a and b paths, and if mediator and outcome variable are in two different types (i.e binary, continuous or continuous, binary or any other mix) then a and b paths will be in a different scale, but the reported indirect effects calculated through marginal mediation approach will be in AMEs and will be easily interpretable. Under marginal mediation approach, the indirect effects are in outcomes original metric and thus do not create the problem of interpretability. Similarly, direct and total effects are measured in the form of AMEs and interpretable in outcomes metric. Because each indirect effect, direct

effect and the total effect is in the same metric (i.e. in outcome's metric) therefore they are all comparable. Marginal mediation analysis is implementable due to recently developed and available package "MarginalMediation" in R software, that is easy to use. This package reports both standardized and unstandardized direct effects and specific indirect as well as the confidence intervals through the bootstrapping method.

1.3 Model

The literature of economics can be divided into two broad categories with regard to analyzing returns to education. The studies that attempted to find the role of education as a component of human capital in overall economic growth. There are hundreds of studies in this regard that attempted to explain the role of education theoretically as well as empirically in explaining the economic growth of an economy. The neoclassical and endogenous growth theories, and all the empirical work done in this regard, falls into this strand of literature. The second broad category is one that analyzes the impact of education on the earnings of individuals. Mincerian equation by the Mincer(1974) and hundreds of empirical studies in this regard are examples of this type of research. However, with the emergence of the economics of happiness as a branch of economics. And the realization that only increasing incomes of individuals and nations are not enough for achieving wellbeing and life satisfaction. The economists are also interested in analyzing the role of education in increasing life satisfaction of individuals and wellbeing of nations.

In the literature of economics, the relationship between education and life satisfaction is mostly analyzed by single equation model. Where the effect of education is modelled by including education as an explanatory variable along with other control variables in the life satisfaction or happiness equation. For example, Botha (2013), Chen(2012),

Blanchflower and Oswald (2004), Hayo and Sefert (2003), Easterlin(2001) and many others used the single equation model like one given below as an example for analyzing the impact of education on life satisfaction.

$$\boldsymbol{u_i = \alpha + \beta EDU_i + \gamma Z_i + \varepsilon_i} \qquad i = 1, 2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{I}$$

Where u represents the response of happiness or life satisfaction question which can take values from 1 to 10. EDU is representing education of an individual, Z is a vector of control variables for example age, health, marital status etc and ε is a random error term. While i is representing the ith individual.

The problem with the use of single-equation model to analyze the relationship between education and life satisfaction is that the variables that are usually included as control variables like health and income are the functions of education themselves. The ability of education to impact the control variables in these models are completely ignored. It means that in the single equation model the indirect effects of education on life satisfaction that it brings through its effect on control variables like health, income, employment status are not acknowledged. Powdthavee et al. (2015) are the first to analyze the indirect effect of education on life satisfaction. The study reports that although the researchers identified that ignoring the indirect effect of education on life satisfaction will underestimate the contribution of education in explaining life satisfaction, still no efforts are made to correct this estimation bias. Powdthavee et al. (2015) suggested the use of a multiple mediation model to capture the indirect effects of education on life satisfaction in addition to its direct effect.

Following the suggestions of Powdthavee et al. (2015), the current study will analyze the direct as well as indirect effects of education on life satisfaction in Pakistan through

six mediating factors. The literature proposes income as the most noticed and attributed mediating factor of life satisfaction (Powdthavee, 2010a; Clark et al., 2008; Diener et al. 1993), education also impacts life satisfaction through its significant impact on one's health, employability, marriage and children (Powdthavee et al., 2015; Layard, 2005; Layard et al., 2013; Oswald, 1997). In addition to all above-stated paths, we also analyzed the impact of education on life satisfaction through the path of freedom of choice and control over life for the first time.

The impact of education on life satisfaction, its direct and indirect effect can be summarized in the following sequence of equations proposed by Powdthavee et al., (2015) for capturing the indirect effect of education on life satisfaction and based on statistical tools developed by the Judd and Kenny (1981) and Barron and Kenny (1986)

for performing mediation analysis.

$$\boldsymbol{LS_i = \alpha + c\,EDU_i + \theta_0 Z_i' + u_{1i}} \quad \textbf{(1)}$$

$$\boldsymbol{LS_i = \beta_o + \sum_{s=1}^{6} b_s M_{si} + c'\,EDU_i + \theta_0 Z_i' + u_{0i}} \quad \textbf{(2)}$$

$$\boldsymbol{M_{1i} = \alpha_1 + a_1 EDU_i + \theta_1 Z_i' + u_{1i}} \quad \textbf{(3)}$$

$$\boldsymbol{M_{6i} = \alpha_6 + a_6 EDU_i + \theta_6 Z_i' + u_{6i}} \quad \textbf{(4)}$$

where LS stands for life satisfaction. Mediating factors that include income, health, employability, marriage, number of children and freedom of choice and control over life are represented by $\boldsymbol{M_s}$**.** The variable **EDU** represents education while $\boldsymbol{Z_i'}$ denotes control variables which include age and age square.

The theoretical model can be visualized by the following path diagram.

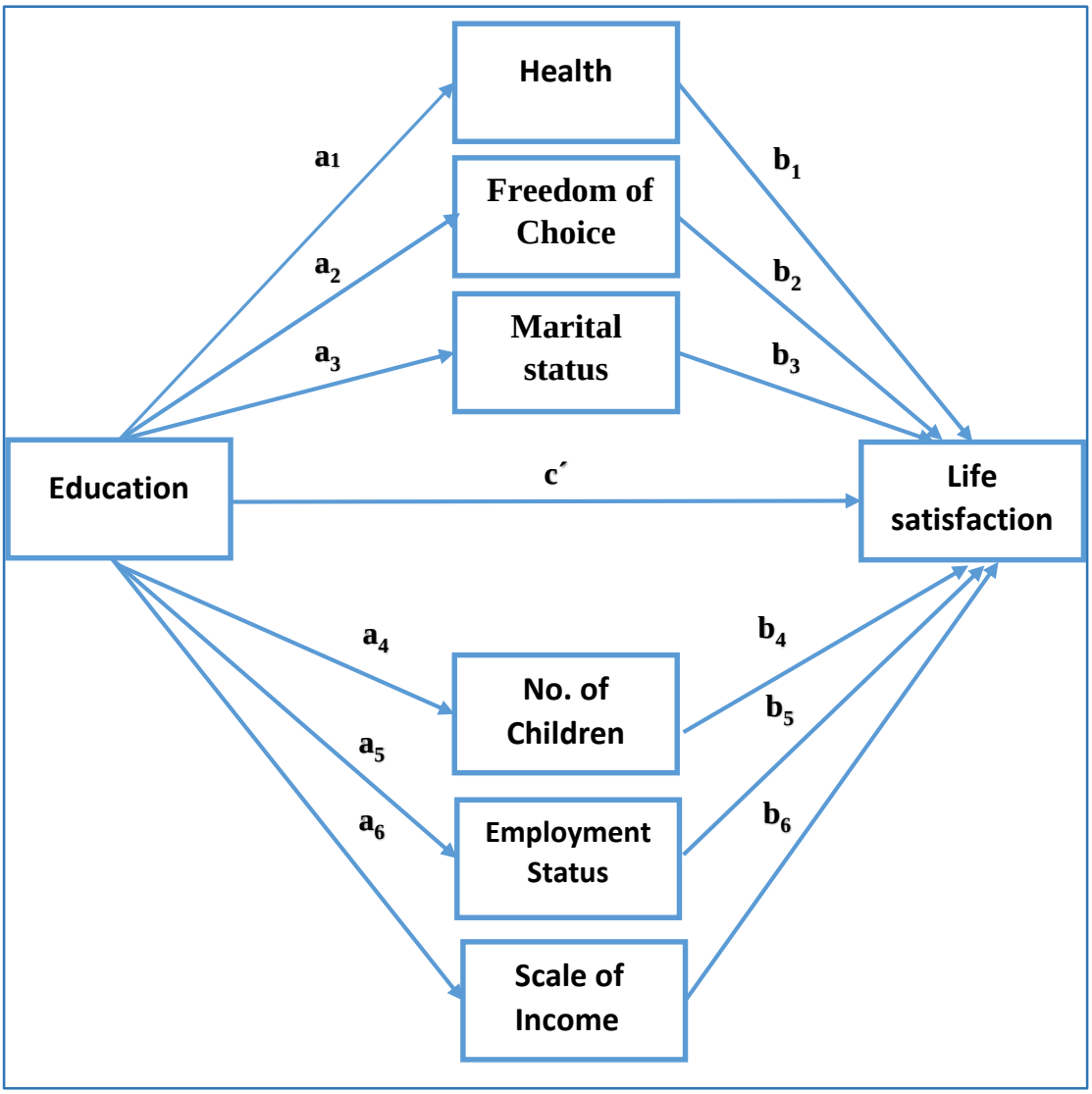

Figure 1.2: Education and Life Satisfaction a Multiple Mediation Model

1.3.1 Estimation Methodology

The literature establishes that association between dependent and independent variables will be different by the addition of the third variable if the third variable is mediating factor i.e. it does not only depends on the independent variable but have the ability to affect the dependent variable of the model (Baron & Kenny, 1986); MacKinnon et al., 2002; Shrout & Bolger, 2002). The effect of the independent variable on the dependent

variable through the mediating variable was termed as the indirect effect by Shrout & Bolger (2002).

To decide about the estimation technique following the study of Iacobucci (2012), we will decide about the type of variable that whether they are categorical or continuous and then we will proceed further. Iacobucci (2012) states that "We consider 5-, 7-, and 9-point rating scales as continuous, to be consistent with the assumptions and treatment of such scales as the majority of scholars in the field, … By categorical in this paper, we mean variables that yield binary responses (e.g., yes, no), nominal categories (e.g., brands A, B, C, or ethnicity groups, etc.), orders such as brand preference rankings, etc." So by this suggestion our outcome variable; Life Satisfaction which is scaled at 10 points will be treated as continuous. Education (predictor), health, freedom of choice, number of children and scale of income will also be considered as continuous. Whereas, because marital status and employment status are binary outcome variables so they will be considered as a categorical variable. Therefore, our model will follow the methodology which will be accurate for the continuous outcome and predictor with a mix of continuous and binary mediators.

Keeping in view the discussion in 2.4.2 the method of marginal mediation analysis is selected to analyze the model. Marginal mediation analysis has the ability to analyze the multiple mediation model with a mix of continuous and binary mediators in such a way that effect sizes are interpretable and comparable. The marginal mediation method will be implemented in the following way.

1.3.2 Implementation of Marginal Mediation Analysis

The following steps will be followed to estimate the direct and indirect effect of education on life satisfaction as proposed by the method of Marginal mediation by Barrett(2018).

Step 1. Estimation of equation 2 to 8 through a generalized linear model (glm) keeping in view the type of outcome variable in each equation and using family binomial for the equations where the outcome is binary. The regressions in this step will estimate a total of six 'a'paths describing the effect of education on mediators, it will also estimate six 'b' paths unfolding the effect of potential mediators on life satisfaction and estimate the c´ path.

Step 2. The novelty of Marginal mediation analysis is in post-estimation steps. After estimation of all paths, the next step is to find average marginal effects(AMEs) for each path. All 'a' paths have continuous predictor so we will use the following formula.

$$AME_{a_s} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \quad f(\boldsymbol{a_s}\, EDU) \tag{a}$$

Where 's' varies from 1 to 6 presenting 6 mediators, i is representing the number of observations. EDU is used to symbolize education.

So for first a path that is a_1, the path between education and health, the average marginal effect is given by AME_{a_1} which can be written as

$$AME_{a_1} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \quad f(\boldsymbol{a_1}\, EDU) \tag{b}$$

$$AME_{\text{Health}} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \quad \frac{f(a_1\boldsymbol{EDU_1}) - f(a_1\boldsymbol{EDU_2})}{2h} \tag{c}$$

Where $\boldsymbol{a_1}\mathrm{EDU}_1$ and $\boldsymbol{a_1}\mathrm{EDU}_2$ are given by the following matrices

$$\boldsymbol{a_1}\mathrm{EDU}_1 = \begin{bmatrix} \boldsymbol{a_1}\mathrm{EDU}_{11} + h & \boldsymbol{\theta_1}\mathrm{Age}_{12} & \boldsymbol{\theta_2}\mathrm{Age2}_{13} \\ \boldsymbol{a_1}\mathrm{EDU}_{21} + h & \boldsymbol{\theta_1}\mathrm{Age}_{22} & \boldsymbol{\theta_2}\mathrm{Age2}_{23} \\ & \vdots & \\ \boldsymbol{a_1}\mathrm{EDU}_{\mathrm{n1}} + h & \boldsymbol{\theta_1}\mathrm{Age}_{\mathrm{n2}} & \boldsymbol{\theta_2}\mathrm{Age2}_{\mathrm{n3}} \end{bmatrix} \quad \text{(d)}$$

$$\boldsymbol{a_1}\mathrm{EDU}_2 = \begin{bmatrix} \boldsymbol{a_1}\mathrm{EDU}_{11} - h & \boldsymbol{\theta_1}\mathrm{Age}_{12} & \boldsymbol{\theta_2}\mathrm{Age2}_{13} \\ \boldsymbol{a_1}\mathrm{EDU}_{21} - h & \boldsymbol{\theta_1}\mathrm{Age}_{22} & \boldsymbol{\theta_2}\mathrm{Age2}_{23} \\ & \vdots & \\ \boldsymbol{a_1}\mathrm{EDU}_{\mathrm{n1}} - h & \boldsymbol{\theta_1}\mathrm{Age}_{\mathrm{n2}} & \boldsymbol{\theta_2}\mathrm{Age2}_{\mathrm{n3}} \end{bmatrix} \quad \text{(e)}$$

Matrices given above are the predicted changes in outcome due to very small changes h, where h = 1×10^{-7}.

Similarly, for freedom, the average marginal effect will be written as AME_{a_2} and is given by

$$AME_{a_2} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} f(\boldsymbol{a_2}\, EDU) \quad \text{(f)}$$

$$AME_{\mathrm{Freedom}} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \frac{f(a_2\boldsymbol{EDU_1}) - f(a_2\boldsymbol{EDU_2})}{2h} \quad \text{(g)}$$

Where $\boldsymbol{a_2}\mathrm{EDU}_1$ and $\boldsymbol{a_2}\mathrm{EDU}_2$ are given by the following matrices

$$\boldsymbol{a_2}\mathrm{EDU}_1 = \begin{bmatrix} \boldsymbol{a_2}\mathrm{EDU}_{11} + h & \boldsymbol{\theta_1}\mathrm{Age}_{12} & \boldsymbol{\theta_2}\mathrm{Age2}_{13} \\ \boldsymbol{a_2}\mathrm{EDU}_{21} + h & \boldsymbol{\theta_1}\mathrm{Age}_{22} & \boldsymbol{\theta_2}\mathrm{Age2}_{23} \\ & \vdots & \\ \boldsymbol{a_2}\mathrm{EDU}_{\mathrm{n1}} + h & \boldsymbol{\theta_1}\mathrm{Age}_{\mathrm{n2}} & \boldsymbol{\theta_2}\mathrm{Age2}_{\mathrm{n3}} \end{bmatrix} \quad \text{(h)}$$

$$\boldsymbol{a_2}\mathrm{EDU}_2 = \begin{bmatrix} \boldsymbol{a_2}\mathrm{EDU}_{11} - h & \boldsymbol{\theta_1}\mathrm{Age}_{12} & \boldsymbol{\theta_2}\mathrm{Age2}_{13} \\ \boldsymbol{a_2}\mathrm{EDU}_{21} - h & \boldsymbol{\theta_1}\mathrm{Age}_{22} & \boldsymbol{\theta_2}\mathrm{Age2}_{23} \\ & \vdots & \\ & \vdots & \\ \boldsymbol{a_2}\mathrm{EDU}_{\mathrm{n1}} - h & \boldsymbol{\theta_1}\mathrm{Age}_{\mathrm{n2}} & \boldsymbol{\theta_2}\mathrm{Age2}_{\mathrm{n3}} \end{bmatrix} \quad \text{(i)}$$

Where very small amount, h = 1 x 10^{-7}. In the same manner, AMEs for all 'a' paths will be found.

Step 3. Then we have to find AMEs for 'b' paths. Same procedure as described in step 2 will be followed. Except for 'b' paths from marital status and employment status to life satisfaction as they are binary variables. The following changes will be incorporated in addition to the same margin method described in step 2.

$$AME_{\mathrm{MS}\rightarrow\mathrm{LS}} = AME_{b_3} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} [F(b_3 MS|MS = 1) - F(b_3 MS\,|MS = 0)] \quad \text{(j)}$$

Where $MS \rightarrow LS$ representing a path from marital status to life satisfaction, b_3 is the name of this path and estimate calculated in step 1. MS=1 is representing a married person while MS=0 is representing a single person.

$$AME_{\mathrm{Emp}\rightarrow\mathrm{LS}} = \frac{1}{n}\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} [F(b_5 Emp|Emp = 1) - F(b_5 Emp\,|Emp = 0)] \quad \text{(h)}$$

Where $Emp \rightarrow LS$ is a path from employment to life satisfaction, b_5 is the name of this path and estimate calculated in step 1. Emp=1 is representing an employed person while Emp=0 is representing an unemployed person.

Step 4: The indirect effects are the product of AMEs of a and b paths. For example, the indirect effect for health is AME of the path from education to health (a_1) multiplied by AME of the path from health to life satisfaction(b_1) i.e.

$$indirect\ Effect\ (health) = \quad AME_{a_1} * AME_{b_1} \tag{i}$$

Indirect effects for all paths will be estimated following the same method.

Step 5: The direct effect will be estimated following step 2. The predictor will be the same education or EDU, instead of 'a' we will use the estimate of direct path c´. So AME for c´can be written as

$$AME_{\text{Direct effect}} = AME_{c'} = \frac{1}{n} \sum_{i=1}^{n} \quad f(\,c'EDU) \tag{j}$$

Where c´ is an estimate of the direct path estimated by utilizing equation 2.

$$AME_{\text{Direct Effect}} = \frac{1}{n} \sum_{i=1}^{n} \quad \frac{f(c'\boldsymbol{EDU_1}) - f(c'\boldsymbol{EDU_2})}{2h} \tag{k}$$

Whereas $c'\boldsymbol{EDU_1}$ will be expanded following the matrix given in equation (d), replacing 'a' with c´ and along with age and age square, all mediating factors will also be included in the matrix. Same is true for $c'\boldsymbol{EDU_2}$.

Step 6: After estimating all indirect effects and direct effect the next step is to calculate the bootstrapping confidence intervals with 5000 replications to check the significance of estimates.

All estimations and calculations are done by using R software and utilizing the "MarginalMediation" package developed by Barrett(2018).

1.3.3 Data

The analysis is based on a survey data by World Values Survey (WVS), Wave 6 (2010-2014) which provides information about economic development, religion, gender equality, social capital and subjective well-being as well as beliefs and values of individuals around the world. The required data on life satisfaction, the scale of income,

employment, health, marriage, children, freedom of choice & control over life and other information like gender and age of respondent is obtained from this survey. In this survey, 1200 individuals from Pakistan were interviewed. The WVS-6 used Probability sampling, so every individual was given equal chance of selection. Sample was drawn by dividing the country into four provinces and conserving the proportion of population according to province and rural/urban proportion in census data. Villages and metropolitan were chosen randomly. Similarly, households were selected randomly by random walk and taking consistent interval. Household member for interview was chosen by KISH method i.e. through pre- specified random number table. The sample contains a single observation per household.

The reason for relying on world values survey and not conducting the survey on my own is that this survey has used 100 sampling points in Pakistan, took care of proportion of sampling from each province and urban-rural area, the age distribution is also considered. The sample by world values survey is properly designed keeping in view the distribution of population in Pakistan census 1998. Furthermore, different checks are also performed by them to provide reliable data. Conducting such a broad survey is not feasible for us so we will rely on World Values Survey data. All the required data are based on questions in WVS, wave 6. The variables used in the model and their description along with question number in the questionnaire are given below:

- **Life Satisfaction (LS)**

  The question V23 in WVS is found appropriate for the analysis. The question ask the respondents how satisfied are they with their life, the answer is measured on 10 points scale, 1 for completely dissatisfied to 10 completely satisfied.

- **Health**

  Health variable (V11) is measured at four-point scale, 1 for very good, 2 describing good health by the respondent, 3 for fair and 4 for poor health. However, we re-coded the variable in increasing scale given number 4 to very good health, 3 to good, 2 to fair and 1 to poor health.

- **Freedom of choice & Control (Freedom)**

  Respondents were asked to rate their ability to choose freely and control over their lives on 10 point scale. 1 for no choice at all and 10 for a great deal of choice. The responses are measured against the question number V55.

- **Marital Status (MS)**

  We re-coded the marital status variable by assigning 0 to single and 1 to married persons, 23 observations are excluded that reported widowed, divorced or separated as their marital status. The responses were registered against question number V57 in the questionnaire.

- **Number of Children**

  The number of children variable (V58) is also used in the analysis which provides information on how many children the respondent has.

- **Employment Status (Emp)**

  Employment Status variable (V229) is also modified according to the needs of our study, taking this variable as a binary variable, stating 0 for unemployed and 1 for employed. we have combined partially employed, full time employed and self-employed as employed and no paid employment categories that are unemployed, students, housewives, retired and others as unemployed.

- **Scale of Income**

  The scale of income variable (V239) is in 10 point scale, listing 1 for the lowest income group in the country and 10 for highest, the respondent by their own placed themselves in the appropriate category. The data is grouped into rich, poor, and middle class, the rich consist of all observations in upper three points (i.e. 8,9, 10), middle class comprised of all observations that listed themselves as 4,5,6 and 7 in income scale variable. Whereas poor class contained all observations that reported themselves in category 1,2 and 3 in income scale variable.

- **Education**

  Education variable (V248) is about the highest level of education attained by the respondent. It is measured in 9 distinct categories starting from 1 and ending at 9. 1 is specified as education if the respondent has no formal education. 2 for respondent with incomplete primary school education and so on till 9 that specifies the respondent with a university-level degree.

The following table shows the summary statistics of the data used in the study and that is discussed above.

Table A: Descriptive Statistics

	Minimum	Maximum	Mean	S.D
Life Satisfaction	1	10	7.49	2.100
Health	1	4	3.10	0.838
Freedom	1	10	7.29	2.143
Marital Status	0	1	0.75	0.436
Number of children	0	8	2.26	2.044
Scale of Income	1	10	5.52	2.128
Employment status	0	1	0.36	0.481
Education	1	9	4.04	2.245

2.245

* S.D stands for Standard deviation

Total of 1171 observations are used in the study. The information about age and gender is also derived from the survey. Among them, 612 respondents are male while 559 are female. When the data is segregated for married and unmarried, 298 individuals are unmarried while 873 are married. When data is grouped into three categories rich, poor and middle class, we have 214 observations for rich, 733 for the middle class and 224 for poor.

1.4 Estimation Results

This section reports and explains the estimation results to analyze the impact of education on life satisfaction, by implementing the methodology explained in section 1.3.2. This section is divided into four sub-sections. Section 1.4.1 reports the results of the estimation using the full sample. Section 1.4.2 reports genderwise analysis. Section 1.4.3 illustrates estimation results for two distinct categories; married vs Single. Section 1.4.4 explains and reports the result for data divided into three categories, poor, rich and middle class based on the income scale.

1.4.1 Results of Impact of Education on Life Satisfaction (Full Data)

To analyze the impact of education on life satisfaction, the first step is to calculate the impact of education on the potential mediators identified in the model. Table 1.1 reports the impact of education on the mediating factors of the model that are health, freedom of choice, marital status, number of children, employment status and scale of income. In standard notations call it ‘a’ paths. The results are for full data containing 1171 observations, and all regressions are controlled for age, age square.

The results in Table 1.1 show that there is a significant impact of education on all mediating factors. The results demonstrate a positive significant impact of education on health, freedom of choice, employment status and scale of income while a negative

impact on a number of children and marital status. The strongest positive impact of education is on the scale of income. Marital status and employment status are included in binary form, so the coefficients are showing the probability of getting married or employed. The results are showing that with an increase in education level, the probability of getting employed increases, while the probability of getting married decreases. The negative sign of a number of children coefficient is giving the information that with an increase in the level of education on average people have fewer children, which is as expected and observed. Powdthavee et al. (2015) observed the positive and significant impact of education on health, income, employment status, getting married but a significant and negative impact on a number of children in the case of Australia. So current study reports same signs of coefficients of 'a' paths except for marital status which is positive in case of Australia in the study of Powdthavee et al. (2015) but negative in case of Pakistan.

Table 1.1: Impact of Education on Mediators(a paths)

Mediator	Education	Intercept	Age	Age square
Health	0.04195	3.26671	-0.01483	0.00013
	(0.00023)	(0.0001)	(0.16711)	(0.32529)
Freedom	0.14798	6.15930	0.01689	-0.00003
	(0.00000)	(0.0001)	(0.53816)	(0.93313)
Marital Status	-0.29129	-10.30756	0.62431	-0.00586
	(0.00001)	(0.0001)	(0.00001)	(0.00001)
No. of Children	-0.12130	-3.84447	0.28029	-0.00228
	(0.00001)	(0.0000)	(0.00001)	(0.00001)
Employment Status	0.17984	-3.98773	0.11048	-0.00086
	(0.00001)	(0.0000)	(0.00009)	(0.01442)
Scale of Income	0.23751	4.40779	0.00755	-0.00008
	(0.00001)	(0.0000)	(0.77729)	(0.81405)

* p-values are given in parenthesis

* Estimations are done through glm and the binomial link is used where the mediators are binary.

After finding the 'a' paths, the next step in mediation analysis is to find the impact of predictor and mediators on the outcome variable (i.e. c´ and b paths). So to calculate the direct effect and to see the impact of mediators on life satisfaction, equation 2 in section 1.3 is estimated including all mediators and education as a predictor. The results are summarized in Table 1.2.

Table 1.2: Impact of Education and Mediating Factors on LS (c´ and b paths)

Path	Coefficient	p-value
Education (c´)	0.07352	0.00375
Health	0.68612	0.00000
Freedom	0.37196	0.00000
Marital Status	-0.27982	0.11544
No. of Children	0.00052	0.98853
Employment Status	-0.09587	0.39182
Scale of Income	0.13137	0.00000
Age	-0.01325	0.62812
Age Square	0.00014	0.66714
Intercept	2.13812	0.0006

Note: Estimation results of glm where Life satisfaction was the dependent variable

The results show that the impact of education, health, freedom and scale of income on life satisfaction are positive and highly significant. While the impact of a number of children and employment status are found highly insignificant. The impact of marital status is also insignificant but its p-value is 0.11. The most powerful and significant impact is of health on life satisfaction, while freedom of choice and scale of income are 2nd and 3rd dominant factors having a positive impact on life satisfaction. When the signs and significance of the coefficients are compared with Powdthavee et al. (2015), it is found that they have all effects from mediators to life satisfaction highly significant

and positive except for the direct effect of education (c´) which have a negative sign in the study and found highly significant. In contrast to their study, we find number of children and employment status insignificant. Another notable difference is that they found c´ negative while we have positive and significant coefficient for c´ path. Age and age squared is added to the regression as most of the eminent researchers in field of life satisfaction studies like Blanchflower & Oswald (2004, 2008) and Graham & Ruiz Pozuelo(2017) established a U-shaped relationship between age and life satisfaction, ignoring it can cause bias in the model. The results of our study are in confirmation of these studies having negative coefficient for age and positive coefficient for age squared.

1.4.1a Indirect Effects (Unstandardized and Standardized)

The main purpose of the study is to test the channels through which education affects life satisfaction. Six mediators are chosen to find the paths between education and life satisfaction. The method of marginal mediation was followed proposed by Barrett(2018). Under this approach, all the mediating effects are reported in Average Marginal Effects (AME), therefore they are comparable with each other irrespective of the type of mediator that is whether the mediator is binary, count or continuous. So the coefficient of marital status and employment status are comparable with health and freedom of choice that are non-binary. Table 1.3 shows the unstandardized indirect effects along with 95% confidence intervals calculated through the method of bootstrapping with 5000 replications. A mediator is considered significant if the associated C-I doesn't contain zero. It occurs if both of the limits of C-I are either positive or negative. The coefficients of mediating effects are reported in the form of AMEs and are in the outcome's metric. AME shows the change in outcome expressed in the outcome's units due to one unit change in the predictor. Health, freedom of choice

& control over life and scale of income are found positive and significant mediators in education and life satisfaction relationship. While marital status, number of children and employment status are found insignificant. Comparison of the coefficients of significant mediators shows that the indirect impact of education on life satisfaction is stronger through the channel of freedom of choice and control over life than health and scale of income. The second powerful impact is through the scale of income and then through health. Although results reported in Table 1.2 are for a 95% confidence interval, the results of 90% bootstrapping C-I implies the same decision about the significance of indirect effects. If we add up all the significant indirect effects the total indirect effect is 0.11503.

The results of standardized effects are also reported in Table 1.3 and demonstrate that health, freedom and scale of income are significant mediators while marital status, number of children and employment are not significant.

Table 1.3: Unstandardized and Standardized Mediated Effects

Mediator	**Unstandardized Mediated Effects**			**Standardized Mediated Effects**		
	Coefficient	**Confidence interval**		**Coefficient**	**Confidence interval**	
Health	0.02879**	0.01254	0.04663	0.01371**	0.00597	0.02221
Freedom	0.05504**	0.03242	0.07996	0.02621**	0.01544	0.03808
Marital Status	0.00689	-0.00170	0.01588	0.00328	-0.00081	0.00756
No. of Children	-0.00006	-0.00935	0.00991	-0.00003	-0.00445	0.00472
Employment Status	-0.00372	-0.01268	0.00475	-0.00177	-0.00604	0.00226
Scale of Income	0.03120**	0.01667	0.04675	0.01486**	0.00794	0.02226

Note: 95% Confidence interval is calculated through bootstrapping technique with 5000 replications.
'*' sign shows that effects are significant at 5% level of significance

Standardized indirect effects show the effect of a unit change in variance of the predictor on the variance of outcome variable through mediating factors. According to the results of standardized effects, freedom is the strongest path between education and life satisfaction, followed by a scale of income and then by health. Hence both standardized and unstandardized effects give the same conclusion about significance and sign of mediators.

1.4.1b Direct Effect (Unstandardized and Standardized)

The direct effect of education both standardized and unstandardized are reported in Table 1.4 and shows that the direct path is positive and significant at 5% level of significance. It is noticed that the direct effect is significant and larger than the individual indirect effects. However, it is less than the total indirect effect (i.e. 0.11503, the sum of significant indirect effects). Moreover, it is realized that the model is a partial mediation model because the introduction of mediators does not reduce the direct path to zero or do not make it insignificant. If we compare our study with Powdthavee et al. (2015) then our results are different in respect of direct path, as their study reports negative direct effect and they also find this path significant.

Table 1.4: Direct Effect of Education on Life Satisfaction

Direct effect of Education	**Coefficient**	**Confidence Interval**	
Unstandardized	0.07352**	0.02102	0.12443
Standardized	0.03501**	0.01001	0.05926

Note: 95% Confidence interval is calculated through bootstrapping technique with 5000 replications
'**' sign shows that effects are significant at 5% level of significance

Finally, it is observed in the analysis of a full sample that health, freedom of choice and scale of income are significant and positive mediators in the relationship between education and life satisfaction. While marital status, number of children and employment status are found insignificant indirect effects. The direct effect is positive

and significant. It is greater than individual direct effects but less than the total indirect effect.

1.4.2 Gender Differences in the Impact of Education on Life Satisfaction

In order to see how differently mediating factors work for male and female in the relationship between education and life satisfaction, the data is divided into two distinct groups based on gender. The sub-sample of female contains 559 observations while sub-sample of the male have 612 observations. All regressions are controlled for age and age squared. Moreover, each equation of 'a' path contain the intercept but in order to maintain the clarity of results only the result of required education coefficient is presented in the table. The results of the impact of education on mediators ('a' paths) are provided in Table 1.5.

Table 1.5: Genderwise Effect of Education on Mediators (a paths)

Mediator	**Male**		**Female**	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Health	0.03577	0.02670	0.05759	0.00081
Freedom	0.05160	0.18845	0.11138	0.00946
Marital Status	-0.25617	0.00019	-0.32634	0.00000
No. of Children	-0.08532	0.00251	-0.14391	0.00001
Employment Status	-0.03972	0.34355	0.49370	0.00013
Scale of Income	0.28350	0.00000	0.24422	0.00000

Note: Estimations are done through glm and the binomial link is used where the mediators are binary. n= 612 for male and n=559. Constant term was included in each 'a' path both for male and female.

While comparing the paths from education to mediating factors it could be seen that effect of education on all mediating factors are stronger for female than male except its impact on the scale of Income, which is higher for male as compared to female. These

results give some interesting findings, such as an increased level of education for women means a more positive impact on their health as compared to men. Similarly, higher education contributes more to the freedom of choice & control over the life of women than for men. If we compare the coefficients of marital status for two groups it is showing that more negative impact of education is for women than for men in terms of getting married. Similarly, the results show that on average educated female have fewer children as compared to educated men. The results of employment status show that education as a predictor of employment status is insignificant for male. The reason might be that in the case of Pakistan men have to earn a livelihood and get employment whether they are educated or not. On the other hand coefficient of employment status for a female is significant and positive which shows that with an increased level of education there are more chances for a female to get employed or women with a low level of education are not encouraged to get employed. The effect of education to influence the scale of income is higher for men as compared to female and positive and significant for both.

Table 1.6 shows the direct effect of education on life satisfaction as well as the impact of mediating factors on life satisfaction for both male and female. 'b' paths from health and freedom are found significant and positive for both genders. However, the coefficient of health is much higher for male while the coefficient of freedom is much higher for female as compared to each other. It implies that on average male give more importance to their health in describing their life satisfaction and need to be healthier to feel satisfied in their lives as compared to female.

On the other hand, female give more weight to their freedom and control over life, they acknowledge their ability to choose and act freely more than men and feel more satisfied in their lives if they have more freedom. Gender differences are also found in results

for the scale of income, where for male the scale of income in explaining life satisfaction is highly significant. While for female the coefficient value is much lower. It is also observed that number of children and employment status are not significant for both men and women in life satisfaction regression.

Table 1.6: Impact of Education and mediating factors on LS (c´ and b paths)

	Male		**Female**	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Education (c´)	0.07677	0.03043	0.06654	0.07149
Health	0.82802	0.00001	0.55355	0.00001
Freedom	0.23795	0.00001	0.53436	0.00001
Marital Status	-0.52991	0.04340	-0.20048	0.41677
No. of Children	-0.02742	0.58679	0.04320	0.40324
Employment Status	-0.06752	0.68031	-0.20158	0.68311
Scale of Income	0.17969	0.00001	0.05167	0.14578
Age	0.03164	0.40991	-0.05636	0.16948
Age Square	-0.00029	0.50592	0.00060	0.24386
Intercept	1.72351	0.02954	2.65293	0.00037

Note: Estimation results of glm where Life satisfaction was the dependent variable

Moreover, for men, the marital status coefficient is negative and significant showing that married men generally have less satisfaction as compared to unmarried men. For women, marital status is found insignificant in defining life satisfaction. The estimation of both 'a' and 'b' paths are done through generalized linear models and the binomial link is used where the mediator is binary.

1.4.2a Comparison of Gender Differences in Mediated Effects

The following Table 1.7a shows the results of unstandardized indirect effect for male and female separately that helps in comparisons of gender-based differences in the effect of education on life satisfaction. The 95% C-I calculated through bootstrapping technique with 5000 replications are also reported. A mediator is taken as significant if

the relevant C-I doesn't contain zero. The strongest indirect effect of education on life satisfaction for a male is through the scale of income, while for female it is through freedom of choice and control over life. For men health, marital status and scale of income are significant at 5% level of significance, while freedom, number of children and employment status are found insignificant even at 10% level of significance. The reason for rejection of freedom as a mediator between education and life satisfaction is that the effect of freedom on life satisfaction is significant but freedom for men is not caused by education, because the path from education to freedom is insignificant. Employment status is also do not play mediating role between education and life satisfaction, 'a' and 'b' paths associated with employment status both are insignificant for men, and hence employment status is not mediating factor. Education has a significant and negative impact on number of children for men but the 'b' path is insignificant, i.e. men do not give significant weight to the number of children in defining life satisfaction. So the number of children do not play a mediating role between education and life satisfaction.

Table 1.7a: Unstandardized Mediated Effects

	Male			**Female**		
Mediator	**Effect**	**C-I**		**Effect**	**C-I**	
Health	0.02962**	0.00300	0.05997	0.03188**	0.01180	0.05467
Freedom	0.01228	-0.00725	0.03401	0.05951**	0.01154	0.10964
Marital Status	0.00954**	0.00028	0.02094	0.00622	-0.00900	0.02210
No. of Children	0.00234	-0.00810	0.01435	-0.00622	-0.02159	0.00681
Employment Status	0.00055	-0.00373	0.00517	-0.00199	-0.00892	0.00397
Scale of Income	0.05094**	0.02731	0.07792	0.01262	-0.00658	0.03444

Note: 95% Confidence interval through Bootstrapping is reported in the table however same decision regarding significance remains at 10% significance level.
''** sign shows that effects are significant at 5% level of significance

For women, only health and freedom are significant mediators between education and life satisfaction. It is interesting to note that all the ‘a’ paths are highly significant, showing a positive effect of education on health, freedom, the scale of income and employment status and negative on marital status and number of children. But this effect does not lead to a higher level of life satisfaction because only ‘b’ path through health and freedom is significant and all other ‘b’ paths are insignificant. Comparison with Powdthavee et al. (2015) shows that we have some different results, their study found all indirect effects that are health, marital status, number of children, income and employment positive and significant for men while in this study for Pakistan it is observed that only indirect effects of health, the scale of income and marital status are significant and it is positive also, indirect effects of education through freedom of choice, number of children and employment status are found insignificant. Similarly, for women, the study of Powdthavee et al. (2015) have reported that all effects are significant except employment. If we compare our results then it could be seen that only two channels freedom of choice and health are significant in case of women and all other channels are found insignificant in case of Pakistan.

- **Standardized Mediated Effects**

The standardized mediated effects are the changes in the standard deviation of outcome variable due to changes in the predictor. The standardized indirect effects are also calculated and reported along with bootstrapping confidence interval at 5% level of significance in Table 1.7b. The results show that health, marital status and scale of income are the significantmediators for men. Where the scale of income have the strongest mediating impact, followed by health and then by marital status. For women, only two channels are significant between education and life satisfaction, those are

health and freedom, where the path through freedom is powerful than a path through health.

Table 1.7b: Standardized Mediated Effects

	Male			Female		
Mediator	**Effect**	**C-I**		**Effect**	**C-I**	
Health	0.01420**	0.00144	0.02876	0.01521**	0.00563	0.02609
Freedom	0.00589	-0.00348	0.01631	0.02840**	0.00551	0.05232
Marital Status	0.00457**	0.00014	0.01004	0.00297	-0.00430	0.01054
No. of Children	0.00112	-0.00389	0.00688	-0.00297	-0.01030	0.00325
Employment Status	0.00026	-0.00179	0.00248	-0.00095	-0.00426	0.00189
Scale of Income	0.02443**	0.01309	0.03737	0.00602	-0.00314	0.01644

Note: 95% Confidence interval through Bootstrapping is reported in the table however same decision regarding significance remains at 10% significance level.
''** shows that effects are significant at 5% level of significance

1.4.2b Comparison of Gender-Based Differences in Direct Effects

The unstandardized direct effect of education for men is slightly higher than the direct effect of education on life satisfaction for women. The results for both standardized and unstandardized effects are provided in Table 1.8 below.

Table 1.8: Direct Effect of Education of Life satisfaction

Direct Effect		**Coefficient**	**Confidence Interval**		
Unstandardized	**Male**	0.07677*	-0.00143	0.15508	(95%)
			0.0098	0.141	(90%)
	Female	0.06654*	-0.00786	0.14482	(95%)
			0.00179	0.13166	(90%)
Standardized	**Male**	0.03682*	-0.00068	0.07437	(95%)
			0.0047	0.06762	(90%)
	Female	0.03175*	-0.00375	0.06911	(95%)
			0.00086	0.06283	(90%)

Note: Confidence interval is calculated through bootstrapping technique with 5000 replications
'*' shows that effects are significant at 10% level of significance

The indirect paths are not significant at 5% level of significance but become significant at 10% level of significance. The results of standardized effects imply the same.

Summing up, it is found that the impact of education translates into life satisfaction differently for men and women. Channels of the scale of income, health and marital status are significant for men while for women freedom of choice and health are significant mediators. If we add up all the significant indirect effects for men its total is 0.0901 and for women it is 0.09139, implying that both have almost the same total indirect effect. While the direct effect of education is slightly higher for men (0.07677) than for women (0.06654).

1.4.3 Differences in Impact of Education on Life Satisfaction (Single Vs Married)

This section analyzes the impact of education on life satisfaction for single and married persons. The data is divided into two distinct categories single vs married. Sub-sample consisting of all married persons have 873 observations while sub-sample for single persons contains 298 observations. All regressions are controlled for age and age squared. Moreover, each equation of 'a' path contain the intercept but in order to maintain the clarity of results only the result of required education coefficient is presented in the table.The results for the impact of education on potential mediating factors are given in Table 1.9 both for single and married persons separately.

The results show that the impact of education on freedom, employment status and scale of income is significant for single persons while on health it is insignificant. While for married persons all of 'a' paths are highly significant with all of them having a positive impact of increasing level of education except number of children which is as expected.

Table 1.9: Results for Effect of Education on Mediators (a paths)

Mediator	Single		Married	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Health	0.02054	0.32306	0.03926	0.00437
Freedom	0.16015	0.01166	0.14313	0.00002
No. of Children	--------	--------	-0.10251	0.00008
Employment Status	-0.16049	0.01628	0.29951	0.00001
Scale of Income	0.13187	0.02101	0.27994	0.00001

Note: Estimations are done through glm and the binomial link is used where the mediators are binary. n= 298 for single and n= 873 for married

Table 1.10 illustrates the direct effect of education and the impact of potential mediators on life satisfaction (i.e. b paths) both for married and single persons. The regression contains intercept and control variables, age and age squared. To maintain the clarity only the required results are presented in the table.

Table 1.10: Effect of Education and Mediators on Life Satisfaction (c´ and b paths)

	Single		Married	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Education (c´)	0.03963	0.39907	0.08519	0.00623
Health	0.59960	0.00001	0.71425	0.00001
Freedom	0.45020	0.00001	0.33743	0.00001
No. of Children	-------	--------	-0.00946	0.80189
Employment Status	-0.14151	0.56817	-0.11013	0.39940
Scale of Income	0.15254	0.00279	0.11799	0.00007

Note: Estimations are done through glm and the binomial link is used where the mediators are binary.

The results show that in case of single persons ‘b’ paths from health, freedom and scale of income to life satisfaction are highly significant and positively associated while the estimate of ‘b’ path associated with employment status is found insignificant. For

married persons, all b paths are highly significant except that is associated with number of children and employment status. The signs of estimates of health, freedom and scale of income are positive and as expected. The c´ path that shows the direct effect of education in presence of mediating factors is found insignificant in case of single persons but highly significant in case of married persons.

1.4.3a Comparison of Indirect Effects (Single vs Married)

According to the mediation analysis, it is found that the most effective channel between education and life satisfaction is through freedom of choice for both married and single persons. However this indirect channel is stronger for singles than married persons, in both cases, it is positive and significant at 5% level of significance. The results of unstandardized mediated effects are summarized in the Table 1.11a along with respective 95% C-I estimated through bootstrapping technique with 5000 replications.

Table 1.11a: Unstandardized Mediated Effects

	Single			**Married**		
Mediator	**Effect**	**C-I**		**Effect**	**C-I**	
Health	0.01232	-0.01183	0.04244	0.02804**	0.00782	0.05047
Freedom	0.07210**	0.01767	0.13575	0.04830**	0.02394	0.07480
No. of Children	---------	----------		0.00097	-0.00736	0.00981
Employment Status	0.00380	-0.00937	0.02000	-0.00722	-0.02465	0.00957
Scale of Income	0.02012**	0.00073	0.04946	0.03303**	0.01443	0.05388

Note: 95% Confidence interval through Bootstrapping is reported in the table however same decision regarding significance remains at 10% significance level.
''** shows that effects are significant at 5% level of significance

A mediator is considered as a significant mediator if the relevant C-I doesn't hold zero. The second strongest significant channel in both cases is the impact of education through the scale of income on life satisfaction. This indirect effect is powerful in case

of married than single. For single, the other two channels that are of health and employment status are found insignificant. For married person health is found a significant mediator in the path of education to life satisfaction. Number of children and employment status in case of married persons are not found to be mediating factors and they remain insignificant even at 10% level of significance.

- **Standardized Mediated Effects**

The standardized mediated impacts are reported in Table 1.11b which shows the effects in terms of changes in the variance of the outcome variable. All the implications explained in the case of unstandardized effects above implies to standardized effects. The only difference is in the scale of effects while unstandardized effects are reported in terms of AMEs and are in outcomes variable metric the standardized effects are in terms of variance of the outcome variable. The standardized indirect effects are significant in case of freedom and scale of income for single persons while in addition to these for married persons the indirect effect of education through health is also significant.

Table 1.11b: Standardized Mediated Effects

	Single			**Married**		
Mediator	**Effect**	**C-I**		**Effect**	**C-I**	
Health	0.00583	-0.00560	0.02008	0.01359**	0.00379	0.02446
Freedom	0.03412**	0.00836	0.06423	0.02341**	0.01160	0.03625
No. of Children	-------	----------		0.00047	-0.00356	0.00476
Employment Status	0.00180	-0.00443	0.00946	-0.00350	-0.01194	0.00464
Scale of Income	0.00952**	0.00035	0.02340	0.01601**	0.00699	0.02611

Note: 95% Confidence interval through Bootstrapping is reported in the table however same decision regarding significance remains at 10% significance level.
'**' shows that effects are significant at 5% level of significance

1.4.3b Direct Effects (Single Vs Married)

Table 1.12 reports the standardized as well as an unstandardized direct impact of education on life satisfaction.

Table 1.12: Direct Effect of Education on Life satisfaction

	Direct Effect	Coefficient	Confidence Interval		
Unstandardized	**Single**	0.03963	-0.05021	0.13133	(95%)
			-0.03439	0.11554	(90%)
	Married	0.08519**	0.0206	0.15322	(95%)
			0.02747	0.14026	(90%)
Standardized	**Single**	0.01875	-0.02376	0.06214	(95%)
			-0.01627	0.05467	(90%)
	Married	0.04128**	0.00998	0.07426	(95%)
			0.01331	0.06797	(90%)

Note: Confidence interval is calculated through bootstrapping technique with 5000 replications
'**' shows that effects are significant at 5% level of significance

For single persons the direct path is found insignificant with the introduction of mediators in the model, it remains insignificant even at 10% level of significance. For married persons not only more indirect channels are operative than single persons but also the direct path is positive and significant at 5% level of significance. It shows that education serves more for married persons in reporting higher life satisfaction than for a single. The conclusions are the same for standardized as well as the unstandardized direct effect only the scale of measurement is different.

Summing up, for single persons, health and scale of income are significant mediators while for married persons in addition to these mediators freedom of choice is also a significant mediator. Adding up the significant indirect effects for single gives the number .09222 while for married persons it is 0.10937. So the total indirect effect is larger in case of married then for single. It is also observed that the direct effect of

education for married persons (0.08519) is significant and much larger than its direct effect for single (0.03963) which is found insignificant. In nutshell, education plays a more crucial role in achieving higher life satisfaction for married persons than for single persons.

1.4.4 Difference in Effect of Education on Life Satisfaction on Basis of Scale of Income

In the world values survey, the scale of income consists of 10 different levels. To analyze the possible differences in the role of education in life satisfaction for poor, middle class and rich we have divided the data into three different segments. The first group which refers to poor in our study consist of all observations who listed themselves in the lowest 3 scales out of 10. The rich refers to the people lying in the upper three scales i.e. 8, 9 and 10. While the middle class is constituted by combining all observation which is in 4, 5, 6 and 7 scales in the scale of income variable. All regressions are controlled for age and age squared. Moreover, each equation contain the intercept but in order to maintain the clarity of results only the result of required coefficient is presented in the respective tables. Table 1.13 shows the results of all three groups i.e. poor, middle class and rich which gives information on estimated coefficient values and their significance for each path that goes from education to mediating factors.

It is found that the impact of education on health is significant in the case of the poor and middle class but it is highly insignificant for rich even at 10% level of significance. The impact of education on freedom of choice is highly significant in the case of the middle class while this path is insignificant in the case of poor and rich. It implies that the increased level of education increases the ability of individuals living in the middle class to choose and make their decisions freely. For poor, increased level of education

does not mean a higher level of freedom. The insignificant effect of education on freedom for the rich might be because the freedom of the rich might not depend on the level of education.

Table 1.13: Results for Effect of Education on Mediators (a paths)

Mediator	Rich	Middle Class	Poor
Health	0.00375	0.03364	0.05309
	(0.87262)	(0.02179)	(0.07854)
Freedom	-0.05160	0.18633	0.03127
	(0.37821)	(0.00000)	(0.72179)
Marital Status	-0.17572 0	-0.27912	-0.57748
	(0.11755)	(0.0001)	(0.00005)
No. of Children	-0.07752	-0.09671	-0.23012
	(0.08806)	(0.00032)	(0.00001)
Employment Status	0.24300	0.20047	0.08385
	(0.00057)	(0.00000)	(0.24929)

Note: Estimations are done through glm and the binomial link is used where the mediators are binary. Number of observations for Rich, Middle class and poor are 214, 733 and 224.

* **p-values** are given in parenthesis

Marital status is a binary variable and the coefficients associated with this variable are in the form of probability. The results show that an increase in education decreases the probability of getting married. The impact of education in all three cases is significant, with highest negative impact for poor than for the middle class and smaller for rich with significance level dropping down to 11% from highly significant coefficients for the middle class and poor. Impact of education on number of children are negative and significant for all income classes, referring that people with higher education on average have fewer children. The coefficient is higher in case of poor, the middle class have the lesser impact of education on a number of children as compared to the poor class and people in the rich class also have this path significant but the effect is less than the

middle and poor class. The impact of education on employment status is highly significant and positive in case of the middle class and rich but it is insignificant in case of poor. The results are very much evident of the prevailing conditions in developing countries like Pakistan where poor face more difficulty in finding employment and improving employment status as compared to the middle and rich class and that's why the results show that increasing education is not enough to get employment for poor and so the coefficient showing the impact of education for poor on employment status is found insignificant.

Table 1.14 shows the impact of potential mediators on life satisfaction and their respective p-values. While analyzing paths from mediating factors to life satisfaction, it is found that health and freedom of choice have a highly significant and positive impact on life satisfaction for all three categories. The results also show that marital status has a significant positive effect in case of poor, significant negative effect in the case of the middle class and insignificant effect in case of rich on life satisfaction. So the results imply that for poor being married increases the chances of being satisfied in life, while for the middle class on average the married persons report less satisfaction then unmarried. However, for rich, this path is insignificant implying that for the rich class marital status do not play any role in life satisfaction. The results indicate that the number of children has a negative impact on life satisfaction in case of poor and significant at 10% significance level. For the middle class, the effect of the number of children on life satisfaction is positive and significant while for rich it is insignificant. Comparison of employment status coefficients tells us that employment status is insignificant in defining life satisfaction for the rich and middle class while for poor it is significant and its effect is negative. Implying that the probability of being satisfied in life decreases if the person in the poor class is employed.

Table 1.14: Effect of Education on Mediators on Life Satisfaction (c´ and b paths)

Path	Rich	Middle Class	Poor
Education (c´)	0.01726 (0.73426)	0.04145 (0.16374)	0.19432 (0.01346)
Health	0.77492 (0.00000)	0.53916 (0.00000)	0.98114 (0.00000)
Freedom	0.28503 (0.00000)	0.44284 (0.00000)	0.28088 (0.00000)
Marital Status	-0.40771 (0.28026)	-0.77704 (0.00019)	1.49807 (0.00568)
No. of Children	-0.04102 (0.60781)	0.08278 (0.05149)	-0.16799 (0.09087)
Employment Status	-0.09148 (0.69415)	0.06876 (0.60992)	-0.61209 (0.05087)

Note: Estimations are done through glm.
p-values are given in parenthesis

1.4.4a Mediated Effects for Different Income Classes

Comparing the unstandardized indirect effects of education on life satisfaction among different income classes, it is found that for poor, channels of health is significant at 10% level of significance while marital status is significant at 5%. The results are reported in Table 1.15a. A mediator is reported as significant if it does not hold zero in the respective bootstrapping C-I. All other paths for the poor are found insignificant. In the case of the middle class all channels that are of health, freedom of choice and marital status and number of children are significant at 5% level of significance except the channel of employment status. It is thought-provoking to note that all the indirect effects are found insignificant in the case of the rich class. Implying that health, freedom, marital status, number of children and employment status none of them are bridging the effect of education and life satisfaction for rich people. So all of them are not mediating factors between education and life satisfaction for rich people.

Table 1.15a: Unstandardized Mediated Effects

	Indirect Effects		
Mediator	**Rich**	**Middle Class**	**Poor**
Health	0.00290	0.01814**	0.05209*
Freedom	-0.01471	0.08251**	0.00878
Marital Status	0.00549	0.01970**	-0.05562**
No. of Children	0.00318	-0.00801**	0.03866
Employment Status	-0.00505	0.00284	-0.01149

Note: ** shows significance based on 95% C-I through bootstrapping with 5000 replications
* shows significance based on 90% C-I through bootstrapping with 5000 replications

- **Standardized mediated effects**

The results of standardized mediated effects express the indirect effects in terms of variance of outcome variable i.e. life satisfaction. The final decision about the significance of indirect effects remains unchanged from the decision under the unstandardized effects. The results are summarized in Table 1.15b.

Table 1.15b: Standardized Mediated Effects

Mediator	**Indirect Effects**		
	Rich	**Middle Class**	**Poor**
Health	0.00170	0.00922**	0.02138*
Freedom	-0.00862	0.04194**	0.00360
Marital Status	0.00322	0.01001**	-0.02283**
No. of Children	0.00186	-0.00407**	0.01587
Employment Status	-0.00296	0.00144	-0.00471

Note: ** shows significance based on 95% C-I through bootstrapping with 5000 replications
* shows significance based on 90% C-I through bootstrapping with 5000 replications

1.4.4b Comparison of Direct Effects for Different Income Classes

The results of unstandardized direct effects show that for rich the direct effect is insignificant even at 10% level of significance. For the middle class, the direct effect becomes insignificant as the effect of education is translated through the significant

indirect effects. It is important to note that for poor the direct effect is significant at 5% level of significance and it has a large coefficient value which means that there is the strong impact of education on life satisfaction of poor. The results of standardized direct effects imply the same only the unit of measurement is different, that is a variance of life satisfaction. The results are reported in Table 1.16.

Table 1.16: Direct Effect of Education of Life satisfaction

	Direct Effect	Coefficient	Confidence Interval		
Unstandardized	**Rich**	0.01726	-0.10936	0.13543	(95%)
			-0.08638	0.11532	(90%)
	Middle class	0.04145	-0.02197	0.10381	(95%)
			-0.01117	0.09473	(90%)
	Poor	0.19432**	0.04235	0.33702	(95%)
			0.06702	0.31094	(90%)
Standardized	**Rich**	0.01011	-0.06406	0.07933	(95%)
			-0.0506	0.06755	(90%)
	Middle Class	0.02107	-0.01117	0.05277	(95%)
			-0.00568	0.04815	(90%)
	Poor	0.07975**	0.01738	0.13832	(95%)
			0.02751	0.12762	(90%)

Note: Confidence interval is calculated through bootstrapping technique.
''** shows that effects are significant at 5% level of significance

Summing up, the analysis of the impact of education on life satisfaction for rich, middle and poor class implies that more indirect effects are stronger and significant in case of the middle class than poor and are insignificant in case of rich. For the middle class, health, freedom, marital status, number of children are significant and only employment status is found insignificant. In the case of poor health and marital status are significant and freedom, the number of children and employment status are found insignificant. For rich all the paths are found insignificant. In case of direct effect, the strongest direct effect is for poor (0.19432) and it is also significant. For the middle class, the direct

effect is found to be insignificant and the value (0.04145) is quite small as compared to the direct effect for the poor. For rich, the direct path is also insignificant and the smallest of all (.01726).

1.5 Conclusion

The following conclusions can be drawn on the basis of analysis done and reported in section 1.4.

- It is observed that education plays a significant role in affecting life satisfaction. The indirect effects are analyzed through six mediating factors; health, freedom, marital status, number of children, employment status and scale of income out of which health, freedom and scale of income are found significant in the analysis of the full sample. Besides, the direct effect is significant, positive. It implies that the model is a partial mediation model as the introduction of mediators do not make the direct path insignificant.

- When the sample is divided into two groups on the bases of gender, it is found that the impact of education takes different paths in life satisfaction of male and female. For men, the channels of the scale of income, health and marital status while for women freedom of choice and health are found significant. For men, the strongest effect of education on life satisfaction is through the scale of income and for women it is through freedom of choice. Comparison of indirect effect through health which is significant in both cases, it is found that health channel is a little stronger for women than for men. The total indirect effect of education for women is slightly higher than for men. The direct effect for male and female both are significant at 10% level of significance and greater than individual indirect effects but less than total indirect effect.

- The analysis of the impact of education on life satisfaction for single persons shows that health and scale of income are significant mediators, while for married persons three indirect effects are significant that are of health, freedom of choice and scale of income. For married persons, the total indirect effect is higher than single persons. The direct path is significant and has a positive coefficient value for married persons while for single persons it is found insignificant. It implies that education plays a more crucial role in affecting the life satisfaction of married persons than that of single.
- The analysis of the impact of education on life satisfaction based on the scale of income illustrates that as compared to rich and poor more channels are effective for the middle class. It is found that all indirect effects, as well as a direct effect, are insignificant in case of the rich class, that means the role of education in defining and affecting the life satisfaction of rich is not supported by the data and is found insignificant. It means that in the case of Pakistan the upper class do not significantly value education in explaining their life satisfaction. On the other hand, for the middle class, all of the indirect effects are significant except employment status. It implies that the level of education is playing a crucial role in improving life satisfaction of persons belonging to the middle class. The direct path between education and life satisfaction for the middle class is also effective. For poor class, although only health and marital status are significant mediating effects, the coefficient of direct effect is 0.19432 which shows a much higher value as compared to the direct path of the middle class. It means that although most of the indirect effects like freedom of choice, number of children and employment status channels are insignificant still education has the ability to affect the life satisfaction of poor

through its direct effect.

1.6 Policy Implications and Ideas for Future Research

The study of the impact of education on life satisfaction has the following policy implications.

- The analysis of full sample shows that the channel of employment status is insignificant between education and life satisfaction, and the deeper look in the matter tells us that the path from education to employment status is significant and positive, which means that increased level of education increases the chances of getting employed. But the path from employment status to life satisfaction is broken or is found insignificant. It gives a clear message to the policymakers defining labour policy to look into the problems of employed persons and work environments and to make working environments better so that the individuals not only get monetary benefits but also the better employment status or getting employment could also help in increasing life satisfaction that is missing currently. Furthermore, the employment status variable is found insignificant in each case in our study. Effective labour policies should be designed to make this channel effective and to translate the effect of increased education in increased life satisfaction.

- Similarly, in the case of female, it is observed that only two channels health and freedom of choice is significant. The policymakers dealing with labour, human and women rights should be concerned to define such policies that make other channels effective too for women. Especially the channel of employment status and scale of income. To see if the paths from education to employment status and scale of income are positive and significant (see Table 1.5) meaning

education is impacting them positively then why these positive impacts are not resulting in higher life satisfaction. It indicates the need for policy formulation and further research to repair the broken links between education and life satisfaction in case of female in particular and for all in general.

- The health channel is significant in case of every model in our study that is a full sample, male or female, married or single, middle class or poor except for rich. That gives guidelines to both health and education policymakers, that good of education is effectively translating to health and then to the life satisfaction of individuals. So the policy of increased education will also lead to increased health in the country.

- The analysis of the impact of education for different income classes (rich, poor and middle class) shows that there is a significant role of education in impacting life satisfaction of poor and middle class so an educational policy should be design to increase the level of education of poor and middle class to increase the level of life satisfaction in the country.

Although the current study is first in its nature for Pakistan to address the role of education and its indirect effects in impacting life satisfaction of individuals give important insight into the matter, the research gap remains to find the reasons of broken links between education and life satisfaction in Pakistan. The research is also needed to formulate appropriate policies to address these issues.

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ESSAY 2

ROLE OF EDUCATION IN ECONOMIC GROWTH OF PAKISTAN

2.1 Introduction

Education as the main determinant of human capital is considered a fundamental factor of economic growth. Although in economics, the recognition of the role of education in improving productivity and economic growth is as old as the subject itself, the recent growth theories acknowledge the role of education in the following three distinct ways. First, the neoclassical growth theories, that illustrate education as a source of increasing human capital embedded in the labour force which is important for increasing labour productivity and thus economic growth, for example, Mankiw et al., 1992; Barro, 1991. Second, the endogenous growth theories that demonstrate education as the basis for innovation and new knowledge, technology and improved methods of production that stimulates economic growth, for example, Lucas, 1988; Romer, 1990; Aghion & Howitt, 1998. Third, theories, that acknowledge the role of education in economic growth as its ability to speed up technological catch-up and diffusion (e.g. Nelson and Phelps, 1966; Benhabib and Spiegel, 1994).

The literature of economics elaborates that in addition to private returns of education to individuals, it also has social returns due to its spillover effect. The benefits of education spread to other workers in a firm or industry, to other community members in a community, to members of the city or region and the economy in general. It is established in the literature that in addition to increase in productivity, education increases economic growth by having positive externalities, for example, Barro and Lee (2001) stated that "the level and distribution of educational attainment has a strong

impact on social outcomes, such as child mortality, fertility, education of children and income distribution." Furthermore, Galor & Zeira (1993) described that the main source of inequality in income is the result of inequality in education. It helps in good parenting, wider and better political participation of individuals in a society, better community participation and curbing crime and negativity in a society (OECD, 1998). This spillover characteristic and social returns makes education a public good and provides the ground for the allocation of government funds to promote education in a country (Sianesi & Reenen, 2003).

The inability of microeconometric analysis to capture the social returns of education as well as testing the emerging growth theories motivated the use of aggregate level analysis in the recent past (Krueger & Lindahl, 2001).

The macroeconometric analysis of education and economic growth increased at an exponential rate during the past few decades. Most of the empirical studies regarding education and economic growth have used cross-country regressions using average years of education or enrollments as a measure of education or human capital. Holland et al. (2013), Sianesi and Reeenen (2003), Temple (2001), Krueger and Lindahl (2001), Topel (1999) and Renelt (1991) provides a comprehensive review of literature in this regard. There are comparatively too few studies based on time series analysis to analyse the relationship. Temple (1999) prefers and suggests time series analysis over cross country regressions for studying growth dynamics due to the problem of heterogeneity. Moreover, the majority of empirical work used average years of schooling as a proxy for measuring education or human capital and there are relatively few studies that are devoted to analyzing the effect of different levels of education on economic growth.

The problem with using average years of schooling as a proxy for education level or human capital is that it does not differentiate between an additional year of a higher level of education and an elementary level of education. It treats the additional year of primary education the same as an additional year of college or university. It implies that an increase of education in any level of education whether it's primary, secondary or tertiary will have an equal effect on economic growth. This underlying assumption cannot be justified. Therefore, it is more appropriate to use different levels of education instead of aggregating it to a single measure in the form of average years of schooling.

Pakistan is a developing country and is facing enormous challenges on economic, social and political fronts. The ability of education to deal with economic, political and social issues simultaneously makes it essential to focus on education and thereby increasing the human capital. There are numbers of studies with reference to Pakistan which analyzes the link of human capital and economic growth. These studies can be grouped into three broad categories according to the measurement of human capital. First, are those who proxy human capital by enrollment rates at a particular level of education i.e. primary or secondary or take more than one level of education. This category includes the works of Afridi(2016), Jangraiz et al(2015), Jalil & Idrees (2013), Kiani(2013), Amir(2012), Peck & Abbas (2008) and Khan (2005). The second category captures the effect of human capital by using the education and health index. This category includes the work of Bushra et al (2014), Nabila et al (2012) & Sajid et al (2012). They reported a significant positive impact of human capital on economic growth. The third category is of those studies that used public expenditure on education to see the impact of human capital on economic growth. This group includes studies of Alvina et al (2013), Imran et al (2012) and Zaheer et al (2011). They confirmed the

existence of a long-run relationship between public expenditure on education and economic growth.

From the review of studies with reference to Pakistan, it is clear that while attempts

have been made to analyze the impact of different levels of education on economic growth e.g Jalil & Idrees (2013), still there is a gap in the literature to find its effect on the growth of agriculture, industry and services sector separately.

The current study is particularly aimed to analyze the impact of different levels of education (i.e. Primary, Secondary and Tertiary) of employed persons on the level and growth of national output in Pakistan. Moreover, this study is an attempt to find the possible differences in the impact of education in different sectors of the economy i.e. Agriculture, Industry and Services Sector. The study uses output per employee as a dependent variable, as most of the growth models when solved have a dependent variable as Y/L denoted by y. Although per capita output is the most widely used proxy for Y/L, it is more appropriate to measure it as output per worker or employee, if there are no data issues. Benhabib and Spiegel (1994), Pritchett (1997), and Bils and Klenow (1997), Hall and Jones(1999), Klenow-Rodriquez(1997), de la Fuente and Domenech (2000) and Barro and Lee(1994) used output per worker as a dependent variable. This study is distinct in considering output per employee as the dependent variable and using the education of employed persons instead of overall enrollment rates. If the dependent variable is output per worker then it is more appropriate to analyze the educational level of those who are employed and participating in the production of GDP rather than to consider the education of all the people living in the economy. Moreover, it is a first attempt in finding the impact of education on different major sectors of the economy.

2.2 Objectives of Study

The core aim of this study is to analyze the impact of different levels of education on the economic growth of Pakistan during the period 1985-2018.

More specifically the objectives are:

1) To analyze the effect of education segregated in different levels of education i.e. primary, secondary or higher education on economic growth in Pakistan. To compare which level of education i.e. primary, secondary or higher education is more contributing to the economic growth of Pakistan.

2) To analyze and compare the impact of all three levels of education in major economic sectors (i.e. Agriculture, Industry and Services) separately.

2.3 Literature Review

It is well established in the literature that education as the main determinant of human capital is inevitable for economic growth and differences in GDP per capita can better be explained by considering the differences in human capital (Lucas, 1988; Barro and Sala-i-Martin, 1994). Human capital is defined as "The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" *(Healy et al. 2001).*

Education as the main determinant of human capital not only contributes to the wellbeing of society due to increased productivity of the workforce but also because it helps individuals to become more innovative, act as helpful citizens and restraint crimes and negativity in the economy. In addition to the positive effect of education for an individual, it has spillover effects for the other individuals in a firm, community, city and country in general. Barro and Lee (2001) stated that the accumulation of human

capital not only helps in increasing productivity but also in "... the absorption of advance technology from developed countries … the level and distribution of educational attainment has a strong impact on social outcomes, such as child mortality, fertility, education of children and income distribution." Similarly, reduction in inequality in income, wider and better political participation of individuals in a society, better community participation and curbing crime and negativity in society are some of the spillover effects of education for the society (OECD, 1998).

2.3.1 History of Recognition of Education and Human Capital in Economic Literature

The recognition of individual skills by economists can be traced back to the works of Sir William Petty (1676) and Adam Smith (1776). Although Adam Smith in his book "An Inquiry into the Nature and Causes of the **Wealth of Nations**" did not explicitly use the word "Human capital" but his emphasis to acquire education and accumulating Human capital can be drawn by the following words recorded in his book.

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

In the Concise Encyclopedia of Economics, Smith's view about differences in wages is termed as the basis for the modern view of human capital. Smith (1776) elaborated, five main reasons that describe differences in wages. One of them is the difference in

difficulty and expense of learning jobs. He explains the significance of education in explaining wage differentials in the following words, " The work which he learns to perform, it must be expected, over and above the usual wages of common labour, will replace to him the whole expense of his education, with at least the ordinary profits of an equally valuable capital . Education in the ingenious arts and in the liberal professions is still more tedious and expensive"p-84, 85.

But in the era of Alfred Marshall, economists were shy to term human as human capital, it was considered empirically less important, on the ground that it cannot be sold and purchased. This important idea remained in dark until the time when the seminal works of Schlutz (1961), Becker (1962) and Denison (1962) reintroduced the concept of human capital in explaining economic growth.

2.3.2 The Seminal Works of Solow(1957), Schlutz (1961), Becker (1962) and Denison (1962)

Studies of Solow (1957), Kendrick (1956) and Fabricant (1954) established that physical capital accumulation is unable to define the whole of observed per worker economic growth. The identification of Solow residual and efforts to analyze it gave provision for linking Human capital to economic growth. For example, Kendrick (1956) elaborated this concept in the following terms "This "cultural" capital is largely the technical knowledge of individuals, accumulated by investment in *education and research*, and its services are manifested through the application of technical know-how by individuals directly in productive activity, or through the instruments of production."

In his commendable work Schultz (1961) elaborated in detail why economists like Marshall and John Stuart Mill and many others were shy to term human as human capital and their view of refraining from it; on basis that it is counter to human freedom

and it pushback humans to slavery era where humans were considered as property and could be bought and sold. He explained that the classical notion that “labourers are endowed equally” is wrong. And simply adding numbers of labour to account for growth will not give fruitful results in explaining economic growth. He emphasized the role of acquisition of knowledge and skills in explaining economic growth and said that omitting the role of knowledge and skill in economic growth is like studying soviet ideology excluding Marx. In addition to this, he illustrated that the growth of national output cannot be fully explained by an increase in physical capital, man-hours and land unless investment in human capital is taken into account. In his own words, “Many paradoxes and puzzles about our dynamic, growing economy can be resolved once human investment is taken into account”. He explained and proved this stance through practical examples and gave policy recommendations, he concluded his study with the thought-provoking words "The man without skills and knowledge leaning terrifically against nothing."

Becker (1962) accentuated that “ a simple analysis of the incentive to invest in human capital seems capable of explaining, therefore, not only why the overall distribution of earnings is more skewed than the distribution of abilities, but also why earnings are more skewed among older and skilled persons than among younger and less skilled ones”. He explained that investment in human capital show higher earnings at older ages because returns of education add up to the greater value in older ages than younger ages when costs are being paid i.e. investment in human capital is made at younger ages and its benefits are reaped at older ages. He further explained that since “abler” persons invest more in human capital their distribution of earnings might be unequal and skewed even though the ability is not unequally distributed. He also highlighted that it might be possible that earnings might not be affected because of investment in human capital and

the reason might be that costs are not made by individuals but firms, industries or countries and they acquire the benefits so the earnings remain unchanged.

Denison(1962) in an attempt to explain the sources of growth in the United States and estimating future growth rate, shedded light on the contribution of education to the growth rate of national income. He estimated the effect of education on the quality of the labour force and thereby on output and national income. Furthermore, his study suggested that three-fifths of earning differentials were associated with differences in education and experience and the remaining two-fifths with natural abilities, energy and other factors. The results for the data from 1929 to 1957 revealed that in the United States, on average the education of workers has increased by 2% per year, the average increase in quality of labour due to advancement in education was increased by 0.97% per annum and real national income was increased by 0.67% on average. He has concluded that 23% of the growth of real national income and 42% of real national income per employee can be attributed to improvement in education based on estimated coefficients for the data of 1929-1957.

2.3.3 The Human Capital Augmented Solow Model; Mankiw, Romer and Weil Model

Mankiw, Romer & Weil (1992) attempted to empirically test the validity of the Solow model and its implications and as a result, proposed and developed a human capital augmented Solow model. They found that Solow's prediction that saving and population are the two main factors in explaining income differences are supported by data but the estimated magnitudes of these factors were too large than what was predicted by the Solow model. They established that raise in magnitude was due to the fact that human capital was not incorporated in the model. By defining a human capital augmented Solow model and by using "The percentage of working-age population that

is in secondary school" as a proxy for Human capital, they concluded that " the Solow model is consistent with the international evidence if one acknowledges the importance of human as well as physical capital". The estimated values showed that 80% of cross country differences are explained by differences in Human capital, physical capital and population growth. They utilized Summer and Heston (1988) data set consisting of annual data from 1960 -1985. They used three different groups of countries for purpose of empirical analysis, the first group consisted of all 98 countries in the data set (excluding centrally planned economies and oil-producing countries), the second group contained 75 countries (small countries whose population was less than one million were excluded) and the third sample was of 22 OECD countries.

2.3.4 Education and the Endogenous Growth Theories

Endogenous growth theories can be grouped into two broad categories. First, the theories that demonstrate education as the basis for innovation, new knowledge, technology and improved methods of production that stimulates economic growth, for example, Lucas, 1988; Romer, 1990; Aghion & Howitt, 1998. Second, theories, that acknowledge the role of education in economic growth as its ability to speed up technological catch-up and diffusion (e.g. Nelson and Phelps, 1966; Benhabib and Spiegel, 1994).

Lucas (1988) established that human capital is fundamental to economic growth. The two main sources of accumulating human capital in his model were education/schooling and learning by doing. The production function for human capital was developed in the model. The model explains the decision making process by individuals to allocate their time between the accumulation of human capital and participation in the production process. The consequences of individual decisions of allocation of time

between acquiring human capital on their productivity and economic growth were analyzed. The theory concludes that human capital accumulation is the main driver of economic growth.

Romer(1990) modified the Solow model by making the technological change endogenous to the model. It is shown that the model is just like a Solow model with labour and human capital augmented technological change. The model concludes that growth depends on the technological change that in itself depends on the stock of human capital and is interest-rate sensitive. The model uses physical capital, Human capital, labour and technology as four basic inputs. There are three major sectors in the model. The research sector, the intermediate-goods sector and the final output sector. In the research sector stock of knowledge and human capital are used as inputs. The intermediate goods sector under monopolistic competition is modelled by taking the output of the research sector and foregone output as inputs of the sector. Finally, the output sector is shown as a sector with human capital, labour and output of the intermediate-goods sector as inputs. The output that is not consumed is saved and then used in the intermediate goods sector. The model is solved by discussing the consumer's decision of consumption and saving, the decision of individuals having human capital to work for the research sector or final output sector; the decision of equilibrium quantities of inputs of final output sector, the decisions about optimal quantities of inputs and output of intermediate goods sector and price of its output.

Aghion and Howitt (1992) introduced a new growth theory based on Schumpeter’s idea of ‘creative destruction’. According to this theory, the growth in an economy depends on the amount of research and the resultant innovations. Innovations are shown as an intermediate good in the production of a final output. It is shown that as a result of

innovations the old ones become obsolete. The business firms that produce intermediate goods as a result of new research earns monopoly profits against it, will face the risk of obsolesce in the future as a result of innovations. So, the innovations are shown to be inversely related to the expected future innovations in the model.

Nelson and Phelps (1966) demonstrated that an educated workforce is more adaptable to changes and new production processes. Hence they are more helpful in the diffusion of technology and innovation. By exemplifying the agriculture sector of the US, it is explained that the farmers with higher education were found more adaptable to new technologies as compared to those with lower education level. it is advocated that same is true for the industrial sector. The overall production function in the economy is assumed to have Harrod-neutral technological progress; the labour augmented progress. The article developed and elaborated two models for technological diffusion by means of education. The first model implies that the time gap in the formation of new technology and its adoption is inversely related to the index of human capital or education. The returns of education are shown to be higher if the pace of technological advancement is faster. The second model shows that the rate of technological adoption depends on education as well as upon the lag between the theoretical and implemented level of technology.

Benhabib and Spiegel (1994) suggest that differences in economic growth across countries are mainly due to differences in stocks of human capital that is the basis for innovations and catch up with the technological advancement of developed countries. The model is estimated as a log linearized Cobb-Douglas production function with physical capital, labour and human capital as inputs. Human capital was proxied by the average years of schooling of the working-age population. The human capital variable

was found insignificant in effecting per capita growth of output. It was concluded that human capital is unable to affect the growth rate of output as the third input in the production function but it affects output by affecting total factor productivity (TFP).

2.3.5 Empirical Evidence of Education and Economic Growth

The economic growth literature increased at an exponential rate during the past few decades. Still, there is a lack of consensus regarding the impact of education on economic growth. Although, most of the studies suggest a positive relationship between education and growth some studies like Islam (1995), Bils and Klenow (2000) and Pritchett (2001) concluded no or negative relationship between the two. Also, the debate that whether it is the stock of human capital or human capital accumulation that affects economic growth is also inconclusive.

Most of the empirical studies regarding education and economic growth relation have used cross-country regressions using average years of education or enrollments as a measure of education or human capital. Holland et al. (2013), Sianesi and Reeenen (2003), Temple (2001), Krueger and Lindahl (2001), Topel (1999) and Renelt (1991) provides a comprehensive review of literature in this regard.

2.3.6 Time Series Analysis of Education and Economic Growth

Apart from the country comparative analysis of education and economic growth, there are comparatively too few studies based on time series analysis to analyse the relationship. A few of them are summarized as under:

Jenkins (1995) analysed time series data for the United Kingdom for the years 1971-1992. The aggregate output is modelled by including physical capital, human capital and capacity utilization as inputs. Workforce qualification is used as a proxy for human capital. It is concluded that an increase in human capital increases productivity. It is

found that as compared to a worker with no education the highly educated worker produce two times more output.

Asteriou & Agiomirgianakis (2001) has used time-series data from 1960 to 1994 to find the long-run relationship between education and GDP per capita and to find the direction of causality. They have used the Johansen(1988) test to check the cointegration and then applied the Granger causality test. The educational variables are taken in the form of percentages of enrollments in different levels of education to the working-age population. They have also tested the impact of the ratio of public/ government expenditure on education and total public expenditure on GDP per capita. All educational variables were found cointegrated with GDP per capita suggesting the existence of a long-run relationship between an educational variable and economic development. The study also established that causal direction is from educational variables to development except in the case of higher education where reverse causality exists.

Loening (2004) attempted to establish the education and growth relationship using the error correction model for Guatemala for the years 1951 to 2002. The education variable is measured in terms of average years of schooling. The results favoured the claim that education has a positive impact on economic growth. It is reported that 50% of the growth of output is explained by education.

Kyophilavong et al. (2018) used time series data for the years 1984 to 2013 to test the existence of causality between education and output growth in Laos. Education is measured in terms of enrollments in different educational levels. It is concluded that the long-run relationship exists at all three levels of education and economic growth.

They employed the Granger causality test as well as Johansen cointegration analysis as a method of analysis.

Tsamadias and Pegkas (2012) attempted to analyze the education and GDP per worker relationship for Greece for the years 1981-2009. The theoretical model of Mankiw et al. (1992) is followed in the study. Human capital is proxied by average years of schooling, the proportion of labour force with secondary level of education and enrollments. Granger Causality test and Johanson cointegration test are used to confirm the causality and existence of the long-run relationship. The results show that a negative relationship exists between education and economic growth in Greece during 1981-2009. However, the negative coefficient was found insignificant except in the case of human capital measured in the form of enrollment rates. the cointegration test showed no long-run relationship between education and economic growth.

Sari & Soytas (2006) used time-series data from 1937-1996 to check the causality and existence of a long-run relationship between education and Income measured by the GDP of Turkey. Enrollments at primary secondary and university level are used as a measure of education and human capital. By using the VECM and granger causality test, it is concluded that primary and secondary education causes national income, while the causality is bidirectional in the case of university-level education. The results of VECM confirms the existence of cointegration between education variables and GDP of income over the sample years 1937-1996.

Lin (2003) examined the relationship between education and economic growth keeping in view the impact of technological advancement on economic growth in Taiwan for the years 1965-2000. The education variable in the model was the average years of schooling per labour in the labour force, while gross domestic product is used as a

dependent variable. The cointegration test proposed by Engel and Granger (1987) is employed. Education is found to have a significantly positive impact on economic growth.

De Meulemeester & Rochat (1995) attempted to analyze the impact of higher education on economic development for six countries; UK, Sweden, Japan, France, Italy and Australia. Time series data for more than 50 years was collected for each country. Granger causality test and cointegration test are performed for analysis. The data for the UK, Sweden, Japan, France supported the hypothesis that higher education causes economic development while the causal relation can not be established in the case of Italy and Australia.

Self and Grabowski (2003) analyzed the impact of primary, secondary and tertiary education as well as vocational education on the growth of national income in Japan in the post and pre-war era. The education variable is taken as average years of schooling in each level of education. It is concluded that primary education has a causal effect on economic growth in both periods. While a secondary and higher level of education is found to have a causal effect in the post-war era. However, the causal relationship between vocational education and growth could not be found in both pre and post-war periods.

2.3.7 Studies with Reference to Pakistan

There are numbers of studies with reference to Pakistan which analyzes the link of human capital on economic growth. These studies can be grouped into three broad categories. First, are those who proxy human capital by enrollment rates at a particular level of education i.e. primary or secondary or tertiary education. The second category captures the effect of human capital by using the education and health index. The third category is of those studies that used public expenditure on education to see the impact of human capital on economic growth.

2.3.7.1 Enrollment Rates as Proxy of Human Capital

This category consists of studies with reference to Pakistan that uses enrollment rates at a particular level of education i.e. primary or secondary or tertiary as a proxy of human capital. This category includes the works of Afridi(2016), Jangraiz et al(2015), Jalil & Idrees (2013), Kiani(2013), Amir(2012), Peck & Abbas (2008) and Khan (2005) and is summarized as under:

Afridi(2016) attempted to find the impact of human capital on the economic growth of Pakistan. The study has used the data from 1972- 2013 and applied ARDL and VECM techniques to find the results. Enrolments rate at primary level education, infant mortality rate and birth rate are used as proxies for human capital while GDP per capita is used as a proxy for economic growth while physical capital is used as a control variable. The study concludes that human capital has an important role in promoting economic growth.

Jangraiz et al (2015) used time-series data from 1971-2012 to analyze the impact of human capital on the economic growth of Pakistan. They used expenditure on research and development, enrolment rates in primary, secondary and higher education, gross enrollment rate, and health as a proxy to human capital. By use of the Granger causality test, they concluded that the causal relationship between Human capital variables and economic growth exists. They found in their study that the direction of causality is from research and development to economic growth while in the case of education (in the form of gross enrolment), it is from growth to education.

Jalil & Idrees (2013) attempted to analyze the impact of education on economic growth by not only taking average years of schooling as a proxy but also analyzing the effect through enrolments in primary, secondary and tertiary education. The analysis was

based on data from 1960- 2010. Nonlinear 2SLS was used to estimate the error correction model. It was found that average years of schooling, as well as enrolment rates in primary, secondary and tertiary education each, have a positive impact on the economic growth of Pakistan. The secondary level of education was reported to be more contributing than primary and tertiary education.

Kiani (2013) examined the role of education in the economic growth of Pakistan. They used annual data from 1980 to 2007 and used the OLS technique for analysis. This study used four levels of education i.e. primary, middle, high and other school enrollments to capture the effect of education. The study concluded that each level of education contributes significantly to economic growth.

Amir et al (2012) examined the role of education in the economic growth of Pakistan. They used primary, secondary, college, university, vocational enrollment rates for capturing the effect of education. They included the different levels of education separately in production function only one at a time. To analyze the effect of technology, the ratio of imports to gross domestic investment and expenditure on research and development were used. By using the Johansen cointegration test and error correction mechanism they established that there exists a long-run relationship between human capital and economic growth.

Peck & Abbas (2008) attempted to find the relationship between human capital and economic growth by using secondary level of education per worker and ratio of government expenditure on health to GDP as proxies for human capital. They used data from 1960-2005 and analyzed it by Johansen cointegration test. They found that human capital has a positive contribution to GDP from the 1960s to 1990 while from 1990 to

2000 it showed a negative impact and they elaborated that this result is due to the negligence of human capital in economic policies.

Khan (2005) analyzed the relationship between human capital and economic growth by utilizing panel data for 72 developing countries including Pakistan for the years 1980-2002. Average years of schooling, gross secondary school enrollment, adult literacy rate and life expectancy at birth were used as proxies of human capital. They concluded that along with capital formation, quality of institutions the education and health variables have a significant effect on economic growth. The study used the OLS technique for analysis.

2.3.7.2 Use of Education and health index as a proxy for human capital

The Second category captures the effect of human capital by using the education and health index. This category includes the work of Bushra et al (2014), Nabila et al (2012) & Sajid et al (2012), they are summarized below.

Bushra et al(2014) analyzed the relationship of economic growth and human capital of Pakistan. They used annual data from 1979-2010 and used the Johansen cointegration approach to analyze the data. Infant mortality rate, education enrollment index was used to proxy human capital while the Gini coefficient and fixed capital formation were used as control variables while GDP was measured in level. They reported a significant impact of human capital on economic growth.

Nabila et al (2012) investigated the role of human capital in the economic growth of Pakistan by taking education and health index as proxies for human capital. Time series data from 1974 to 2009 was used and the Johansen and Juselius cointegration and VECM are applied to analyze data. A strong positive impact of human capital on economic growth was testified.

Sajid et al (2012) studied the role of human capital in promoting the economic growth of Pakistan by utilizing time-series data from 1972-2010, Granger causality test and OLS technique. They used the health and education enrollment index as a proxy for human capital. They found a positive and significant effect of the education enrollment index on economic growth.

2.3.7.3 Public Expenditure on education as a Proxy of Human Capital

This category consists of those studies that used public expenditure on education to see the impact of human capital on economic growth. This group includes studies of Alvina et al (2013), Imran et al (2012) and Zaheer et al (2011), their brief is given below.

Alvina et al (2013) endeavoured to find the relationship between public expenditure on education and economic growth. Panel data based on 14 countries and 17 years from 1990-2006 was used. The countries were categorized into developed and developing countries. Panel cointegration test proposed by Pedroni was utilized to check the existence of a long-run relationship and to get the estimates fully modified ordinary least square is implied. A positive association between public expenditure on education and economic growth was determined. It was concluded that the impact is greater in the case of developing countries as compared to developed countries.

Imran et al (2012) examined the relationship between human capital and economic growth by using public expenditure on health and education as a proxy for human capital. Time series data from 1972-2002 is used and the Granger causality test and Johansen cointegration were used as analytical techniques. The results confirmed the existence of a long-run relationship between human capital and economic growth.

Zaheer et al (2011) investigated the impact of government expenditure on education to find the link between education and economic growth of Pakistan. The study utilized

time-series data from 1980-2009 and applied the Johansen cointegration test and error correction model to find short and long-run dynamics. They described the existence of a long-run relationship between education and economic growth but in the short run, no significant relation was found.

From the review of studies with reference to Pakistan, it is evident that while attempts have been made to analyze the impact of different levels of education on economic growth, still there is a gap in the literature to find its effect on the growth of agriculture, industry and services sector separately.

2.4 Theoretical Model

It is well established in the economic literature that physical capital accumulation alone is not capable of explaining all the growth that occurs in per capita GDP (Solow, 1957; Kendrick, 1956). The new growth theories well acknowledge the role of education, as sources of acquiring human capital, in economic growth. The well-celebrated endogenous growth theories provide a variety of theoretical frameworks in which education enhances economic growth. One of the basic implications of the endogenous growth theories is that technological changes bring increasing returns to scale and therefore economies tend to grow without converging to a steady-state. Jones(1995) elaborates that time-series data is capable of testing endogenous growth theories and their implication. It is argued by analyzing the time series data for 15 OECD countries over 100 years that despite the permanent rise in investment rates, the GDP growth rates were found stationary. This refutes the implication of endogenous growth theories that a permanent rise in investment rates or human capital investment will permanently increase the growth rate. On the other hand, the Mankiw, Romer & Weil (1992) model augments human capital as a separate input in the basic Solow model and does not

imply unbounded growth. Fedderke (2002) referring to the work of Mankiw et. al(1992) reports that

> "introduction of human capital into the Solow model successfully enhances its explanatory power to such a degree as to preclude the necessity of resorting to endogenous growth models of either the Romer (1986) or (1990) variants"

Following the footsteps of Mankiw, Romer & Weil (1992) our theoretical model includes human capital as a third input in production function along with labour and capital. The basic production function is given by human capital augmented Solow model well illustrated by Mankiw, Romer & Weil (1992) and given below

$$\boldsymbol{Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)\, L(t))^{1-\alpha-\beta}} \qquad (\mathbf{2.4.1})$$

Where Y is representing output, K is physical capital, 'H' is human capital, L is labour and A is representing the level of technology. $\alpha + \beta$ is assumed to be less than 1 which indicates decreasing returns to human and physical capital. Labour and technology grow at exogenous rates and represented by textbook symbols n and g respectively.

$$\boldsymbol{L(t) = L(0)e^{nt}} \qquad \mathbf{(2.4.2)}$$

$$\boldsymbol{A(t) = A(0)e^{gt}} \qquad \mathbf{(2.4.3)}$$

Output can either be consumed, invested in physical capital or can be used to increase human capital. It is assumed that a constant fraction 's_k' is invested in physical capital while fraction s_h is devoted to human capital.

The capital accumulation process can be written as

$$\boldsymbol{\dot{K} = s_k Y(t) - \delta K(t)} \qquad \mathbf{(2.4.4)}$$

Where δ is denoting depreciation.

The human capital accumulation proposed by Mankiw, Romer and Weil (1992) assumes the same pattern as it is assumed for physical capital accumulation and is

illustrated by the following equation.

$$\dot{H} = s_h \mathbf{Y(t)} \; - \delta \mathbf{H(t)} \qquad \textbf{(2.4.5)}$$

The dynamics of the economy are represented by the following equations. Where y = Y/ AL , k = K/ AL and h = H/AL.

$$\dot{k}(t) = \mathbf{s_k y(t)} \; - (\mathbf{n + g + \delta})\mathbf{k(t)} \qquad \textbf{(2.4.6)}$$

$$\dot{h}(t) = \mathbf{s_h y(t)} \; - (\mathbf{n + g + \delta})\mathbf{h(t)} \qquad \textbf{(2.4.7)}$$

Steady state values are obtained by solving equation (2.4.6) and (2.4.7) and are listed below

$$\mathbf{k^*} = \left(\frac{s_k^{1-\beta} \, s_h^{\beta}}{n+g+\delta} \right)^{\frac{1}{1-\alpha-\beta}} \qquad \textbf{(2.4.8)}$$

$$\mathbf{h^*} = \left(\frac{s_k^{\alpha} \, s_h^{1-\alpha}}{n+g+\delta} \right)^{\frac{1}{1-\alpha-\beta}} \qquad \textbf{(2.4.9)}$$

By substituting steady-state values of k and h (i.e. equation 2.4.8 and 2.4.9) in production function (given by equation 2.4.1) and by taking logs the following equation for per capita income is derived.

$$\mathbf{ln} \left[\frac{Y(t)}{L(t)} \right] = \mathbf{ln\ A(0)} + \mathbf{gt} - \frac{\alpha+\beta}{1-\alpha-\beta} \mathbf{ln\ (n + g + \delta)} + \frac{\alpha}{1-\alpha-\beta} \mathbf{ln}(s_k) + \frac{\beta}{1-\alpha-\beta} \mathbf{ln}(s_h)$$

(2.4.10)

Equation (2.4.10) illustrates that per capita income depends not only on population growth and physical capital accumulation but also on human capital accumulation.

2.5 Econometric Methodology

In order to empirically test the above illustrated theoretical model, we will have to make certain assumptions about the proxy of human capital. it is difficult to get exact data about the share of output which is devoted to human capital i.e. to know the investment in human capital which is not only made by governments but by family and individuals themselves and also cost in form of foregone earnings which is low in case of a worker having low education and high in case of a worker having higher education (Mankiw, Romer and Weil, 1992). Keeping in view this difficulty most of the studies have used average years of schooling or percentage of the working-age population with secondary enrollments as a proxy of human capital (Barro, 1996, 2001; Mankiw, Romer and Weil, 1992). The current study used the number of employed persons with different education levels as a proxy for human capital. The following econometric model and methodology will be followed.

2.5.1 Univariate Analysis

The Augmented Dicky-Fuller (ADF) test is applied to examine the stationarity of variables used in the study. In stationary time series, shocks are temporary and with time, the series returns to its long-run average value. While in non-stationary time series there is a permanent component and its mean and variance depends on time. Consequently either the non-stationary time series has no long-run mean to which the series reverts or the variance depend on time and approaches infinity as time goes to infinity. The information about the nature of the series is important in deciding

estimation techniques. As in the case of non-stationary variables application of Ordinary Least Square method gives spurious results.

2.5.2 Autoregressive Distributed Lag Model (ARDL)

ARDL approach suggested by Pesaran and Shin (1999) and Pesaran et. al (2001) is deemed fit for data analysis. The advantages of the ARDL method are that it is capable of identifying cointegration irrespective of the order of variables being one or zero. It appropriately deals with the problem of serial correlation. It is capable of dealing with the problem of endogeneity of variables under consideration (Pesaran and Shin, 1999). It is consistent in the case of small samples (Pesaran and Shin, 1999; Narayan, 2005). It is not affected by the potential bias of the cointegration test or unit root test.

Therefore, the following ARDL model is used to analyse the data

$$\Delta y_t = \alpha + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_p_{t-i} + \sum_{i=0}^{mj} \beta_{ki}\, \Delta Z_{j,t-i} + \lambda_1 y_{t-1} + \lambda_2 k_{t-1} + \lambda_3 Edu_{t-1} + \lambda_j Z_{j,t-1} + \mu_t \quad [2.5.1]$$

$$\Delta y_t = \alpha + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_s_{t-i} + \sum_{i=0}^{mj} \beta_{ki}\, \Delta Z_{j,t-i} + \lambda_1 y_{t-1} + \lambda_2 k_{t-1} + \lambda_3 Edu_{t-1} + \lambda_j Z_{j,t-1} + \mu_t \quad [2.5.2]$$

$$\Delta y_t = \alpha + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_h_{t-i} + \sum_{i=0}^{mj} \beta_{ki}\, \Delta Z_{j,t-i} + \lambda_1 y_{t-1} + \lambda_2 k_{t-1} + \lambda_3 Edu_{t-1} + \lambda_j Z_{j,t-1} + \mu_t \quad [2.5.3]$$

Where:

y = real GDP per employed person

k = capital stock per employed person

Edu_p = Number of employed persons having primary education

Edu_s = Number of employed persons who have secondary education

Edu_h = Number of employed persons with higher education

Z_j = Set of j Control variables used in the model

Δ represents the first difference, *m* is the maximum number of lags included in the model and μ_t is the error term. Whereas, λ_i symbolizes parameters of the long-run relationship.

2.5.3 Cointegration Test / The Bounds Test

Cointegration describes the existence of an equilibrium relationship between two or more time series. The bounds testing approach proposed by Pesaran et al (1999) is used for testing the existence of the long-run relationship between non-stationary variables. The Bounds testing approach employs wald test to the parameters of one period lagged regressand and regressors in the ARDL equation. The test validates the existence of a long-run relationship if the calculated value is greater than the upper bound of the critical value. If the value falls below the lower bound then no long-run relationship is concluded. The test becomes inconclusive if the calculated F-value lies between upper and lower bounds.

2.5.4 Long Run Parameter Estimates

To deduce the long-run parameter estimates from the ARDL model the parameter estimates of lagged independent variables are divided by the estimate of lagged dependent variable and then each value is multiplied by -1. The resultant normalized vector shows the long-run coefficients.

2.5.5 Short-Run Dynamics

To show the short-run dynamics, the Error correction model (ECM) is estimated. ECM model contains the lagged error term of the long-run model and all independent variables in differenced form. The dependent variable of the model is the first difference

of real GDP per employed person. The short-run models are represented by the following equations.

$$\Delta y_t = \gamma + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_p_{t-i} + \sum_{j} \sum_{i=0}^{mj} \beta_{ji}\, \Delta Z_{j,t-i} + \delta\, ECM_{(-1)} + \nu_t \quad [2.5.4]$$

$$\Delta y_t = \gamma + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_s_{t-i} + \sum_{j} \sum_{i=0}^{mj} \beta_{ji}\, \Delta Z_{j,t-i} + \delta\, ECM_{(-1)} + \nu_t \quad [2.5.5]$$

$$\Delta y_t = \gamma + \sum_{i=1}^{m1} \beta_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m2} \beta_{2i}\, \Delta k_{t-i} + \sum_{i=0}^{m3} \beta_{3i}\, \Delta Edu\_h_{t-i} + \sum_{j} \sum_{i=0}^{mj} \beta_{ji}\, \Delta Z_{j,t-i} + \delta\, ECM_{(-1)} + \nu_t \quad [2.5.6]$$

Where ECM represents the residual of the long-run model calculated by the difference of estimated and actual values of y_t. ν_t is the error term. j is to list the control variables included in the model. m1, m2, m3, mj are the maximum no. of lags included of each variable. Δ is representing the first difference.

Note: The same models will be re-estimated for Agriculture, Industry and Services Sector. The methodology will be the same for each model. However, capital, output and education variable will represent the capital, output and education of the respective sector, and control variables will also be different.

2.5.6 Diagnostic Tests

Different diagnostic tests are applied to check the stability and validity of the estimated ARDL model. Breusch-Godfrey Serial Correlation LM test derived from Breusch (1978) and Godfrey (1978) is carried out to deduct serial correlation. To test heteroscedasticity, the ARCH test by Engle (1982) is used. Ramsey Reset test is employed to check if the model is correctly specified. The stability of the models are

checked by the cumulative sum of recursive residuals (CUSUM) and the CUSUM of squares test by Brown et al (1975) are applied.

2.5.7 Variables and Data

In order to execute the analysis time series data for the years, 1985-2018 is gathered on the following variables from the sources mentioned below.

(a) GDP per employed person

The dependent variable is the real GDP per employed person. The data is acquired from the World Bank's World Development Indicators.

(b) Educational levels

The main variable of this study the Education level is taken as the number of employed persons who have a specific level of education i.e. Primary, Secondary or Tertiary Education. Educational levels will be divided into four categories as used by Barro and Lee(2010).

i) No formal education

ii) Some primary education

iii) Some secondary education

iv) Some higher education

The data is gathered from various issues of the Labour Force Survey of Pakistan (LFS). It is important to mention here that all the data is available in data files of LFS so the data which was not printed in print form is acquired from data files e.g. education levels of employed persons in agriculture, industry and services sector.

(c) Control Variables

The control variables used in the study are foreign direct investment (FDI), the difference between the weighted average rate of return on advances and deposits (RS), inflation (INF), external debt (ED), exports of the overall economy, export of manufacturing sector and export of agriculture sector and credit to private sector(CPS). The data for interest rate both for advances and deposits are acquired from 'Handbook of statistics on Pakistan Economy' published by State Bank of Pakistan. The data on all other variables are attained from the World Bank's World Development Indicators. The data for agriculture sector-specific control variables Land, fertilizers, water, improved seed distribution is collected from 'Economic Survey of Pakistan'.

(d) Capital per employee

The data for capital per employee is generated through the method explained below based on the series of gross fixed capital formation. The gross fixed capital formation series is taken from the Economic Survey of Pakistan. The capital series is generated for the overall economy as well as for agriculture, industry and services sectors separately.

2.5.8 Construction of Capital Stock Series

The method proposed by Berlemann and Wesselhöft (2014) is followed to construct the capital stock series. The proposed method based on the Perpetual Inventory Method. However, it unifies three existing approaches Nehru and Dhareshwar (1993), De La Fuente and Domenech (2000) and KAMPS (2006) to have merits of all three. The method is briefly explained as under.

Step 1: Following Nehru and Dhareshwar (1993) the Initial value of the investment is derived by following the regression equation reported below

$$Ln\, I_t = \alpha + \beta t + \varepsilon_t \qquad [2.5.7]$$

complete investment series from period two (t_2) to T is used in estimation. Once the estimates of α and β are calculated. The value of an investment in time-period 1 is calculated by substituting t=1 in the equation. As the estimation utilized the logarithmic values of investment so the exponential value of α + β will give the investment in time-period 1.

Step 2: The second step is to find the growth rate of Investment. The method utilizes the value of β as a measure of the growth of investment.

Step 3: Following Kamps(2006), depreciation is considered as time-varying and not fixed.

After making these three modifications the method estimates the initial capital stock by the following formula

$$K_0 \approx \frac{I_1}{g_I + \delta} \qquad [2.5.8]$$

And then follows the perpetual inventory method

$$K_t = (1-\delta)^{t-1} K_0 + \sum_{i=0}^{t-1} (1-\delta)^i I_{t-(i+1)} \qquad [2.5.9]$$

Note: We in our study followed all the steps mentioned above except step 3 that suggests the use of time-varying depreciation rates, but due to the unavailability of depreciation rates for each year we used a fixed depreciation rate of 5%.

The capital stock for the agriculture, industry and services sector is also construed following the same procedure.

2.6 Results and Discussion

Section 2.6 reports and discusses the results comprehensively. In section 2.6.1, the results of unit root tests are registered. The second subsection illustrates the impact of different levels of education on the growth and output of the agriculture sector. The third and fourth sections are allocated for analysis of the impact of different levels of education on the Industry and Services sector respectively. The fifth subsection is reserved for analysis of the overall economy. While in the last subsection, the results of different sectors are compared.

2.6.1 Unit Root Test

In order to check the stationarity of variables, the Augmented Dicky Fuller test is employed. The results of ADF τ-statistics along with their p-values are stated in Table 2.1. It is found that all the variables used in the models for the overall economy, agriculture, industry and services are integrated of order 1 i.e. they are non-stationary at levels but stationary at first difference.

Table 2.1: Augmented Dickey-Fuller Test results

Variables	**Levels**		**First Difference**	
	ADF	**p-value**	**ADF**	**p-value**
Overall Economy				
Y	-1.5189	0.5113	-5.5019	0.0001
K	-0.6910	0.8350	-6.5593	0.0000
Primary Education	-1.8601	0.6514	-6.8798	0.0000
Secondary Education	-2.4019	0.3717	-6.2015	0.0000
Tertiary Educaton	-3.4225	0.0661	-6.7074	0.0000
FDI	-2.8995	0.0565	-3.7584	0.0077
RS	-1.3562	0.5914	-6.5675	0.0000
INF	-2.4796	0.1294	-7.0061	0.0000
ED	-0.6842	0.8371	-4.9215	0.0004
Exports	-0.6825	0.8376	-4.3999	0.0015
CPS	-1.3158	0.6104	-4.4556	0.0013

Variables	Levels		First Difference	
	ADF	p-value	ADF	p-value
Agriculture Sector				
Y	-2.3298	0.1692	-6.0502	0.0000
Output	-0.0761	0.9438	-6.2247	0.0000
K	-1.2897	0.8724	-5.4238	0.0001
Primary Education	-1.8041	0.6791	-6.7716	0.0000
Secondary Education	-2.7437	0.2271	-5.6277	0.0001
Tertiary Educaton	-1.2368	0.8853	-4.7779	0.0006
Land	-2.2917	0.1806	-8.3224	0.0000
Fertilizer	-0.1209	0.9387	-6.0584	0.0000
Water	-1.8803	0.6412	-8.3598	0.0000
Seed	-2.6586	0.2591	-14.4927	0.0000
Export_Agri	-0.4499	0.5122	-6.647544	0.0000
Industry				
Y	-1.9147	0.3216	-6.5728	0.0000
K	-1.0117	0.7370	-5.1166	0.0002
Primary Education	-0.9703	0.9339	-6.1951	0.0000
Secondary Education	-1.1989	0.8938	-6.1193	0.0000
Tertiary Educaton	-0.9972	0.7422	-6.5501	0.0000
Export(Manufacturing)	-1.3700	0.5848	-5.0407	0.0003
Services Sector				
Y	-1.7456	0.7070	-8.7591	0.0000
K	-2.4617	0.1339	-9.3439	0.0000
Primary Education	-0.2133	0.9269	-6.9893	0.0000
Secondary Education	-1.9917	0.5835	-5.3849	0.0001
Tertiary Educaton	-1.9382	0.6115	-6.1767	0.0000
Trade	-1.6478	0.4476	-6.8871	0.0000

* y and k represents output and capital per employed person respectively

2.6.2 Agriculture Sector

a) Agriculture Sector's Output per employed person as the dependent variable

The impact of educational levels on output per employed person of the agriculture sector is analyzed by considering the per employed person capital in the agriculture sector and the number of employees with primary, secondary and tertiary level of education along with land, fertilizer, improved seed distribution, water and exports of agriculture sector's products as control variables. A separate model for each level of education is fitted by utilizing the model explained in Section 2.5 and taking the natural log of each variable given in the model.

The results of the Bounds test for the model of each education level are reported in Table 2.2. The value of the F-bound test for models of primary, secondary and higher education lies in between lower and upper bound of related critical values even at a 10% level of significance. The test is inconclusive about the existence of a long-run relationship in all three cases. The results of long-run in case of models with output per employed person as the dependent variable are not reported because the F-bound test does not validate the existence of a long-run relationship.

Table 2.2: Bounds Test results

	Primary	**Secondary**	**Tertiary**
F-bounds test	2.841494	3.668981	2.235252

* Critical value for F-bound test are 2.73 and 3.90 at 1% level of significance

The results of the short-run effects of education levels on the output per employed person in the agriculture sector derived by fitting the ARDL model is given below in Table 2.3. The results show that capital per employed person has a significantly positive impact in the models estimated for primary, secondary as well as tertiary education.

The coefficients associated with the education levels are found negative in all three models. However, in the model where primary education is considered the coefficient is found insignificant, while in the case of secondary and tertiary education the coefficients are highly significant. The coefficients of control variables along with p-values are also reported in Table 2.3. The coefficients of land, fertilizer, seed, water and exports of agriculture product all have a positive sign in all three models for modelling the agriculture sector output per employed person with different education levels.

Table 2.3: Short-Run Impact of Education on Growth of Agriculture Sector in Pakistan

Variable	Primary	Secondary	Tertiary
Education	-0.149597 (0.1406)	-0.268610 (0.0226)	-0.145109 (0.0670)
K	0.782196 (0.0011)	0.391912 (0.1022)	0.249492 (0.1012)
Land	0.133457 (0.5575)	0.169806 (0.4661)	0.203712 (0.5529)
Fertilizer	0.088868 (0.3281)	0.132368 (0.2161)	0.116934 (0.2713)
Seed	0.045310 (0.1820)	0.139053 (0.0157)	0.017853 (0.6931)
Water	0.081016 (0.7857)	0.665697 (0.0572)	0.524766 (0.1897)
Exports_Agri	0.040790 (0.3513)	0.000550 (0.9899)	0.007061 (0.9116)
C	5.215370 (0.0060)	3.305193 (0.0704)	3.387593 (0.0356)

* p-values are reported in parenthesis

The results regarding the impact of different education levels on per employed person output of the agriculture sector are in contrast with what is generally expected but few

examples exist in literature exhibiting the negative impact of education on agriculture sectors output. For example, Oduro-Ofori et al. (2014) in a micro-level study of farmers found that average years of schooling have a negative but insignificant coefficient in the regression of agriculture output as the dependent variable. In addition, it was observed in the study that primary and secondary education have positive but tertiary education have a negative effect on output. Similarly, Lee (2012) tested the effect of higher education on the agriculture output of Japan and found that all major groups in higher education that is science, social sciences, humanities and education have a significant negative effect on the growth of agricultural output. Although few examples exist of finding the negative coefficient of education, the issue is further investigated and discussed in the subsequent section.

The summary of diagnostic tests to check the accuracy of the model is given in Table 2.4 given below. The model clarifies goodness of fit test, for the primary and secondary education model the value is 0.97 and for tertiary education, it is 0.91 which are fairly reasonable values to conclude that the fit is a good fit. Similarly, all three models clarify the serial correlation LM test, an ARCH test of heteroscedasticity, Ramsey Reset test and test for stability of models CUSUM and CUSUM of squares test.

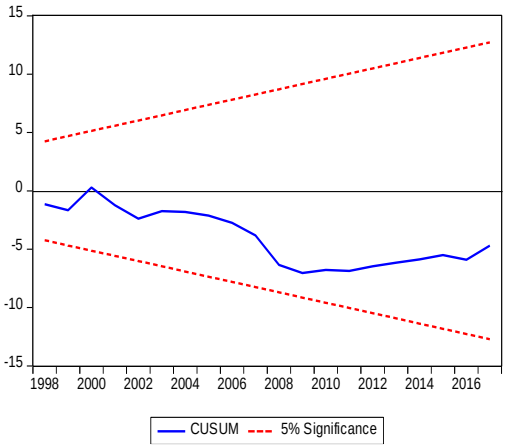
Table 2.4: Diagnostic Test Results

	Primary	**Secondary**	**Tertiary**
$\boldsymbol{R^2}$	0.97	0.97	0.91
Serial Correlation	0.374958 (0.5403)	2.829344 (0.1089)	0.272629 (0.6016)
Heteroskedasticity	0.963802 (0.5065)	1.550322 (0.1899)	0.659441 (0.7209)
Ramsey RESET Test	1.176395 (0.2917)	1.687570 (0.2095)	2.474942 (0.1299)

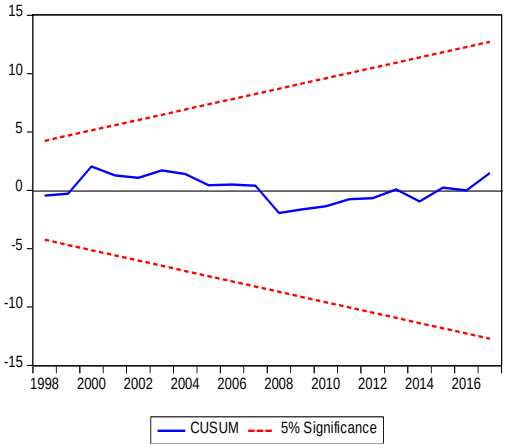
*p-values are given in parenthesis.

Results of CUSUM Test

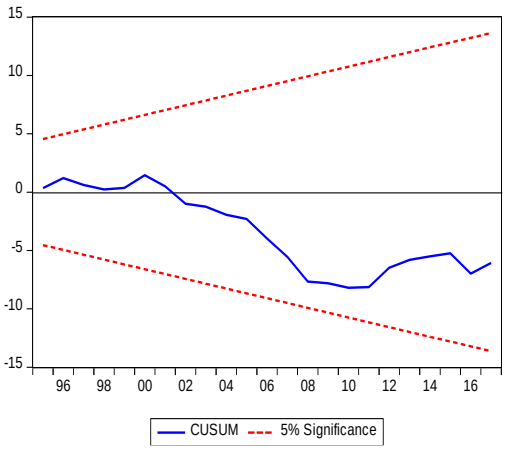
Primary Education



Secondary Education

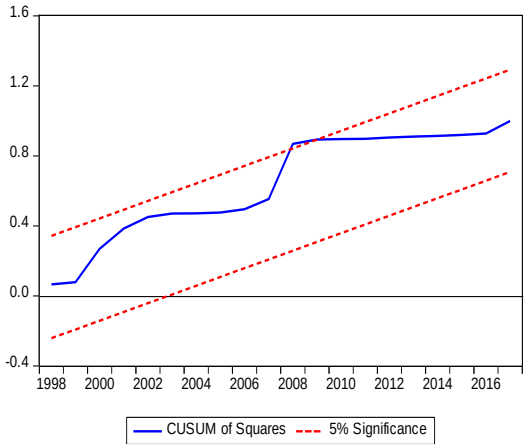


Tertiary Education

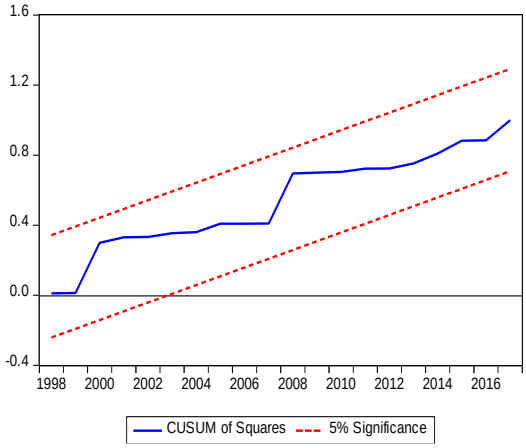


Results of CUSUM of Squares

Primary Education



Secondary Education



Tertiary Education

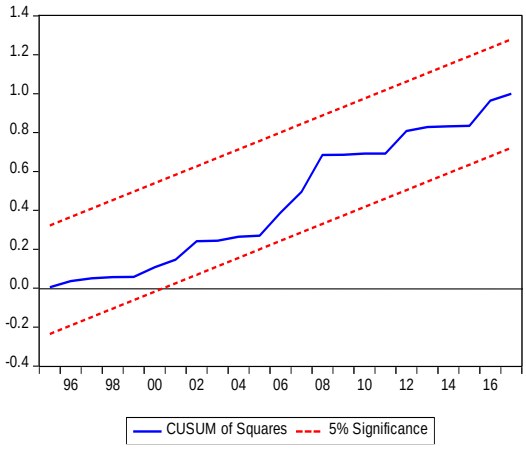


***Figure 2.1*:** Agricultural Sector

b) Agriculture Sector's Output as Dependent Variable

In order to further investigate the effect of different levels of education in the agriculture sector, the analysis is repeated by taking the output of the agriculture sector as a dependent variable instead of output per employed person and adding the persons employed as an explanatory variable in the model. It helps to find out if the negative relationship between education and output per employed person found in the preceding section is due to increased education or because of the surplus labour in the agriculture sector.

The results of the bounds test are reported in Table 2.5 below. F-bounds test confirms the existence of a long-run relationship in all the three models with different levels of education. The speed of adjustment coefficients are also reported in Table 2.5. The highest speed of adjustment is for the model with tertiary education taken into account, while the speed of adjustment in the case of primary and secondary education is are not very different from each other.

Table 2.5: Bounds Test results and Speed of Adjustment

	Primary	**Secondary**	**Tertiary**
F-bound test	5.093671	5.097568	7.789563
Speed of Adjustment	-0.542932 (0.0001)	-0.539645 (0.0001)	-0.962240 (0.0001)

* Critical value for F-bound test are 2.62 and 3.77 at 1 % level of significance. P values are given in parenthesis

The results of the long-run relationship between different levels of education and agriculture's sector output are presented in Table 2.6. Other variables included in the model are the capital series, generated for the agriculture sector based on gross fixed capital formation series of the agriculture sector, number of persons employed in the agriculture sector, land, fertilizer, seed, water and agriculture sector exports.

Table 2.6: Impact Of Education On Output Of Agriculture Sector In Pakistan (Long-Run)

Variable	Primary	Secondary	Tertiary
Education	0.015845	0.031673	0.097506
	(0.9345)	(0.8937)	(0.0854)
Capital	0.269164	0.274227	0.108617
	(0.0444)	(0.0555)	(0.2305)
Employment	-0.131292	-0.153764	-0.033281
	(0.7461)	(0.7324)	(0.8194)
Land	0.462884	0.473059	0.439196
	(0.2416)	(0.2474)	(0.0303)
Fertilizer	0.168229	0.161490	0.135417
	(0.2484)	(0.3111)	(0.0939)
Seed	0.114471	0.107215	0.148739
	(0.0470)	(0.1836)	(0.0003)
Water	0.499750	0.474214	0.895037
	(0.2428)	(0.3359)	(0.0003)
Exports_Agri	0.009942	0.013398	-0.003521
	(0.8920)	(0.8650)	(0.9214)
C	17.94870	18.16064	17.37172
	(0.0003)	(0.0007)	(0.0001)

*Estimation technique is ARDL, p-values are given in parenthesis.

The results show that primary, secondary and tertiary education all have positive coefficients in the model of output of the agriculture sector with different levels of education. However, the coefficient of education is significant only in the model with tertiary level of education. The impact of capital is found positive in all the three models where it is found significant in the case of primary and secondary education but found insignificant in the model with tertiary level of education. The employment variable has a negative sign in all three models, pointing towards surplus labour in the agriculture sector. The results of control variables land, fertilizer, water, seed and agriculture sector export are also reported in Table 2.6. All the control variables appear

to have positive signs in the model with primary and secondary education, however, the p-values show that most of the coefficients are insignificant. In a model with education taken as the tertiary level of education all other variables i.e land, fertilizer, seed and water appear as significant and positive determinants of agriculture sector output except agriculture sectors export which is found highly insignificant.

Table 2.7: Impact Of Education On Output Of Agriculture Sector In Pakistan (Short-Run)

Variable	Primary	Secondary	Tertiary
Education	0.008603 (0.9341)	0.017092 (0.8923)	0.093824 (0.0993)
Capital	0.146138 (0.0709)	0.147985 (0.0079)	0.104516 (0.2493)
Employment	-0.071283 (0.7393)	-0.082978 (0.7233)	-0.032024 (0.8194)
Land	0.251315 (0.2671)	0.255284 (0.2650)	0.422612 (0.0515)
Fertilizer	0.091337 (0.2832)	0.087147 (0.3515)	0.130303 (0.1034)
Seed	0.062150 (0.1100)	0.057858 (0.2675)	0.074639 (0.0276)
Water	0.271330 (0.3095)	0.255907 (0.3980)	0.313988 (0.1975)
Exports_Agri	0.005398 (0.8911)	0.007230 (0.8630)	-0.003388 (0.9217)
C	9.744930 (0.0090)	9.800301 (0.0093)	16.71576 (0.0003)

*Estimation technique is ARDL, p-values are given in parenthesis.

Table 2.7 reports the results of the impact of different levels of education in the short run for the agriculture sector in Pakistan. The dependent variable is the output of the agriculture sector and the determinants used in the analysis are education, capital, employment, land, fertilizer, seed, water and exports of the agriculture sector. It is

found that the education variable has a positive coefficient in the case of the primary, secondary and higher level of education. The coefficient of capital which represents the capital stock of the agriculture sector also has a positive value in all three cases. While, in all three cases, the coefficients of the employment variable representing the number of persons employed in agriculture have negative values. It is found that in the case of models with primary and secondary education, the capital variable is positive and highly significant but the education variable has a positive coefficient but appeared insignificant in the model. While in the case of tertiary education the education variable has a positive and significant coefficient but the capital variable despite having a positive value appeared to be insignificant. Table 2.7 also reports the results of land, fertilizer, seed, water and exports of agriculture along with the p-values.

The results of diagnostic tests are presented in Table 2.8. All three models clarify the goodness of fit test. Similarly, the results of the serial correlation LM test and ARCH test for heteroscedasticity shows that the problem of heteroscedasticity and autocorrelation does not exist in all three models. Ramsey Reset test results are also showing that the models are adequately specified. While the test for stability of the models CUSUM and CUSUM of squares test are also reported and they show that the models are stable.

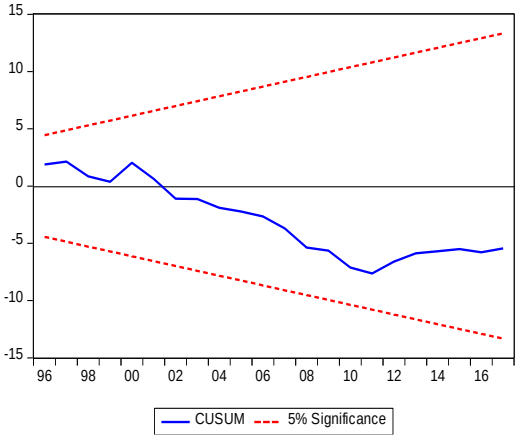
Table 2.8: Diagnostic Test Results

	Primary	**Secondary**	**Tertiary**
$\boldsymbol{R^2}$	0.99	0.99	0.99
Serial Correlation	2.762678	2.769776	0.420900
	(0.1113)	(0.1109)	(0.5165)
Heteroskedasticity	2.151098	2.554386	0.940793
	(0.1425)	(0.1100)	(0.3321)
Ramsey RESET Test	1.158977	1.134694	0.375970
	(0.2939)	(0.2989)	(0.5470)

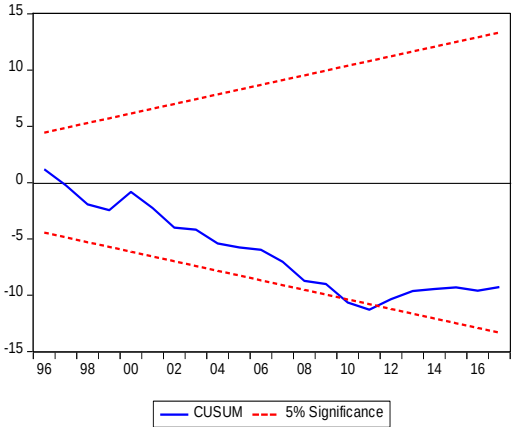
* p-values are listed in parenthesis.

Results of CUSUM Test

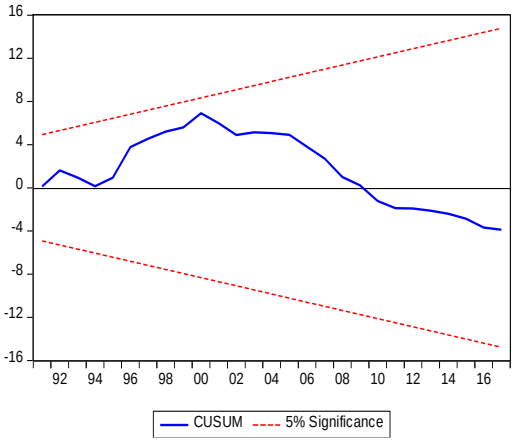
Primary Education



Secondary Education

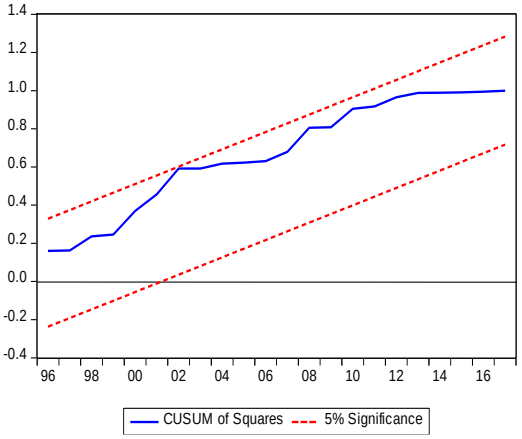


Tertiary Education

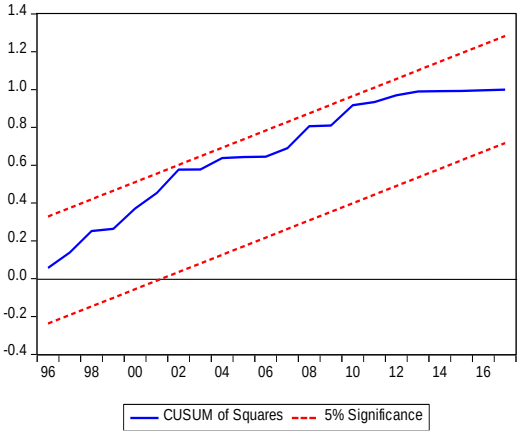


Results of CUSUM of Squares Test

Primary Education



Secondary Education



Tertiary Education

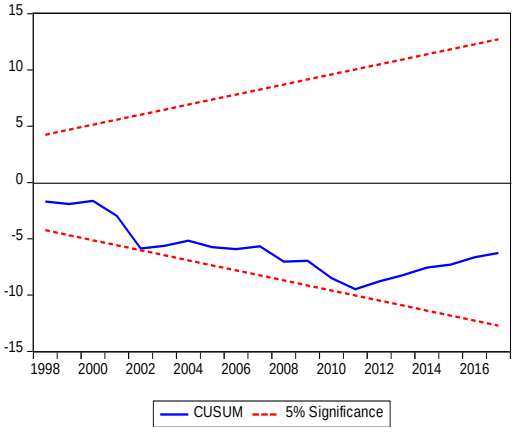


Figure 2.2: Agriculture Sector (Output)

Summing up, the analysis of the role of different levels of education in the agriculture sector of Pakistan shows that when the effect is analyzed on output per employed person of the agriculture sector, education appears to have a negative impact in all three cases. However, the issue is investigated further by taking agriculture's sector output as the dependent variable and including the number of employed persons as a determinant in the model along with other variables. It is then found that the education variable taken in all three different levels appear to have a positive coefficient on agriculture's sector output model. Moreover, the employment variable also has negative coefficients in the models of all three levels of education. Hence the results point towards the well known 'surplus labour' phenomena of developing countries in the agriculture sector.

2.6.3 Industrial Sector

The role of different levels of education on output per employed person of the industrial sector is also analyzed by utilizing the ARDL method and equations described in section 2.5. The results of the bounds test are reported in Table 2.9. It is found that the calculated value of bounds test F-statistic is higher than the upper bound of critical values for all the three models that could be differentiated based on levels of education. Thus it verifies the existence of a long-run relationship for all the three models of output per person employed in the industrial sector.

Table 2.9: Bounds Test results and Speed of Adjustment

	Primary	**Secondary**	**Tertiary**
F-bound test	6.567579	7.453945	5.255022
Speed of Adjustment	-0.536718 (0.0000)	-0.647483 (0.0000)	-0.454918 (0.0000)

* Critical value for F-bound test are 2.79 and 4.10 at 1% level of significance

Table 2.10 reports the impact of education levels on output per employed person in the industrial sector in levels or the long run. The model also includes the industrial sector's capital per employed person (generated by utilizing GFCF series of the industrial sector), foreign direct investment, credit to the private sector, the difference between the weighted average of returns on advance and deposits, external debt and exports of the manufacturing sector as a proxy of exports of the industrial sector as explanatory variables in the model.

Table 2.10: Impact Of Education On Output per employee in the Industrial Sector (Long-Run)

Variable	Primary	Secondary	Tertiary
Education	0.411362 (0.0008)	0.236865 (0.0020)	0.034676 (0.7134)
k	0.454421 (0.0749)	1.049690 (0.0001)	1.479203 (0.0001)
FDI	-0.001219 (0.9611)	0.030322 (0.1802)	0.032754 (0.3692)
CPS	0.014428 (0.1161)	-0.000235 (0.9634)	-0.005951 (0.4177)
RS	-0.018721 (0.2093)	-0.040559 (0.0002)	-0.052690 (0.0022)
INF	0.003494 (0.1769)	0.005145 (0.0694)	0.003319 (0.4525)
ED	-0.006455 (0.0230)	-0.005456 (0.0426)	-0.011196 (0.0062)
Export (Manufacturing)	0.011988 (0.3221)	0.000797 (0.9403)	-0.012751 (0.4334)

* p-values are given in parenthesis.
* k is capital per employed person in the industrial sector

The results show that the coefficients of each level of education are positive in a model of industrial sector output per employed person. The coefficient is greater in the case of primary education followed by the coefficient of education in the case of secondary education as a proxy. The coefficient is found significant in both models. However, in the model where tertiary education is used as a proxy for human capital the coefficient is found insignificant. The capital per employed person is found highly significant and positive in all the models. A deeper look at the results shows that combining a higher level of education with capital makes the capital more productive. The coefficient of per employed person capital in a model with secondary education is higher than its coefficient in the model of primary education. Similarly, the coefficient is higher in the model with tertiary education as compared to primary and secondary education. In conclusion, it is evident from the results that an increased level of education makes capital more productive and the overall impact on output per employed person will be higher in case of an increase of the higher level of education as compared to the lower levels of education. The results of other variables that are included as control variables are also reported in Table 2.10.

Speed of adjustment coefficients are also reported in Table 2.9. The results show that 53% of deviations from long-run equilibrium are adjusted in the model with primary education, in the case of secondary education 64% of deviations get corrected during a year and for tertiary education, the annual corrections are 45%.

The results of the impact of different levels of education on the growth of industrial output per employed person in the short-run are stated in Table 2.11. The coefficients of education in the model for primary, secondary and tertiary education are found positive. However, it is found insignificant in the case of tertiary education. The

coefficient values show that a 1% increase in the number of people employed in the industrial sector with primary education will increase the output per employed person by 0.22%. and a 1% increase in capital per employed person in the same model will increase the output per employed person by 0.87%. The results of the model with secondary education as human capital proxy show that 1% increase in people employed in the industrial sector with a secondary level of education will increase the output per employed person by 0.15% and mixed with this level of education a 1% increase in capital will increase the output by 0.67% in the short run.

Table 2. 11: Impact of education on the growth of the Industrial Sector in Pakistan (Short-Run)

Variable	Primary	Secondary	Tertiary
Education	0.220785 (0.0003)	0.153366 (0.0169)	0.015775 (0.7274)
k	0.871617 (0.0001)	0.679657 (0.0001)	0.672916 (0.0001)
FDI	-0.000654 (0.9607)	0.019633 (0.1980)	0.014900 (0.3956)
CPS	0.007744 (0.0234)	-0.000152 (0.9635)	-0.002707 (0.4542)
RS	-0.010048 (0.1871)	-0.026261 (0.0001)	-0.023970 (0.0009)
INF	0.001875 (0.2639)	0.003331 (0.1015)	0.001510 (0.4758)
ED	-0.003465 (0.0131)	-0.003533 (0.0271)	-0.005093 (0.0032)
Export (Manufacturing)	0.006434 (0.2548)	0.000516 (0.9403)	-0.005801 (0.4374)

* p-values are given in parenthesis

* k is capital per employed person in the industrial sector

It is found that in the industrial sector in the short run primary education is contributing more to the output per employed person of the sector. In the model with tertiary education as a proxy for human capital the coefficient of tertiary education is found insignificant, implying that the data does not support the active role of tertiary education in increasing the per employed person output. Liu and Armer (1993) reported a significant and positive impact of primary and junior high school education on the output of the overall economy in Taiwan, while senior high school and tertiary education were found insignificant in explaining output growth. The model results for tertiary education as a proxy for human capital is pointing towards the developing country phenomenon where the lower levels of education are more effectively contributing as compared to the tertiary level of education because of its underutilization.

The results of diagnostic tests to check the fitness and reliability of the model are reported in Table 2.12 given below. The results of the goodness of fit test for all three models are fairly good. All the R^2 values are equal to or higher than 0.95. The test for serial correlation also rejects the possibility of autocorrelation in all models. Results of the heteroscedasticity test confirm that there is no heteroscedasticity in the models. While results of the Ramsey Reset test and CUSUM and CUSUM square tests are also reported and they confirm that the models are well-specified and stable.

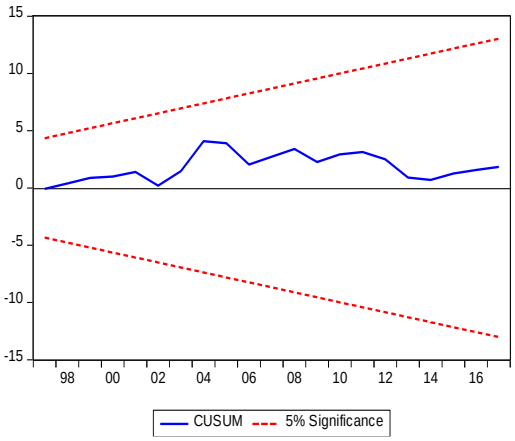
Table 2.12: Diagnostic Test Results

	Primary	**Secondary**	**Tertiary**
$\boldsymbol{R^2}$	0.98	0.96	0.95
Serial Correlation	0.002395	0.095054	0.645253
	(0.9610)	(0.7578)	(0.4218)
Heteroskedasticity	1.465420	0.423245	0.390103
	(0.2261)	(0.5153)	(0.5322)
Ramsey RESET Test	1.061815	0.291053	0.556117
	(0.3151)	(0.5950)	(0.4637)

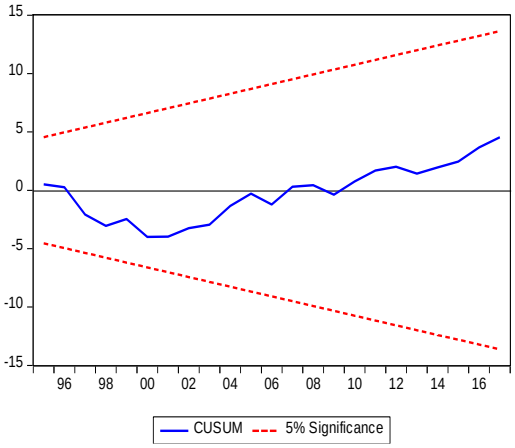
*The table represents χ^2 values along with p-values in parenthesis.

Results of CUSUM Test

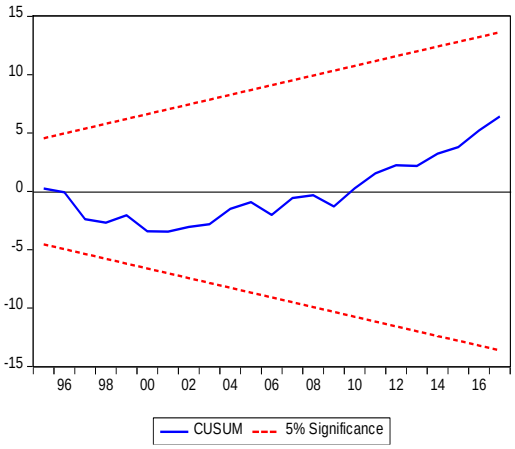
Primary Education



Secondary Education

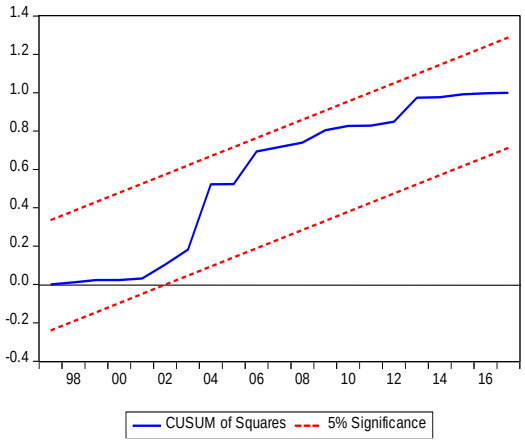


Tertiary Education

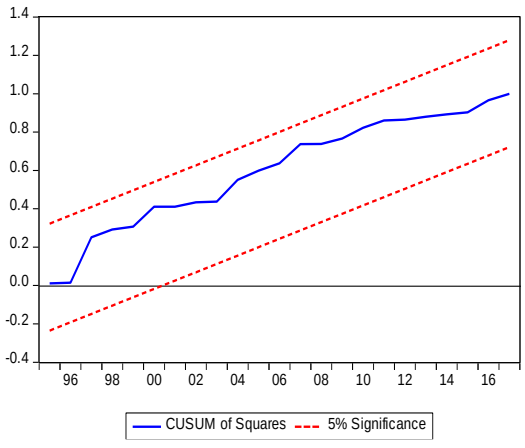


Results of CUSUM Squares Test

Primary Education



Secondary Education



Tertiary Education

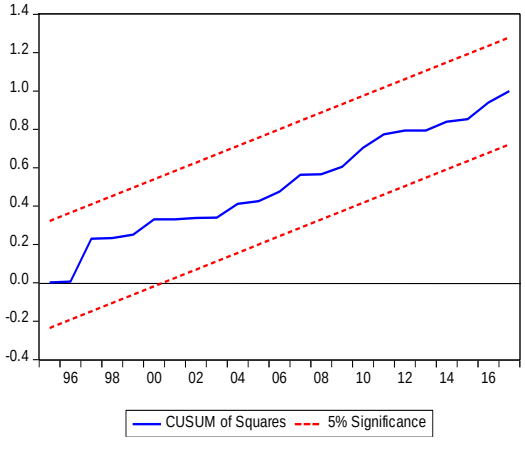


***Figure 2.3*:**Industrial Sector

2.6.4 Services Sector

The results of the analysis of services sector output per employed person are reported in this section. The methodology adopted is the same as for other sectors or the overall economy. ARDL model is fitted for each level of education separately following the general to a specific technique of variable selection. The results of the bounds test and the speed of adjustment coefficient are reported in Table 2.13 given below.

Table 2.13: Bounds Test results and Speed of Adjustment

	Primary	**Secondary**	**Tertiary**
F-bound test	8.197842	8.751988	8.418333
Speed of Adjustment	-0.483860 (0.0000)	-0.718406 (0.0000)	-0.584663 (0.0000)

* Critical value for F-bound test are 2.79 and 4.10 at 1% level of significance. p-values are given in parenthesis for speed of adjustment

The F-bound test results confirm the existence of a long-run relationship between education and output per employed person in the services sector in all three cases. The existence of the long-run relationship is confirmed even at a 1% level of significance. Speed of adjustment coefficients shows that the highest speed of adjustment is in the case of secondary education where 71% of deviations from long-run are corrected in one year, followed by 58% for the tertiary level of education and 48% for the primary level of education.

The results of the impact of different levels of education on output per employed person in the services sector in the long-run are illustrated in Table 2.14. The education variable in all three cases; whether it is proxied by the primary, secondary or tertiary level of education is found positive and significant. It implies that an increase in education in the services sector increases the output per employed person. The coefficients of capital per employed person are also positive and significant in all three models. It could be

seen that the coefficient of capital increases as it is mixed with a higher level of education, which means that a higher education level increases the productivity of capital. It implies that changes in output per employed person will be higher if a higher level of education is combined with capital. The results of the control variables in the model are also reported in Table 2.14.

Table 2.14: Impact Of Education On Output per employee of Services Sector (Long-Run)

Variable	Primary	Secondary	Tertiary
Education	0.322997 (0.0001)	0.300007 (0.0001)	0.166509 (0.0001)
k	0.326675 (0.0048)	0.958221 (0.0001)	1.242560 (0.0001)
FDI	0.017185 (0.0284)	0.008182 (0.4853)	0.008000 (0.5839)
RS	-0.011215 (0.0010)	-0.012319 (0.0132)	-0.007629 (0.1688)
ED	-0.003066 (0.0166)	-0.004349 (0.0001)	-0.006880 (0.0001)
INF	0.001300 (0.2701)	-0.002292 (0.1912)	-0.001956 (0.3647)
Trade	-0.009127 (0.0009)	-0.001452 (0.5408)	-0.003824 (0.1959)
CPS	-0.004821 (0.0054)	0.000918 (0.7430)	0.001505 (0.6705)

*Estimation technique is ARDL, p-values are given in parenthesis.

The results of the short-run effects of education levels on output per employed person of the services sector are summarized in Table 2.15. The coefficient of education variable is found to be significant and positive in all three models, showing that all the three levels of education entering into separate models as a proxy for human capital

have a positive and statistically significant impact. Similarly, the coefficient of per employed person capital is statistically significant and positive in all the three models of different education levels. It is found that in the short run the highest impact on output per employed person of the services sector is of secondary education as compared to primary and tertiary education. The coefficient of capital per employed person is positive and significant in all the three models of output per employed person of the services sector in the short run. The results of the control variables are also reported in Table 2.15.

Table 2.15: Impact Of Education On Growth Of Services Sector In Pakistan (Short-Run)

Variable	Primary	Secondary	Tertiary
Education	0.112493 (0.0304)	0.215527 (0.0001)	0.097352 (0.0001)
k	0.832566 (0.0001)	0.688392 (0.0001)	0.726478 (0.0001)
FDI	0.008315 (0.0641)	0.005878 (0.4841)	0.004677 (0.5838)
RS	-0.005426 (0.0036)	-0.008850 (0.0213)	-0.004460 (0.1728)
ED	-0.001484 (0.0107)	-0.003124 (0.0003)	-0.004022 (0.0001)
CPS	-0.002332 (0.0201)	0.000660 (0.7407)	0.000880 (0.6654)
INF	0.000629 (0.2914)	-0.001647 (0.1854)	-0.001144 (0.3564)
TRADE	-0.000247 (0.7883)	-0.001043 (0.5385)	-0.002236 (0.1976)
c	2.669612 (0.0040)	3.149972 (0.1190)	--------

* p-values are given in parenthesis.

The results of diagnostic tests are shown in Table 2.16. All three models have significantly high values for the goodness of fit test. The results of the serial correlation LM test shows that the problem of autocorrelation does not exist in all three models, an ARCH test of heteroscedasticity shows that the problem of heteroscedasticity does not exist. Ramsay Reset test of is passed all the models. The stability of parameters are checked by CUSUM and CUSUM of squares test and all the models qualify these tests.

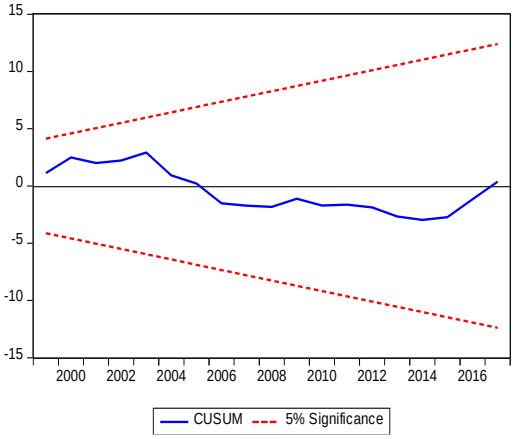
Table 2.16: Diagnostic Test Results

	Primary	**Secondary**	**Tertiary**
$\boldsymbol{R^2}$	0.99	0.99	0.98
Serial Correlation	1.479604 (0.2238)	2.817507 (0.1088)	2.139528 (0.1591)
Heteroskedasticity	0.348786 (0.5548)	0.016674 (0.8973)	0.5324 (0.4656)
Ramsey RESET Test	0.261890 (0.6150)	2.521951 (0.1280)	0.670621 (0.4225)

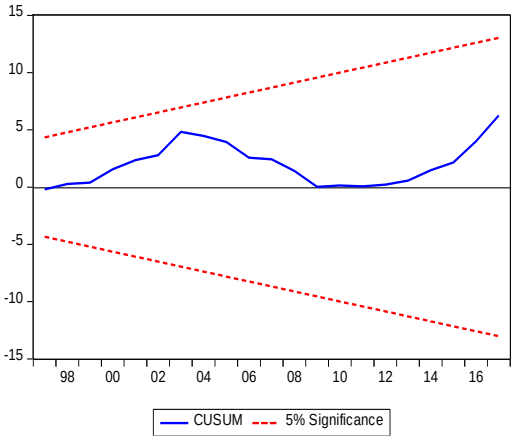
*The table represents χ^2 values along with p-values in parenthesis.

Results of CUSUM Test

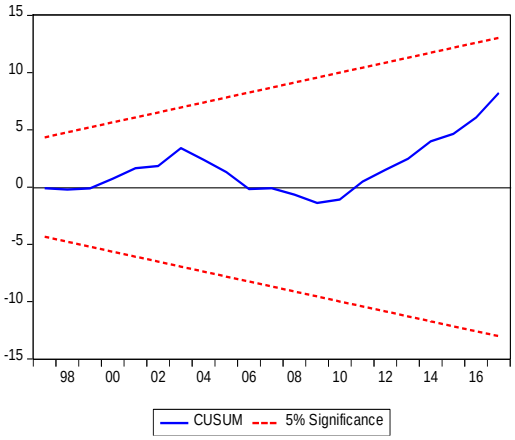
Primary Education



Secondary Education

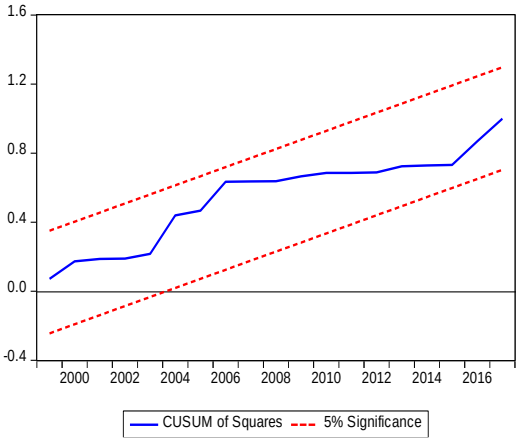


Tertiary Education

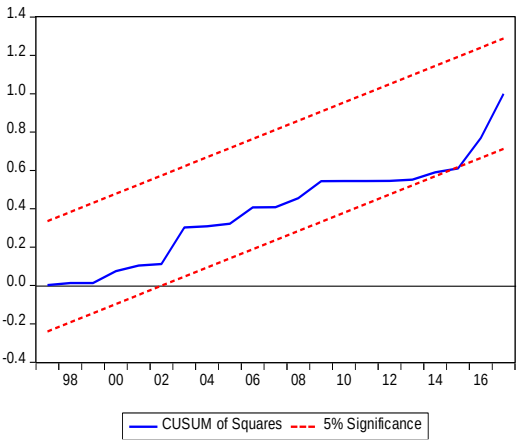


Results of CUSUM of Squares Test

Primary Education



Secondary Education



Tertiary Education

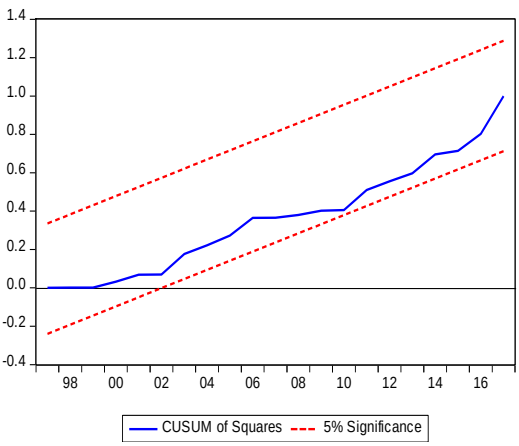


Figure 2.4: Services Sector

2.6.5 Overall Economy

The results for the inquiry of the impact of different levels of education on the economic growth of Pakistan is reported and discussed below. A separate ARDL model is estimated for each level of education. In addition to capital per employee and education variable foreign direct investment (FDI), the difference between the weighted average rate of return on advances and deposits (RS), inflation (INF), external debt (ED, exports and credit to the private sector(CPS) are also included in the model. The coefficient estimates of the bounds tests are summarized in Table 2.17. The results show that the F-bound test value in the models for primary, secondary and higher education as a proxy for human capital falls above the upper bound at a 5% level of significance. Hence F-bound test validates the existence of a long-run relationship. Speed of adjustment coefficients are also listed in Table 2.17. The highest speed of adjustment is in the case of primary education and its value shows that 46% of deviation is corrected during a year. For tertiary education, the speed of adjustment is 39% while for secondary education it is 33%.

Table 2.17: Bounds Test results and Speed of Adjustment

	Primary	**Secondary**	**Tertiary**
F-bound test	5.26	3.68	4.09
Speed of adjustment	-0.4666 (0.0000)	-0.3367 (0.0000)	-0.3989 (0.0000)

* Critical value for F-bound test are 2.22 and 3.39 at 5% level of significance. p-values are given in parenthesis for speed of adjustment.

The results of the impact of different levels of education on the economic growth of Pakistan in the long-run are reported in Table 2.18. The impacts of the primary, secondary and higher level of education are found positive and highly significant for the overall economy in the long-run. The coefficients of capital per employed person are also positive and highly significant in all three models. The highest coefficient of

education variable is in the case of primary education, followed by secondary education and then for tertiary education. However, if we also take the coefficients of capital per employed person into consideration, it could be seen that the coefficient of capital per employee is highest in the model with secondary education. So the impact of the sum of education and the capital variable is highest in the case of secondary education, followed by primary education and then by tertiary education.

Table 2.18: Impact of different levels of education on Economic growth of Pakistan (Long-Run)

Variable	Primary	Secondary	Tertiary
Education	0.447095 (0.0001)	0.277853 (0.0126)	0.233058 (0.0014)
Capital	2.009052 (0.0011)	2.234842 (0.0353)	1.857573 (0.0220)
FDI	0.053494 (0.0044)	0.057543 (0.0442)	0.059541 (0.0116)
RS	-0.033272 (0.0134)	-0.039448 (0.0752)	-0.029917 (0.0731)
INF	-0.000968 (0.6616)	-0.002478 (0.4776)	-0.002072 (0.4651)
ED	-0.001842 (0.4605)	-0.005821 (0.1972)	-0.005278 (0.1138)
Exports	0.002852 (0.6383)	0.006079 (0.5293)	0.003098 (0.6878)
CPS	-0.007413 (0.0651)	-0.008804 (0.2006)	-0.007070 (0.1987)

* p-values are given in parenthesis.

The results of the control variables in the model are also listed in Table 2.18. The impact of foreign direct investment is positive and significant in all three models. The effect of the variable 'RS' which is showing the difference in the weighted average rate of return

on advances and deposits is found negative and significant. It means that if this spread is lower, that will mean the loans are available at lower rates and savings are encouraged by higher returns, then the output per employed person will be higher. Similarly, if the spread between returns on advances and deposits are high, meaning that loans are available at higher rates while the returns on savings are low, in this case, the output per employed person will be low. Similarly, the coefficient of the inflation variable is found to be negative in all three models but they are found insignificant. The impact of external debt is also negative in every model but the parameters are found insignificant. Exports coefficients are positive while the credit to private sector appears as having a negative effect on the output per employed person in the long run.

The results of the impact of different levels of education on output per employed person in the overall economy are presented in Table 2.19. The results show that all three education levels have a positive and significant effect on the economic growth of the overall economy in the short-run. The highest coefficient in the short-run is for primary education, then for secondary education and then tertiary education. Capital per employed person also has a positive and highly significant impact in the short run. The coefficient of capital is higher in the model of primary education and almost the same in the model with secondary and tertiary education. The foreign direct investment variable is positive and is highly significant in all three models of the overall economy in the short-run as well. The interest rate spread showing the difference between the rate of return on advances and deposits have a significant and negative effect. It implies that if the spread is low, meaning that loans are easily available and savings get higher returns, then it will increase output per employed person in the overall economy in the short run. The inflation variable has a negative sign in all three equations but is found insignificant. External debt also has a negative effect in all the three models and is

significant in model with secondary and tertiary education and is found insignificant in model with primary education. The coefficients of Export are found positive in all three equations but the parameter estimates are found insignificant. The coefficient of CPS appeared to have a negative sign in the model with having insignificant coefficients in the model of secondary and tertiary education.

Table 2.19: Impact of different levels of education on Economic growth of Pakistan (Short-Run)

Variable	Primary	Secondary	Tertiary
Education	0.208598 (0.0066)	0.093551 (0.1165)	0.092971 (0.0500)
Capital	0.937347 (0.0001)	0.752456 (0.0007)	0.741017 (0.0005)
FDI	0.024958 (0.0156)	0.019374 (0.0773)	0.023752 (0.0375)
RS	-0.015524 (0.0009)	-0.013282 (0.0080)	-0.011935 (0.0073)
INF	-0.000452 (0.6571)	-0.000834 (0.4663)	-0.000827 (0.4556)
ED	-0.000859 (0.4182)	-0.001960 (0.0758)	-0.002106 (0.0364)
Exports	0.001331 (0.6378)	0.002047 (0.5387)	0.001236 (0.6880)
CPS	-0.003459 (0.0762)	-0.002964 (0.1776)	-0.002820 (0.1846)
C	-9.593674 (0.0005)	-6.966131 (0.0095)	-5.924245 (0.0229)

*Estimation technique is ARDL, p-values are given in parenthesis.

Table 2.20 shows the diagnostic test results for the models for primary, secondary and tertiary level of education as a proxy for human capital.

Table 2.20: Diagnostic Test Results

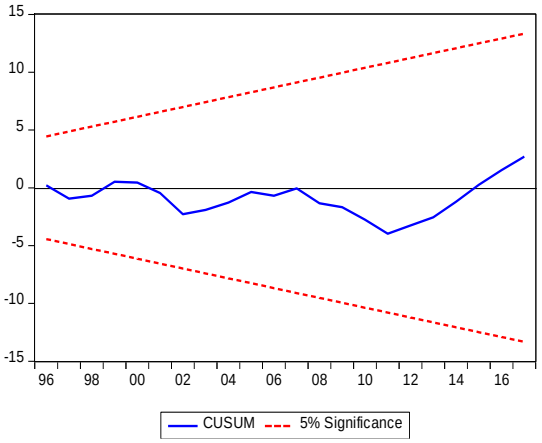
	Primary	**Secondary**	**Tertiary**
R^2	0.982	0.977	0.979
Serial Correlation	0.0000532 (0.9942)	0.103105 (0.7481)	0.713092 (0.3984)
Heteroskedasticity	1.412948 (0.2346)	0.679400 (0.4098)	0.419914 (0.5170)
Ramsey RESET Test	0.859234 (0.3645)	0.717925 (0.4064)	1.028599 (0.3220)

* p-values are given in parenthesis.

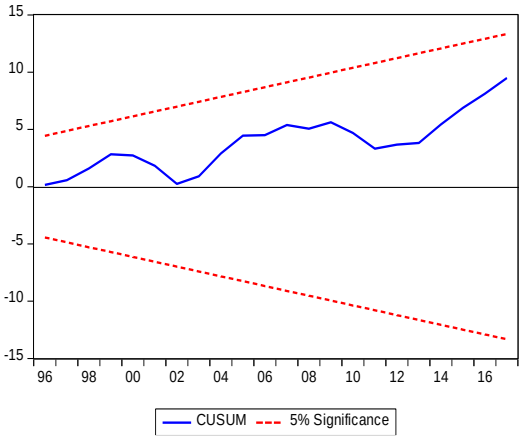
The goodness of fit test shows fairly high values for all three models. The Breusch-Godfrey Serial Correlation LM test confirms that the problem of autocorrelation does not exist in the models. Similarly, all the models clarify the heteroscedasticity test and confirm that there is no heteroscedasticity. The Ramsey Reset test results also show that the models are correctly specified. The test of CUSUM and CUSUM of square tests also show that there is no problem with the stability of the model. The graphs of both tests are given below.

Results of CUSUM Test

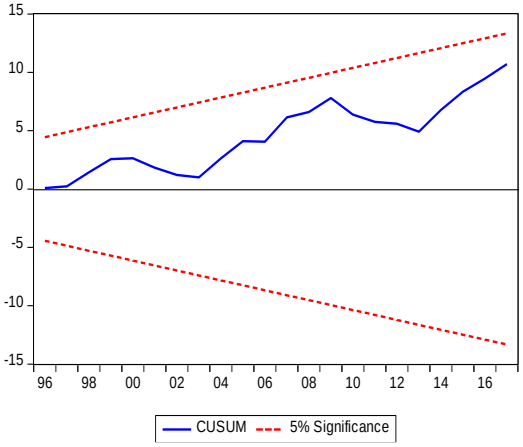
Primary Education



Secondary Education

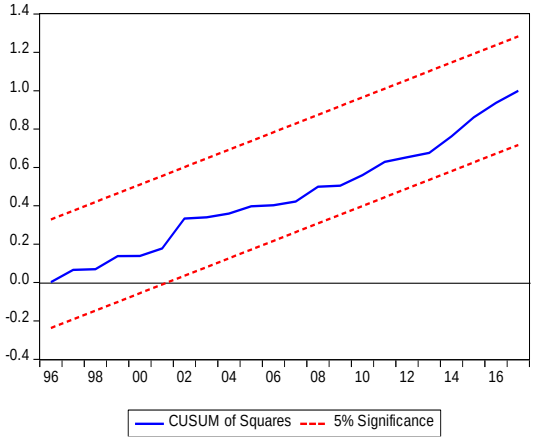


Tertiary Education

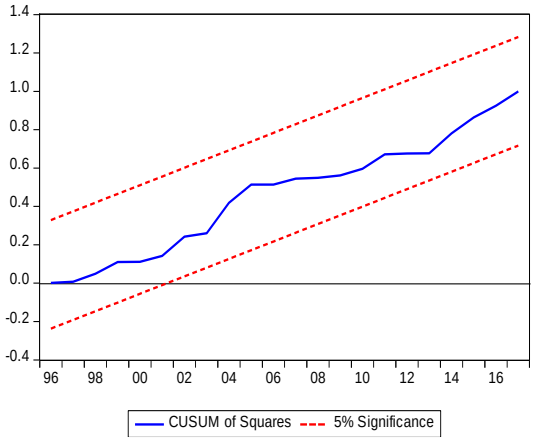


Results of CUSUM of Squares Test

Primary Education



Secondary Education



Tertiary Education

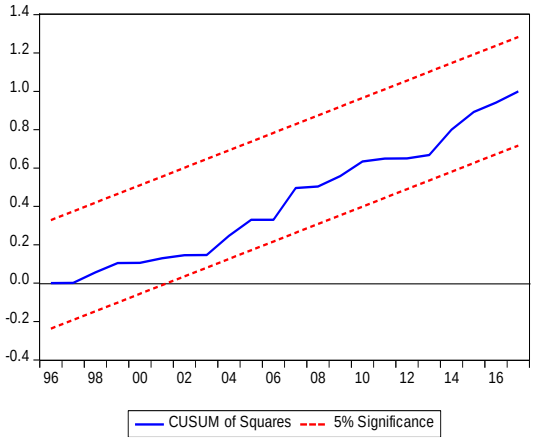


Figure 2.5: Overall Economy

2.6.6 Comparison of major sectors and the overall economy

The comparison of coefficients of different education levels across sectors and with the overall economy gives an important insight into the role of different education levels in the economy of Pakistan. The results of long-run relationship across sectors and for the overall economy are summarized in Table 2.21.

Table 2.21: Comparison Different Sectors And Overall Economy (Long-Run)

Variable	Primary	Secondary	Tertiary
Overall Economy	0.447095 (0.0001)	0.277853 (0.0126)	0.233058 (0.0014)
Agriculture Sector	Bounds test results show that long-run relationship doesn't exist		
Industry	0.411362 (0.0008)	0.236865 (0.0020)	0.034676 (0.7134)
Services Sector	0.322997 (0.0001)	0.300007 (0.0001)	0.166509 (0.0001)
Agriculture Sector (output)	0.015845 (0.9345)	0.031673 (0.8937)	0.097506 (0.0854)

*p-values are given in parenthesis.

The comparison of the coefficients of Primary education as a proxy for human capital across different sectors in the economy shows that primary education is best utilized in the industrial sector. Whereas, secondary education is best deployed in the services sector. The comparison of the coefficients of secondary education across different sectors of the economy shows that the services sector has the highest value for the coefficient. Similarly, the comparison of the coefficients of tertiary education shows that in the long-run the best utilization of tertiary education is also in the services sector. In the services sector, the coefficient of the tertiary level of education is highest and is most significant as compared to other sectors. In the industrial sector, although the

coefficient has a positive value but it is low and is also highly insignificant. Pointing out the inefficient utilization of the tertiary level of education in the industrial sector. In the case of the agriculture sector when output per employed person is taken as a dependent variable the results negate the existence of a long-run relationship. However, in the model for the output of the agriculture sector, the effect of tertiary education is found to be significant and positive. Yet, this positive effect is lower than the effect of tertiary education in the services sector.

The results of the impact of different levels of education on output per employed person in the short run are combinedly presented in Table 2.22.

Table 2.22: Comparison Different Sectors and Overall Economy (Short-Run)

Variable	Primary	Secondary	Tertiary
Overall Economy	0.208598 (0.0066)	0.093551 (0.1165)	0.092971 (0.0500)
Agriculture Sector	-0.149597 (0.1406)	-0.268610 (0.0226)	-0.145109 (0.0670)
Industrial Sector	0.220785 (0.0003)	0.153366 (0.0169)	0.015775 (0.7274)
Services Sector	0.112493 (0.0304)	0.215527 (0.0001)	0.097352 (0.0001)
Agriculture Sector (Output)	0.008603 (0.9341)	0.017092 (0.8923)	0.093824 (0.0993)

*Estimation technique is ARDL, p-values are given in parenthesis.

If we compare the effect of primary education in each sector of the economy in the short-run, its greatest utilization is in the industrial sector, followed by the services sector. Although the coefficient of primary education is negative in the agriculture sector when output per employed person is taken as a dependent variable, the issue is further investigated. The model for the agriculture sector is modified by taking employment of the agriculture sector into account and for this reason, the dependent variable of the agriculture sector is taken as agriculture's sector output. It was found that this modification makes the coefficients of the education variable positive. But still, the coefficient in the agriculture sector remains below the coefficient of the industrial and services sector. Similarly, in the case of secondary level of education the greater impact is in case of the services sector, then for the industrial sector and negative in the agriculture sector when output per employed person is considered and positive in case of agriculture's output after considering the effect of increased employment. In the case of the overall economy, the effect is positive and representative of all sectors. For tertiary education again the largest positive impact is in the services sector. The coefficient of tertiary education in the industrial sector is found positive but insignificant. The coefficient of tertiary education is negative and significant in the model of per employed person output of the agriculture sector and significant and positive in the model of agriculture's sector output. For the overall economy, the effect is significant and positive and representative of all sectors.

2.7 Conclusion

The analysis of the impact of different levels of education of employed persons shows that each level of education whether its primary, secondary or tertiary have a positive effect on the output per employed person both in the short-run as well as in the long-run. It is true for the overall economy, industrial and services sector but the agriculture

sector gives somewhat different results. In the agriculture sector, it is found that each level of education is negatively associated with the output per employed person. The deeper analysis showed us that the greater negative effect of employment evades the positive effect of education in the agriculture sector. However, when the effect of education is considered on output, controlling for the effect of employment in the model, the coefficients turn to be positive.

The comparison of different sectors for each level of education shows that primary education contributes more to the industrial sector. While the contribution of the secondary and tertiary level of education is highest in the case of the services sector. It implies that primary education is best utilized in the industrial sector as compared to other sectors, while secondary education and tertiary education are efficiently used in the services sector as compared to the industrial and agriculture sector.

The analysis of the impact of different level of education on the agriculture sector shows the negative impact of each level of education on output per employed person in the short-run. The data doesn't support the existence of a long-run relationship in all three models of output per employed person of the agriculture sector. The impact of education on the agriculture sector is further analyzed by estimating the model for output of the sector instead of output per employed person and by including the effect of employment along with other control variables in the model. The bounds test reports the existence of a long-run relationship for each level of education. The speed of adjustment was found highest in the case of tertiary education and for primary education, it was slightly higher than secondary education. In the long-run as well as in the short-run the coefficients of education are found positive. However, the coefficients of each level of education are only significant in the case of tertiary education, while in

models with primary and secondary education despite having positive values they are found insignificant.

For the industrial sector, the analysis shows that a long-run relationship exists for primary, secondary as well as for tertiary level of education. A positive relationship between education variables and output per employee was found both in the short-run as well as in the long-run. However, the coefficient of the tertiary level of education remained insignificant in the models of the short run as well as in the long-run. It is also deduced that in the long-run secondary education makes capital more productive as compared to primary education. The coefficient of capital per employed person is found higher in the model of secondary education as compared to primary education. Also, the sum of coefficients of capital and education is higher in the model of secondary education as compared to primary education in the long-run. It is found that the speed of adjustment is greater in the case of secondary education as compared to primary and tertiary education.

For the Services sector, the education variable in all three cases; whether it is proxied by the primary, secondary or tertiary level of education is found positive and significant. The coefficients of capital per employed person are also positive and significant in all three models. Moreover, the coefficient of capital increases as it is mixed with a higher level of education, which means that a higher education level increases the productivity of capital. It implies that changes in output per employed person will be higher if a higher level of education is combined with capital. Speed of adjustment was found highest in the case of secondary level of education followed by tertiary education and then for the primary level of education.

2.8 Policy Implications

This section is devoted to draw some policy implications in light of the analysis done in this essay. A thorough analysis of the impact of education (segregated in different levels) on growth and level of output of the overall economy and of agriculture, industrial and services sectors separately lead us to the following policy implications.

The analysis of the agriculture sector shows that surplus employment in the agriculture sector is evading positive returns of education. It implies that there is a need to lower employment in the agriculture sector or to make the agriculture sector as broader as to absorb all the surplus labour efficiently. It will require defining policies that provide incentives to one's that are associated with the agriculture sector to transfer to other sectors or to increase the productivity and market size of the agriculture sector to absorb the surplus labour. Moreover, the results that education specially tertiary education leading to higher output can be used to guide the policy to further improve education in the agriculture sector. Not only because it will lead to higher productivity but because education has the ability to make farmers competent in meeting the international standards and making the agriculture sector products exportable. This will help grab good prices in the international market.

The results of the industrial sector show a positive relationship between education variables and output per employee was found both in the short-run as well as in the long-run. However, the coefficient of education in model for primary education had a highest coefficient while the sum of coefficients of education and capital per employee was highest in the case of the model with secondary education. It implies that Pakistan's industrial sector is producing commodities for which primary level of education is enough and our industrial sector is lacking in the products which require more technology and higher level of education. It implies that because in Pakistan industrial

sector consists of more of primary nature than that of secondary nature therefore the coefficient of the lower level of education is highest. But when it is seen in combination with a coefficient of capital per employee then it is found that the sum of the coefficient of education and capital in the model for secondary education is highest. The policy implications of these results are that not only it is required to increase education to increase the output of industrial sector but it is needed to expand the secondary industries that use tertiary education and secondary education in order to get benefit from the higher returns of these type of education.

The results also show that secondary and tertiary education have the highest coefficient and is best utilized in the model for the services sector. It implies that these levels of education are less efficiently used in the agriculture sector and the industrial sector as compared to the services sector. It is necessary to analyze the situation to know the reasons why secondary and tertiary education is contributing less to other sectors. It is also required to define policies to make education at least as useful as it is in the services sector.

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ESSAY 3

FORECASTING EDUCATIONAL REQUIREMENTS FOR ECONOMY OF PAKISTAN (A NORMED PLANNING APPROACH)

3.1 Introduction

Manpower development is closely associated with economic growth and this fact is well acknowledged in the economic literature (Hallak, 1990). Economic growth theories and their advancement emphasize the role of human capital and education in economic growth. Whether it is 'learning by doing model' of Lucas (1988), horizontal innovation by Romer (1990) or vertical innovation by Aghion & Howitt (1992, 1998) all suggest improvements in human capital for achieving higher economic growth. Education is seen as an investment that generates magnanimous returns for individuals and societies (Pike, 1981). Investment in human capital through education enhances the ability of workers to work innovatively and productively. Developing countries consider education as a tool for developing their manpower, ladder in a process of development and to acquire the status of developed countries.

Education increased explosively all around the world after World War II. Efforts were made by governments as well as international donor agencies to increase the overall level of education. At the same time, awareness among individuals was increasing to have a higher level of education. The need for manpower planning and educational planning was realized and attempts were made to forecast educational requirements to achieve a certain level of economic growth. Imperfections of the labor market were realized and it was recognized that shortages and surpluses exist in the economy. To eliminate the imbalance between outputs of education and needs of the economy, the need for proper educational and manpower planning was acknowledged (Voll, 1975).

In addition, it is considered important to tackle unemployment, knowledge obsolescence and coping with altering skill requirements (Heijke, 1993).

In the modern era, the need and practice of manpower and educational planning gained importance and popularity during the 1960s. International organizations like UNESCO, World Bank and Organization for Economic Cooperation and Development (OECD) have a major role in the development and implementation of educational plans, especially for developing countries. For instance, a series of meetings were conducted by UNESCO in 1960-1962 for sketching plans for Africa, Arab states, Latin America and Asia for expanding education in the regions. The International Institute for Educational Planning was established by UNESCO in 1964. The Mediterranean Regional Project (MRP) is conducted by OECD illustrated by Parnes(1962). While the World Bank in the 1970s linked educational expansion to the attainment of external assistance.

The question of determining the required manpower in the labour market remained a challenge for educational and manpower planners for decades. Attempts were made to define and develop forecasting techniques that could help in forecasting future manpower needs and educational requirements of a country.

The model designed by Correa and Tinbergen (1962) is considered as the first model that guide to forecast the educational requirements of the economy. They described the purpose of designing their model in the following words, “The model is intended to represent the link between economic development and that of the educational system of a nation”. The basic Correa and Tinbergen (1962) model comprised of 6 basic equations. The simultaneous solution of these equations results in forecasting the needed numbers of enrollments at a primary, secondary and tertiary level of education

for achieving a certain level of national output. The model was developed under the sponsorship of OECD for structuring an educational planning model. It was initially applied to Greece, Turkey and Spain to forecast the requirements to achieve a set target of higher economic growth.

There are a variety of manpower forecasting techniques but the three dominant ones in the educational planning literature are manpower requirement approach, rate of return technique and the social demand methods (Asher, 1988; Debeauvais & Psacharopoulos, 1985). However, Debeauvais & Psacharopoulos (1985) states that nearly 90% of manpower and educational planning is done by manpower requirements approach.

The advancement in data availability on education and human resource development for all countries by the international agencies like UNESCO, World Bank and UNDP made it possible to base the educational planning on the cross country/ international comparisons (Cohen, 2015). The integration of country by country planning and cross country comparisons is done by Cohen (2015) to forecast the educational requirements.

Pakistan lies in the list of medium human development countries with an HDI rank of 150 in a list of 189 countries in the year 2017 (Human Development Report, 2018). According to Human Development Indices and Indicators: 2018 Statistical Update, Pakistan's HDI value for the year 2017 is 0.562 that lies below the average value of 0.638 for the South Asia region. The review of Pakistan's educational policies shows that while higher targets are set in each educational policy, they lack the proper quantitative targets and the strategy to achieve them. The education system in Pakistan lacks uniformity, accessibility and quality. The vast differences in private and public schooling, high numbers of out of school children, low personal investments in education due to poverty, poor policy formulation and implementation, lack of adequate

teachers trainings, lack of proper infrastructure at all levels of education, low participation and poor quality of higher education and low learning outcomes in terms of personal development & productivity are few of the challenges. These facts indicate the need for focusing on educational planning and human development in Pakistan. It is needed to educate the masses to a level where they can recognize their responsibilities and be aware of the duties of governing bodies. So that not only they could earn their living but could contribute to the welfare of society. It is more urgent and should be done without further delay.

The current study will follow Cohen (2015) to estimate the required levels of gross enrollment ratios, enrollments, student-teacher ratio, number of teacher and governments spending and related variables for each level of education (i.e. primary, secondary and tertiary level of education). This aim will be realized by utilizing the normed planning approach. The experience of better performers (10 selected countries) will be compared with the existing situation in Pakistan. Not only the required and actual values of educational indicators will be compared but also the forecasts will be made about enrollments, teachers and government expenditure on education and its composition for the next two decades. The basic idea is that, first, the group of 10 better performing countries will be selected and their basic education statistics will be linked to their GDP per capita through some simple equations. Then to know the requirements of Pakistan economy to perform better in terms of education, the GDP per capita of Pakistan is incorporated in the estimated equations. It will give the required levels of education statistics like gross enrollment ratio and student-teacher ratio for Pakistan based on the fitted model of better-performing countries. So basically, it is knowing how these countries would have performed in terms of education if their GDP would be equal to the GDP of Pakistan. Hence, this gives the guidelines for Pakistan to achieve

the suggested required levels to follow the norm of these countries in terms of education. It makes it possible to compare the actual education statistics in Pakistan to the required levels suggested by the model of 10 better-performing countries.

The essay contributes to the literature by comparing the existing situation of Pakistan's educational sector with 10 selected better-performing countries by means of some basic statistics of the education sector. It identifies the gap between the existing and required level of educational statistics to perform better in terms of educational statistics. It provides useful information about Pakistan's educational sector statistics. The current statistics are compared with what is required to be better performing in terms of education keeping in view the GDP per capita of the country. The required levels of the educational statistics for the coming two decades are also calculated and reported in the study.

3.2 Objectives of Study

The core objective of the study is to delineate a road map for the educational sector in Pakistan for the next two decades. The experiences of 10 better performing countries will be utilized for defining the road map. More precisely projections for the next two decades about the following variables will be made for each level of education:

1. The required levels of Gross enrollment ratios and the number of enrollments
2. The required levels of student-teacher ratios and the number of teachers
3. The required composition of government expenditure among different levels of education.
4. Comparison of actual and required levels of all above-mentioned variables in the current time-period 2017.

3.3 Literature Review

The history of gathering manpower statistic could be traced back to conducting a Roman census to account slaves. Followed by a trend of gathering population census at the end of the eighteenth century (Morton, 1969). In the modern era, the need and practice of manpower and educational planning gained importance and popularity during the 1960s. International organizations like UNESCO, World Bank and Organization for Economic Cooperation and Development (OECD) have a major role in the development and implementation of educational plans, especially for developing countries. For instance, a series of meetings by UNESCO in 1960-1962 for sketching plans for Africa, Arab states, Latin America and Asia for expanding education in the regions. The establishment of the International Institute for Educational Planning by UNESCO in 1964. The Mediterranean Regional Project (MRP) of OECD illustrated by Parnes(1962). Linking educational expansion to the attainment of external assistance by the World Bank in the 1970s.

Education increased explosively after World War II as a result of education expansion policies by the governments of both developing and developed countries. There was a large sum of money allocated for the purpose by governments and international donor organizations. Education and manpower planning became the focus of scholars, governments and international agencies. Furthermore, the recognition that labour market imperfections exist, that leads to shortages and surpluses in the labour market, originated the need for educational and manpower planning (Voll, 1975). Besides, it is important to tackle unemployment, knowledge obsolescence and coping with altering skill requirements (Heijke, 1993).

The question of determining the required manpower in the labour market remained a challenge for educational and manpower planners for decades. Attempts were made to define and develop forecasting techniques that could help in forecasting future manpower needs and educational requirements of a country. Several methodologies were developed that are summarized in the following section.

3.3.1 Employer Survey Method

The employer survey method is aimed to specify the future needs of the labour categorized by education through the survey based on the employer's responses (Bowen, 1964). The results are then aggregated to know the need for labour with a certain level of education in a certain year in an economy. This survey can be based on information from all the employers in the economy or selecting a representative sample and then generalizing the results for the same type of employers. This method has the advantage that it calculates the need for education in the economy by actual demand in future for a specific type of education. The demerit of the method is that it is based on the employer's judgement about the expansion opportunities of their business; market demands of their product, their competitors' actions, expected future state of the economy and other factors associated with the expansion of their businesses (Richter, 1986; Niazi, 1996). This method is used by developed countries like Canada, France, Sweden, UK and USA and for forecasting of some specific sectors in the developing countries also (Niazi, 1996). For example, Psacharapoulos and Woodhall (1985) discuss the use of the employer's survey method in Indonesia for forecasting skilled manpower needs for its energy sector.

3.3.2 Projection of Existing Labour Output Ratios to the Future

Another method of forecasting need for labour categorized by education is to project the existing labour output ratios to the future. Although this method is applied for forecasting labour/ education needs of the whole economy (Bowen, 1964; Spalletti, 2008), this method is more extensively used for projecting the needs for a certain type of occupations like doctors, teachers, engineers and scientists (Niazi, 1996). An example is of forecasting needs of engineers by utilizing data from 1900- 1956 in the Netherlands elaborated by Blaug (1970). The problem with the method is the requirement of long time-series data to deduce stable labour-output ratios.

3.3.3 The Density Ratio Method

This method associates one type of manpower with a level of another type of manpower like student-teacher ratio or with a total population of economy or sector of the economy e.g. doctor-patient ratio or doctors per head in district, province or economy. Forecasting the needs of one type of manpower leads to the prediction of another type of manpower. This method was widely used in centrally planned economies (like USSR) for long term planning to find the estimates of professionals required for a certain type of work e.g. doctors, engineers (Spalletti, 2008). It is used by Woodhall (1973) for forecasting engineers in India, Gannicott et al. (1973) for engineers and scientists in Britain and by Ahamad (1973) for forecasting teachers in Wales and England. It is also used in the USA to forecast the requirements of specialists like scientists and engineers as a ratio of the total labour force in a particular industry (Hinchliffe, 1987). The merits of having rigour concept, less data demand and precise calculations make the method appealing (Richter, 1986).

3.3.4 International Comparisons

International comparisons method analyzes the experience of a single advance country or group of relevant countries. Then targets are set to be achieved for the country that is aimed for taking guidelines, in light of experiences of advance country or countries. For example, Singapore in its 1980s plan took Japan's economy in 1980 as a model, to be followed to set the targets for Singapore in the year 1990 (Niazi, 1996). Layard and Saigal (1966) used empirical data to make international comparisons and concluded that although the relationship between per worker output and structure of educational and occupational was not perfect still a clear association exists between the two. Similarly, this method is also used in France, the educational requirements in 25 sectors of the economy were forecasted in 1960 by combining the international comparison method with the density ratio method (Blaug, 1970). The method is also applied to Puerto Rico in 1957 for forecasting the educational requirements by the year 1975. It was assumed that in the year 1975 the requirements of Puerto Rico will be the same as America's education structure in 1950. Based on this assumption the educational needs for Puerto Rico in the year 1975 were forecasted.

3.3.5 'Manpower Requirements' Approach

The manpower requirements approach is the most popular approach among manpower forecasting techniques. Debeauvais & Psacharopoulos (1985) states that nearly 90% of manpower and educational planning is done by manpower requirements approach. This technique emerged as a result of **the** Mediterranean Regional Project (MRP) by OECD in Parnes(1962) that aims to construct a model for educational and manpower planning. This method is based on three major steps; forecasting the future demands for manpower with different levels of education, projection of supply of skilled/ educated labour and then balancing demand and supply of manpower. The main purpose of the

method is to sketch the needed levels of skilled labour for 15 future years necessary to achieve set targets. This method was initially applied to six Mediterranean countries that are Turkey, Spain, Greece, Italy, Portugal and Yugoslavia.

3.3.6 Tinbergen Model

Tinbergen and Bos (1965) presented a model expresses the relationship between educational requirements and output of a country. The required enrollments and number of teachers are estimated in absolute terms. It differs from the model of MRP by OECD in by-passing the occupational structure and directly linking educational needs to the required level of output or targeted output in future.

3.3.7 Linear-Programming Models

These models use linear programming as a tool to calculate the shadow prices for different kinds of labour based on their education. Optimal levels of school enrollmentswere suggested by the model (Psacharopoulos, 1970; Bowles, 1969).

3.3.8 Social-demand Models

These models are about considering the demands of students and their families for schools of a certain type in their area. These models are only applicable to the developed countries where fulfilling this type of demand is possible due to the availability of funds and needed manpower. Also as higher-level schools/ universities need larger amounts of funds so other considerations (like availability of teachers, funds and a minimum level of students) may also be involved in fulfilling the social demands of these types (Debeauvais & Psacharopoulos, 1985).

3.3.9 Rate of Return Analysis

This method estimates and compares the social and private cost and benefits of education. Guidelines are taken from these estimations then to decide about the

structure of the education system or deciding about expansion or contraction of certain parts of the education system (Spalletti, 2008, Jolly and Colclough, 1972).

3.3.10 The Target Setting Approach (Harbison's Method)

This method is based on the idea that human capital is essential for economic growth that means a healthy, skilled and educated population. This method is about finding educational and manpower requirements as a result of setting targets. Targets are set for each level of education separately. These targets also include on-job training, deciding about manpower mix and defining incentives to achieve targets.

3.3.11 Labour Absorption Method

This method analyzes the ability of the economy to employ and absorb a certain type of educational output. France and Germany have utilized this method for their educational and manpower planning. In France, labour demand or capacity of absorption of economy and graduates were linked based on data from the vocational training qualification survey (Williams, 1993, Niazi, 1996).

3.3.12 Trends Method

This method undertakes that the trends experienced in past can be projected in future assuming that the variables of interest will follow the past trend. It predicts the amount and kind of education that could easily be absorbed in the economy (Youdi & Hinchliffe, 1985). The data is tested for different types of trends possible; linear, cyclical, seasonal, step trend and random fluctuations. Pakistan in its five years plans has used this method (Niazi, 1996).

3.3.13 Normed Planning Approach

Cohen (2015) defines and illustrates the normed planning approach The normed planning approach integrates the country by country planning and international

comparison method. It provides with the road map for what should be the enrollments, teachers and government expenditures at different educational levels in a particular country. This method utilizes the experiences of a pool of better-performing countries to define a road map for a developing country. The model is developed to define a road map for the next two to three decades. So it is long term planning approach for educational sector representative statistics like gross enrollment ratios, number of teachers and government expenditures in each level of education.

3.3.14 History of Pakistan's National Educational Policies

At the time of independence in 1947, the areas that were emerged as Pakistan were far backward in terms of education. 85% of the population was illiterate and women education statistics were even worse. However, the importance of education in nation-building was well realized. The national educational policies of Pakistan are reviewed and discussed in detail by Siddiqui (2016), Ali (2013), Ahsan (2003), Bengali (1999), Khan & Mahmood (1997). The national educational policies are very briefly discussed as under.

The first educational conference was called in November 1947. The conference recommended universal primary education. This target was set to be achieved in the first 20 years. Committees were formed for primary, secondary and university education, also for scientific, technical and women education.

The second national education policy was introduced in 1959. The primary education was made compulsory. Gender equality is also emphasized. Character building, education of science and technology, increasing number of universities and making religious education compulsory till middle and optional at secondary level were the core of the education policy of 1959.

National education policy (1970) was defined again to achieve universal primary education that was the aim of the previous education policies but could not be achieved. The policy aimed to achieve 100% primary education and to make it free. This target was set to be met before 1980. However, this policy could also be not implemented due to the war outbreak of 1971.

Education policy (1972) was proposed by Zulfiqar Ali Bhutto. The policy intended to achieve free education for all up to metric. The promotion of Pakistan ideology, to make education equally accessible to all, the promotion of technical and scientific education were the main objectives of the policy.

National education policy (1979) was announced to achieve the goals of promoting the concept of Muslim Ummah, gender equality in education and promotion of technical and scientific education. It was also decided to revise the curriculum, to adapt Urdu as a medium of education, to make separate institutions for male and female, integration of religious and traditional education.

National education policy (1992) undertook the target of achieving universal primary education again as all the preceding education policies aimed the same but failed to do so. The non-formal education is also given importance and strategy is made to involve the non-government organizations in its provision by defining incentives for them. It was recommended to make social services compulsory for students. General schools were used as technical schools in the evening to increase technical education. Steps were taken to improve female education and improving education in disadvantageous rural areas. Model schools were initiated in rural areas. Programs for teachers training were initiated. Attempts were made to increase the number of teachers in schools and

to provide better infrastructure. It was aimed to achieve 100% literacy in some selected districts.

National education policy (1998-2010) aimed to make primary education accessible to all and also to improve its quality. The provision of quality teaching by initiating teacher training programs. Increasing the involvement of parents, community, non-government organizations and media in provision of primary education. Making the education system equitable and inclusive. Considering non-formal education systems complementary to the formal system. Development of monitoring system. Decentralization to improve management and supervision. And making the system more accountable.

National education policy (2009-2015) is formulated in a period of three years after conducting a series of seminars and meetings and involving different stakeholders in the process. Early childhood education was included for the first time in national education policy. It was decided that public schools should facilitate children of age group 3-5, and at least a year of pre-primary education should be provided in public schools. The education of out of school children due to child labour was also brought in focus and it is planned to make flexible programs of education to facilitate the children in work. The programs for age 14-17 who are older child labourers and could not acquire education were also in the priority list of the education policy (2009-2015). The policy also highlighted the need to focus on curriculum, standard textbooks, teachers, the facilities at learning institution and their environment, assessments and link of education to the labour market.

Educational policy (2017-2025) is intended to increase the enrollment of age group 17-23 that associates to the tertiary education to 15% from 8%. Setting up 15 new

public sector universities are in the plan. The encouragement of the private sector to set up 50 private universities and the promotion of virtual education is also included in the policy. Setting up new libraries, modernization of libraries and easy access to libraries with the help of internet is also in the priority list of national education policy (2017-2025). The policy also includes the promotion of sports and physical education at school, college and university levels. The establishment of a separate directorate is recommended in this regard. The efforts are made and recommended to facilitate the education of special children and to increase their participation rate. 5% of the education budget is allocated to promote the education of special children. Facilities and programs for special children educational institutes and teachers training and many other provisions are defined in the policy to promote the education of special children in Pakistan.

3.4 The Model

The basic purpose of the model is to frame a model which can guide us to determine educational mix depending upon enrollments in primary, secondary and higher education, teacher-student ratio and government expenditure on education. The model will first compare the actual and required levels of variables that define the basic structure of education e.g. enrolments, student-teacher ratio and government expenditure on education and then it will give a road map for next two decades.

The basic idea behind the model is that it links the educational sector variables like gross enrollment ratio, student-teacher ratio, and different variables indicating government expenditure on education to GDP per capita as it was done in the seminal work of Correa and Tinbergen(1962). The innovation of the model is that instead of estimating the equations based on country data, they are estimated on the basis of panel of selected advance countries in terms of education, GDP per capita and with a

comparable population. Then these estimated regressions are used to estimate the required level of educational variables in current and future years for the country of interest by incorporating its current and projected GDP per capita.

The model is based on the work of Cohen(2015) and consists of the following 9 equations comprising of 6 reaction equations and 3 definitional equations. The model assumes and implies that along with the growth of GDP the educational sector also develops accordingly.

The first four equations characterize the educational structure by means of gross enrollment ratios, enrolments, student-teacher ratios and numbers of teachers while the next five illustrates the government expenditure on education.

$GER_e = \alpha_{1e} + \beta_{1e}\, GDP_{pc}$ $e=1, 2, 3$ *(1)*

$ENR_e = GER_e \,.\, SAG_e \,.\, POP$ $e=1, 2, 3$ *(2)*

$STR_e = \alpha_{3e} + \beta_{3e}\, GDPpc$ $e=1, 2, 3$ *(3)*

$TCH_e=[1/STR_e]ENR_e$ $e=1, 2, 3$ *(4)*

Government Expenditure on education.

$GTS / GDP = \alpha_5 + \beta_5\, GDP_{pc}$ *(5)*

$GTE / GTS = \alpha_6 + \beta_6\, GDP_{pc}$ *(6)*

$GREe / GRE = \alpha_{7e} + \beta_{7e}\, GDP_{pc}$ $e =1, 2, 3$ *(7)*

$GRO/ GRE = 1 - GRE_1/GRE - GRE_2/GRE - GRE_3/$ GRE *(8)*

$KRC = \alpha_{9e} + \beta_{9e}\, GDP_{pc}$ $e =1, 2, 3$ *(9)*

Where notations are explained as under:

Educational levels are denoted by index e, where 1, 2 and 3 denote primary, secondary and *tertiary* education respectively.

GERe Gross Enrolment Ratio

GDPpc Gross Domestic Product per capita

ENRe Number of enrollments in level e

SAGe	Share of age group associated with a particular level of education e in total population
POP	Total population of Pakistan
STRe	Student-teacher ratio
TCHe	Number of teachers
KRC	Ratio of government's capital to recurrent expenditure
GTS	Government total spending (all sectors)
GTE	Government total expenditure on education
GRE	Government recurrent expenditure on education
GREe	Government recurrent expenditure on education by level e
GRO/GRE	The proportion of overhead and other activities in government recurrent expenditure on education

Equation 1 relates gross enrollment ratio at each level of education to the GDP per capita. Equation 2 is definitional and shows that enrollments at any level of education can be found by multiplying the gross enrollment ratio to the product of total population of the country and share of the age group that associates to a particular level of education. Equation 3 describes the relation of the student-teacher ratio of any particular level of education to GDP per capita. Equation 4 is again definitional equation showing that the number of teachers of any level of education can be found by dividing the enrollments by student-teacher ratio.

The next five equations (5-9) give information about the government's expenditure on education. Equation 5 narrates the relationship of the government's total spending on all sectors as a proportion of GDP to GDP per capita. This gives information about the size of the government budget. Equation 6 explains the relationship of government's total spending on education as a proportion of its all sectors spending to GDP per capita. It informs about the size of the education budget. Equation 7 illustrates the proportion of expenditure on each level of education in the government's recurrent expenditure on

education to GDP per capita. Equation 8 is the definitional equation and shows that government's overhead and other activities expenditure can be found as a residual of total and sum of government expenditures on different levels of education. As we are taking GRO as a proportion of governments recurrent expenditure on education(GRE) so it can be found by deducting proportions of expenditures in all sectors from 1, as 1 represents total in terms of proportions. Equation 9 gives information about the government's capital expenditure on education as a ratio of its recurrent cost. It relates this ratio to GDP per capita. This model will be solved to get the required levels of above-mentioned education statistics for Pakistan.

3.5 Data and Methodology

Section 3.4 consists of four sub-sections. Section 3.4.1 describes the selection of countries for comparison. Section 3.4.2 provides information about sources of data and information about projected data. Section 3.4.3 explains the followed methodology and 3.4.4 is about estimation technique.

3.5.1 Selection of Countries for Estimation

The idea behind solving the basic model of the study is to utilize the experience of the better performers in terms of education and economic growth and then their experience will be applied to Pakistan. For this purpose group of 10 countries were selected. Pakistan lies in the list of medium human development countries so all the countries are selected from the list of countries that corresponds to high human development. The following conditions were applied to select the relevant countries.

a) The countries have experienced high economic growth during the last decade.
b) Have population size comparable or bigger than Pakistan
c) Have ranked HDI higher than the ranked index of GDP per capita.

The application of above-mentioned criteria results in the selection of Algeria, Brazil, China, Colombia, Iran, Malaysia, Mexico, Russian Federation, Thailand and Turkey. Table 3.1 summarizes the HDI, population and GDP per capita rank of each selected country and Pakistan

Table 3.1: HDI, Population and GDP per capita rank of selected countries

	HDI rank	Population rank	GDP per capita
Algeria	85	33	80
Brazil	79	5	78
China	86	1	75
Colombia	90	28	85
Iran (Islamic Republic)	60	18	61
Malaysia	57	44	43
Mexico	74	10	67
Russian Federation	49	9	53
Thailand	84	20	70
Turkey	64	19	50
Pakistan	150	6	127

3.5.2 Data

The study utilizes panel data containing 10 cross-sections and time period 2003 to 2017. The data for most of the variables are acquired from the UNESCO Institute for statistics. Others from the data bank of world development indicators of the World Bank and UN world population prospects 2019. The data on the share of the age group for primary, secondary and tertiary for the year 2017, 2025, 2030, 2035 and 2040 is acquired from UN world population prospects 2019 and some calculations are done to get the share of relevant age group. For primary education relevant age group is 5-9, for secondary, it is 10-16 and for tertiary, it is 17-23. The data on the share of each age group that are associated with different levels of education for different required periods are reported in the following Table3.1.

Table 3.2: Share Of Age Group in Total Population

Year	Share Of Age Group in Total Population		
	Primary	**Secondary**	**Tertiary**
2017	0.1168	0.1518	0.1398
2025	0.1150	0.1430	0.1290
2030	0.1070	0.1440	0.1270
2035	0.1000	0.1370	0.1280
2040	0.0920	0.1300	0.1270

Similarly, to get data on GDP per capita ($PPP) for future years the actual data on GDP per capita in the constant dollar (PPP) is used along with the assumption that growth rate will be 5% for years 2017 to 2025, then it will rise by 0.5 percentage points after every 5 years. So during 2025-2030, the growth rate is assumed to be 5.5 for 2030-2035 it is assumed to be 6% and for 2035-40 it is 6.5%. The projected values are presented in Table 3.3.

Table 3.3: Projected Values of GDPpc ($PPP)

Year	GDPpc ($ 2011 PPP)
2017 (Actual)	5035
2025	7439
2030	9722
2035	13010
2040	17825

3.5.3 Methodology

To solve the model given above and to deduce fruitful results the following procedure is followed.

The model given in section 3.3 is solved by initially estimating the reaction functions explained by equation 1, 3, 5, 6, 7 and 9. These equations link the basic variables that

describe the performance of the educational sector of a country to its GDP. For estimation, panel data of 10 selected countries for the years 2003 to 2017 is used. These equations are tested for their functional form by estimating the equations in linear, semi-log, quadratic and hyperbolic form and the model with high R^2 and low standard error of the regression is selected. These equations are solved repeatedly for a primary, secondary and higher level of education.

The estimated regression equations 1, 3, 5, 6, 7 and 9 provides the information that how education sector variables, gross enrollment ratio, student-teacher ratio, the share of government spending in GDP, the share of education in total government spending, distribution of government expenditure on education among each level of education and composition of capital and recurrent expenditure in government spending on education, are linked to GDP per capita in these better performing countries.

Once the panel estimation is done and the parameters of equations 1,3,5,6, 7 and 9 are estimated by utilizing the data of 10 selected countries, the next step is to solve these equations to find guidelines for Pakistan economy. For this purpose, these estimated equations will be solved by incorporating the GDP per capita of Pakistan for the year 2017. The incorporation of GDP per capita of Pakistan for the year 2017 in equation 1 that is estimated for each level of education will give the required level of gross enrollment ratio for primary, secondary and higher level of education in the year 2017. Similarly, plugging the GDP per capita of Pakistan for the year 2017 in estimated equation 3 will give the required student-teacher ratio in each level of education. Solving equation 5, 6, 7 and 9 by incorporating GDP per capita of Pakistan in the year 2017 will give the required level of share of government spending in GDP, the share of education in total government spending, distribution of government expenditure on

education on each level of education and composition of capital and recurrent expenditure in government spending on education respectively. The same procedure will be repeated for finding the estimated values of dependent variables in equation 1,3,5,6,7 and 9 for future years by incorporating the projected GDP per capita of Pakistan for the year 2025, 2030,2035 and 2040 that is explained in section 3.4.2 and given in Table 3.3.

Next step is to solve the remaining three equations of the model that is equation 2, 4 and 8. The required level of enrollments in primary, secondary and tertiary level of education is solved by equation 2. The required information for solving equation 2 is the share of the age group in population for each education level is given in Table 3.2. While information deduced from equation 1 will also be used for solving this equation. The incorporation of the required information will give the number of enrollments required in each level of education for Pakistan. This equation will repeatedly be solved to get the required level of enrollments in each level of education for the year 2017, 2025, 2030, 2035 and 2040. Equation 4 will be solved by utilizing information derived from equation 2 and 3. The incorporation of information relevant to the year 2017 and then calculated values for subsequent years at 5 years interval from 2020-2040 in equation 4 will give the required number of teachers in each level of education. The same procedure is followed for solving equation 8 that gives information about the proportion of overhead expenditures in government recurrent expenditure on education.

3.5.4 Estimation Technique

Fixed effect models in panel data make it possible to control the effect of all those variables that are time-invariant and are not included in the model or those that cannot be measured. The underlying idea is to, “use each individual as his or her own control”

(Alison, 2009). The distinct feature of a fixed-effect model is that it can capture the effects of all of the variables that are specific to individual or cross-section and are time-invariant. So if it is used for a panel of countries, factors like geographical peculiarities, natural idiosyncrasies and other such features that differ among countries but do not change over time are all be considered (Asteriou and Hall, 2015). This method allows the constant of the regression equation to vary for each group/cross-section. It is possible by including a dummy for each cross-section in a regression, therefore fixed effect estimates are also known as least square dummy variable estimates. Econometrically for Y representing a dependent variable, X independent variable(s), N cross-sections and T time periods, the fixed-effect model can be expressed as

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_{k1} X_{kit} + u_{it} \qquad 3.4.4.1$$

In matrix notation, the fixed effects model is given by

$$Y = D\alpha + X\beta' + u \qquad 3.4.4.2$$

Where:

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ \vdots \\ \vdots \\ Y_N \end{bmatrix} \qquad \alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \vdots \\ \vdots \\ \alpha_N \end{bmatrix} \qquad \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \vdots \\ \vdots \\ \beta_N \end{bmatrix}$$

$$\boldsymbol{X} = \begin{bmatrix} \boldsymbol{x_{11}} & \boldsymbol{x_{12}} & \ldots & \ldots & \boldsymbol{x_{1k}} \\ \boldsymbol{x_{21}} & \boldsymbol{x_{22}} & \ldots & \ldots & \boldsymbol{x_{2k}} \\ \vdots & \vdots & \ldots & \ldots & \vdots \\ \vdots & \vdots & \ldots & \ldots & \vdots \\ \vdots & \vdots & \ldots & \ldots & \vdots \\ \boldsymbol{x_{N1}} & \boldsymbol{x_{N2}} & \ldots & \ldots & \boldsymbol{x_{Nk}} \end{bmatrix} \qquad \boldsymbol{D} = \begin{bmatrix} \boldsymbol{i_T} & \boldsymbol{0} & \ldots & \ldots & \ldots & 0 \\ \boldsymbol{0} & \boldsymbol{i_T} & \ldots & \ldots & \ldots & 0 \\ \vdots & \vdots & \ldots & \ldots & \ldots & \vdots \\ \vdots & \vdots & \ldots & \ldots & \ldots & \vdots \\ \vdots & \vdots & \ldots & \ldots & \ldots & \vdots \\ \boldsymbol{0} & \boldsymbol{0} & \ldots & \ldots & \ldots & \boldsymbol{i_T} \end{bmatrix}$$

3.6 Results and Discussion

This section discusses and reports the results of the basic model of the study illustrated in section 3.3. The results are based on the data from 10 selected high achieving

countries in terms of education as well as economic growth. The solution of the model gives important guidelines for the next 20 years about the required levels of the variables that define the basic structure of the education system. These variables include Gross enrollment ratio (GER), Enrollments (ENR), Student-teacher ratio (STR), Number of teachers and government expenditure on education and distribution of government expenditure on different levels of education. The results are then compared with the actual values to analyze the existing situation and gaps that are needed to be covered to accelerate in terms of a better education system. The results are illustrated in the following sections.

3.6.1 Gross Enrolment Ratio

Gross enrollment ratio (GER) gives important information about the participation level in the education system. It is one of the basic statistics in defining and analyzing the education system of a country. It is expressed as a percentage of those who are enrolled in a particular level of education (e.g. primary) to the population that belongs to official age- group of that particular level of education. An analysis is carried out to describe the relationship between GER and GDP per capita. The estimation results are based on data from 10 selected countries over the time period of 2003-2017. The results of equation 1 of the model described in section 3.3 are reported as under:

$$\mathbf{GER_1 = 221.75 - 11.78\ Ln\ GDPpc} \qquad \mathbf{3.5.1}$$

$$\mathbf{R^2 = 0.77 \qquad S.E = 5.25}$$

Equation 3.5.1 shows that the relationship between the gross enrollment ratio at the primary level is negatively associated with GDPpc. The reason is that all the countries included in the estimation have achieved 100% gross enrollment ratio long ago and have much higher GER(primary) during the time period under consideration. The mean GER for the primary level of education in the data was 108 while the maximum was

151. So as they have already achieved higher than 100% GER with more advancement they need not have much higher than 100% GER at primary level. Based on the information given in equation 3.5.1 the required level of GER at the primary level of education for Pakistan is estimated by incorporating the GDP per capita of the country in the year 2017 and projected GDP per capita in the future years. These required levels of GER at primary level are reported in Table 3.4 along with the actual GER in the year 2017.

Table 3.4: Required and Actual Gross Enrollment Ratio (Primary)

Year	Gross Enrollment Ratio (Primary)	
	Actual	Required
2017	95.92	121.36
2025		116.76
2030		113.61
2035		110.18
2040		106.47

It is found that despite the focus of national government as well as the guidelines of the international agencies like UNESCO to achieve 100% GER at primary level, Pakistan's latest statistic available for the year 2017 shows that the target is not met yet. Although the country is close to the value of 100, still the estimated figures that predict the requirements of GER in the country shows a wide gap. For the year 2017, actual GER at primary level is 95.92 while the required level is 121.36, showing a gap of 25 percentage points. Similarly, the estimates of GER (Primary) for every 5^{th} year till 2040 are also listed in Table 3.4, showing the need of not only achieving 100% GER at primary level but to maintain this statistic well above 100%.

The link between Gross enrollment ratio at the secondary level of education and GDPpc is described by the equation 3.5.2.

$$\mathbf{GER_2 = -138.18 + 23.50\ Ln\ GDPpc} \qquad \mathbf{3.5.2}$$

$$\mathbf{R^2 = 0.66 \qquad S.E = 6.83}$$

The estimates show a positive association between gross enrollment ratio of the secondary level of education and GDP per capita, implying that as GDP per capita increases in a country the gross enrollment ratio of the secondary level also increases. The predicted values that show the requirements of GER of secondary level in Pakistan are tabulated in Table 3.5. The values are based on equation 3.5.2 and found by incorporating actual GDP per capita in 2017 and projected GDP per capita in the equation one by one. The results shown in Table 3.5 demonstrates a wide gap between the actual and required level of gross enrollment ratio at the secondary level. While the actual GER is around 45% the required level is 62%. The Table also suggests not only achieving this particular level of GER at secondary level but the need to increase it to the higher levels in the following years. By the year 2040, Pakistan is required to achieve 92% gross enrolment ratio at the secondary level that means more than100% increase in the existing GER of the secondary level.

Table 3.5: Required and Actual Gross Enrollment Ratio (Secondary)

Year	Gross Enrollment Ratio (Secondary)	
	Actual	**Required**
2017	45.48	62.17
2025		71.34
2030		77.63
2035		84.48
2040		91.88

The results of the relationship between the gross enrolment ratio at tertiary level and GDP per capita of a country is illustrated by the following equation 3.5.3.

$$\mathbf{GER_3 = 22.08 + 0.001273\ GDPpc} \qquad \mathbf{3.5.3}$$

$$\mathbf{R^2 = 0.86 \qquad S.E = 7.37}$$

The association between GER at tertiary level and GDP per capita is found positive that is as expected, indicating an increase in GER of the tertiary level of education as a result of an increase in GDP per capita of a country. By incorporating the GDP per capita of Pakistan in the different time periods, the required levels of GER of the tertiary level of education are estimated and reported in Table 3.6.

Table 3.6: Required and Actual Gross Enrollment Ratio (Tertiary)

Year	Gross Enrollment Ratio (Tertiary)	
	Actual	**Required**
2017	10.12	28.49
2025		31.55
2030		34.46
2035		38.64
2040		44.77

Similar to the results of the GER of primary and secondary level of education, the estimated/ required level of GER at the tertiary level also shows a huge gap between existing and required levels. The actual GER for the year 2017 is 10.12% while the required level is 28.49%. Also, not only catching up the required level of GER is needed but it needs to go up in the following years.

3.6.2 Enrollments (ENR)

This section solves equation 2 of the model described in section 3.3. The solution of equation 2 requires information on the share of the age group (SAG) associated with

each level of education, the actual and projected population of Pakistan and the estimated gross enrollment ratios. The information on the first two variables are explained in section 3.4.2 and the estimated values of GER are explained and listed in section 3.5.1. Required enrollments can be found by just incorporating these values in equation 2 of the basic model of the study. These required enrollments are calculated, listed, compared and explained in this section. Equation 2 of the model is reproduced for easy reference, it shows that enrollments at each level of education can be found by multiplying the gross enrollment ratio, the share of age group associated with that particular level and population of a country.

$$ENR_e = GER_e \,.\, SAG_e.\, POP \qquad e = 1, 2, 3 \qquad (2)$$

Actual and required enrollments are reported in Table 3.7. The results in Table 3.7 identify a wide gap between actual and required enrollments at primary level. It is found that a gap of 7.78 million exists in enrollments of the primary level. Moreover, the coming years requires a higher level of enrollments until 2030. However, after 2030, the required levels decline from its previous value due to expected decline in population because of the declining growth rate of population and decline in the share of age group associated with a primary level of education.

Table 3.7: Required and Actual Enrollments in millions of persons (Primary)

	Enrollments (Primary)		
Year	**Actual**	**Required**	**Gap**
2017	21.686451	29.470360	7.783909
2025		32.525728	
2030		34.355988	
2035		33.292975	
2040		29.594261	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

Similarly, required enrollments at a secondary level of education are also calculated in the same manner as calculated for the primary level by utilizing equation 1 and 2 of the

basic model. The results are shown in Table 3.8. It is found that the gap between actual and required enrollments is 7.09 million, presenting a huge gap in enrollments of the secondary level. The results show that required numbers of enrollments are increasing from its preceding value for every 5^{th} year it is calculated.

Table 3.8: Required and Actual Enrollments in millions of persons (Secondary)

	Enrollments (Secondary)		
Year	**Actual**	**Required**	**Gap**
2017	12.529168	19.620450	7.091282
2025		24.712689	
2030		29.396787	
2035		32.738218	
2040		36.088227	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

The results of the actual and calculated/ required number of enrollments for the tertiary level of education are presented in Table 3.9. The comparison of actual and required enrollments in the year 2017 shows that Pakistan needs to increase its enrollments of the tertiary level of education about 326% to catch up the trend of developed countries that are followed in this study. The estimated values for future years show an increasing need for expanding enrollments with the advancement in time. By 2040 Pakistan needs to increase the enrollments to 17.18 million.

Table 3.9: Required and Actual Enrollments in millions of persons (Tertiary)

	Enrollments (Tertiary)		
Year	**Actual**	**Required**	**Gap**
2017	1.941478	8.280692	6.339214
2025		9.858803	
2030		11.508190	
2035		13.990178	
2040		17.178421	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

Summing up, it is found that the numbers of enrollments are far below the required levels of enrollments at each level of education. It is important to note here that this analysis implies that if the GDP per capita of the selected countries were equal to the GDP of Pakistan in the year 2017, still their education would be higher by the value shown under the heading "gap" in each Table, showing there better performance in terms of education.

3.6.3 Student Teacher Ratio (STR)

Another important determinant of the education structure analyzed in this study is the student-teacher ratio (STR). A lower value of STR indicates a higher quality of education at a particular level of education. As lower STR means that there are more numbers of teachers available in the system and students get a relatively higher concentration of the teachers. The results of equation 3 of the basic model of the study are reported in this section that links STR at different levels of education to GDP per capita. The results of STR for primary education is represented by the equation 3.5.4.

$$\mathbf{STR_1 = 64.32 - 4.4\ Ln\ GDPpc} \qquad \mathbf{3.5.4}$$

$$\mathbf{R^2 = 0.91 \qquad S.E = 1.54}$$

The estimated equation shows a negative relationship between GDP per capita and the student-teacher ratio at the primary level. It implies that as GDP per capita increases

the student-teacher ratio declines signifying improvement in the quality of education. To get the estimated values for the year 2017 and future years the actual GDP per capita in 2017 and projected GDP per capita reported in Table 3.3 of section 3.4.2, are incorporated in the equation 3.5.4.

The actual and estimated values are reported in Table 3.10. The actual STR at primary level in Pakistan is 45 that means for every 45 students in the primary education sector there is a teacher hired. However, the guidelines from the selected countries in the analysis suggest hiring a teacher against every 26th student. That represents the shortage of teachers in the primary education sector of Pakistan's economy. Moreover the required STR at primary level further declines in future periods that are calculated up to the year 2040.

Table 3.10: Actual and Required Student Teacher Ratio (Primary)

	Student Teacher Ratio (Primary)	
Year	**Actual**	**Required**
2017	45	26.18
2025		24.44
2030		23.24
2035		21.93
2040		20.53

*Required values are estimated values from equation 3.5.4

The estimated equation for student-teacher ratio at the secondary level is presented by the equation 3.5.5 that shows negative relationship between STR of the secondary level and GDP per capita. The equation is estimated in semi-log form.

$$\mathbf{STR_2 = 48 - 3.1596 \ Ln \ GDPpc} \qquad \mathbf{3.5.5}$$

$$\mathbf{R^2 = 0.92 \qquad S.E = 1.44}$$

The estimated values by incorporating the relevant GDP per capita in different years are reported in Table 3.11 given below

Table 3.11: Actual and required Student Teacher Ratio (Secondary)

	Student Teacher Ratio (Secondary)	
Year	**Actual**	**Required**
2017	19.4	21.40
2025		20.16
2030		19.30
2035		18.39
2040		17.40

*Required values are estimated values from equation 3.5.5

The results reported in Table 3.11 apparently show that in Pakistan the student-teacher ratio is lower than the required level of STR at the secondary level, showing better performance than required. But the deeper look shows that this low level of STR is at the cost of a low level of enrollments at the secondary level. More elaborately, the actual GER at the secondary level is 45% while the required level is roughly 62% while the actual STR is 19.4 and required is 21.4. So the low actual STR is due to fewer enrollments than required.

The result of the link between STR at tertiary level and GDP per capita is explained by the equation 3.5.6. The relationship is found to be negative implying that an increase in GDP per capita lowers the student-teacher ratio at tertiary level. Thus indicating an improvement in the quality of education in terms of more teachers available.

$$\mathbf{STR_3 = 22.70 - 0.00031\ GDPpc} \qquad \mathbf{3.5.6}$$

$$\mathbf{R^2 = 0.88 \qquad S.E = 2.28}$$

The estimated values of student-teacher ratio at tertiary level for the year 2017, and then for the next 20 years at 5 years interval are represented in Table 3.12 along with the actual value in 2017.

Table 3.12: Actual and Required Student Teacher Ratio (Tertiary)

Year	Student Teacher Ratio (Tertiary)	
	Actual	**Required**
2017	33.1	21.13
2025		20.39
2030		19.68
2035		18.65
2040		17.16

The estimations are based on equation 3.5.6 and the substitution of relevant year GDP per capita of Pakistan. The results show that there is a gap between actual and required values for the year 2017, indicating that more teachers are required to lower the student-teacher ratio to the required level. The following years also require to lower the STR of the tertiary level from its preceding values.

3.6.4 Required Number of Teachers (TCH)

This section by using information derived from equation 2 and 3 and substituting it in equation 4 of the basic model reports the required numbers of teachers for each level of education in Pakistan. Equation 4 of the basic model is reproduced here for ready reference.

$$TCH_e = [\ 1/\ STR_e\ ]\ ENR_e \qquad (4)$$

The results for the required number of teachers for the primary level of education are represented in Table 3.13.

Table 3.13: Required and Actual Number of Teachers (Primary)

	Number of Teachers (Primary)		
Year	**Actual**	**Required**	**gap**
2017	0.484267	1.125682	0.641415
2025		1.330840	
2030		1.478313	
2035		1.518148	
2040		1.441513	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

The results indicate the need to hire more teachers in the system of primary level of education to fill the gap between the actual and required level of education. The number of teachers required for the year 2017 is 1.125682 million that corresponds to the required level of student-teacher ratio and gross enrollment ratio for the year 2017. While the actual value 0.484267 million for the year 2017 relates to the actual GER and STR of primary level of education in Pakistan. The gap in the actual and required numbers of teachers is greater than the existing value suggesting that to get the target the number of teachers needs to be more than doubled. More specifically 0.6414152 million more teachers are required to be in the system to meet the target. The estimated requirements for the system of secondary level of education are conveyed in Table 3.14.

Table 3.14: Required and Actual Number of Teachers (Secondary)

	Number of Teachers (Secondary)		
Year	**Actual**	**Required**	**gap**
2017	0.646318	0.916843	0.270525
2025		1.225828	
2030		1.52315	
2035		1.780218	
2040		2.074036	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

It is found that a shortage of 0.27 million teachers exists in the system. The estimated values for future years at the interval of 5 years urges the need for hiring more teachers than the preceding period to lower STR and increase in enrollments at the secondary level.

Table 3.15 illustrates the results of the estimation of the required level of teachers at the tertiary level of education. Currently, in the year 2017, about 0.058733 million teachers are associated with the tertiary level of education while the requirement is of 0.391893 million showing a shortage of about 0.333 million. Thus to meet the targets of lowering STR and increasing enrollments to increase GER the system requires the employment of 0.333 million teachers. With the advancement in time this requirement to hire more teachers in the system of tertiary level of education increases.

Table 3.15: Required and Actual Number of Teachers (Tertiary)

	Number of Teachers (Tertiary)		
Year	**Actual**	**Required**	**gap**
2017	0.058733	0.391893	0.333160
2025		0.483512	
2030		0.584766	
2035		0.750144	
2040		1.001073	

*Figures are converted to millions for readability, ignoring decimal gives raw numbers.

3.6.5 Government Expenditure on Education

This section discusses different aspects of government expenditure on education. The share of government expenditure on education in proportion to its overall spending and the share of overall government expenditure in GDP is discussed. Moreover, the distribution of government expenditure on education among different levels of education is also considered and deliberated.

3.6.6 Share of Government Total Spending in Gross Domestic Product (GTS/GDP)

Share of government total spending in the gross domestic product (GTS/GDP) shows the size of government spending in the economy. The estimated equation that shows the link of GDP per capita to the size of government spending as a proportion of GDP is represented in the equation 3.5.7. The semi-log form of the equation is found best in terms of high R^2 and low standard errors.

$$\mathbf{GTS/GDP = -0.56 + 0.089\ Ln\ GDPpc} \qquad \mathbf{3.5.7}$$

$$\mathbf{R^2 = 0.88 \qquad S.E = 0.027}$$

The positive relationship is found between the share of government total spending in the overall output of the economy and GDP per capita. It implies that as the GDP per capita increases governments tend to spend more. The estimated values for the year 2017 and onward until 2040 at 5 years interval are reported in Table 3.16.

Table 3.16: Actual and Required Share of Government Total Spending

	GTS/ GDP	
Year	**Actual**	**Required**
2017	0.21	0.19
2025		0.23
2030		0.25
2035		0.28
2040		0.30

The actual value of GTS/GDP is 0.21, it shows that governments overall spending in the economy is 21% of the total GDP. The estimated value is, however, less than the actual value and suggests 19% of GDP as government total spending. However, in the future years, it shows an increasing trend with an expected increase in GDP per capita.

3.6.7 Share of Government Spending on Education in its Total Spending (GTE/GTS)

The share of government total spending on education in the government's total spending is analyzed in relation to GDP per capita. The results are represented in the form of equation 3.5.8.

$$\mathbf{GTE/GTS = 0.0568 + 0.0000696\ GDPpc} \qquad \mathbf{3.5.8}$$

$$\mathbf{R^2 = 0.85 \qquad S.E = 0.017}$$

The equation shows a positive relationship between the share of the government's expenditure on education in its overall spending and GDP per capita. Implying that as the GDP per capita of a country increases the government devotes higher share to education in its overall spending. The estimated values by utilizing equation 3.5.8 are reported in the following Table along with actual value for 2017.

Table 3.17: Actual and Required Share of Government Total Spending

	GTE/ GTS	
Year	**Actual**	**Required**
2017	0.138	0.092
2025		0.108
2030		0.124
2035		0.147
2040		0.181

The guidelines from 10 selected countries advocate 9.2% of overall government spending to education while its actual value in Pakistan is 13.8% suggesting less share of spending as compared to the existing value. Contrary to the general perception that the government should spend more the suggestion is to spend less. However, it can be inferred from results and overall analysis that the selected countries are efficient in utilizing funds and less of government share devoted to education is used to achieve the

higher targets. The results show a positive association between higher levels of GDP per capita and GTE/GTS, so with an increase in per capita GDP, the government needs to spend more in the education sector.

3.6.8 Share of each Level of Education in Government Spending On Education

This section is reserved to analyze and compare the needed distribution of the government's recurrent expenditure among different levels of education. The results of the required proportion of government's spending to primary, secondary and tertiary education are reported one by one.

$$\mathbf{GRE_1/GRE = 0.29 + 0.00000244\ GDPpc} \qquad \mathbf{3.5.9}$$

$$\mathbf{R^2 = 0.71 \qquad S.E = 0.036}$$

The result of estimation for the government's recurrent expenditure to primary education is listed by equation 3.5.9. It describes a positive relationship between GDP per capita and the proportion of government's spending on primary education in its overall recurrent spending to education. As the GDP per capita increases the government devotes more proportion than the preceding one to primary education. The estimated values for the year 2017 and onward are reported in Table 3.18.

Table 3.18: Share of Government Recurrent Spending to Primary Education

	GRE1/ GRE	
Year	**Actual**	**Required**
2017	0.44	0.3033
2025		0.3091
2030		0.3147
2035		0.3227
2040		0.3345

*The actual value for 2017 is missing so the actual value for the year 2016 is reported.

Table 3.18 indicates that Pakistan is devoting a higher proportion of government recurrent expenditure to primary education than what is required or deduced by using the data for 10 selected countries. The problem with devoting more proportion to primary education in total government's recurrent expenditure to education is that it could only be done at the cost of reducing the proportion for secondary or tertiary education or both.

For government recurrent expenditure on the secondary level of education and its relationship with GDP per capita, the following equation 3.5.10 is estimated.

$$\mathbf{GRE_2/GRE = 0.21 + 0.0000907\ GDPpc} \qquad \mathbf{3.5.10}$$

$$\mathbf{R^2 = 0.74 \qquad S.E = 0.038}$$

The results show that as the GDP per capita of a country increases, it increases the proportion of expenditure ratio of secondary level of education in overall recurrent expenditures of government. The estimated values that utilized equation 3.5.10 are presented in Table 3.19.

Table 3.19: Share of Government Recurrent Spending to Secondary Education

	GRE2/ GRE	
Year	**Actual**	**Required**
2017	0.29	0.26
2025		0.28
2030		0.30
2035		0.33
2040		0.37

*The actual value for 2017 is missing so the actual value for the year 2016 is reported.

Table 3.19 illustrates that the proportion of government expenditure on the secondary level of education to its overall recurrent expenditure on education is also high than required. Pakistan is spending 29% of total recurrent spending on education by the

government to the secondary level of education while the required proportion is 26%. Moreover, with an increase in GDP per capita higher proportion is suggested.

To know the relationship between the proportion of government's recurrent expenditure on tertiary education to its total budget and GDP per capita the following equation 3.5.11 is estimated.

$$\mathbf{GRE_3/GRE = 0.44 - 0.0000133\ GDPpc} \qquad \mathbf{3.5.11}$$

$$\mathbf{R^2 = 0.79 \qquad S.E = 0.033}$$

The equation suggests a negative relationship between the proportion of the government's recurrent expenditure on tertiary education to its total budget and GDP per capita. It implies that as GDP per capita increases government reduces the ratio of its expenditures to tertiary level. However, the positive and relatively high intercept combined with small slope coefficient suggests higher expenditures when GDP per capita is low and then gradual reduction in the proportion. Estimated values for the year 2017 and onward are reported in Table 3.20

Table 3.20: Share of Government Recurrent Spending to Tertiary Education

	GRE3/ GRE	
Year	**Actual**	**Required**
2017	0.1017	0.37
2025		0.34
2030		0.31
2035		0.27
2040		0.20

Results represented in Table 3.20 shows that the actual proportion of government recurrent expenditure allocated for tertiary level is quite low than required in the year 2017. The guidelines suggest that 37% of government expenditures on education should

be devoted to the tertiary level of education. The estimated values then suggest a gradual reduction in this proportion reaching the requirement of 20% in 2040.

The results about proportions of government recurrent spending are combined in Table 3.20 for the reason of comparison.

Table 3.21: Share of Government Recurrent Spending to each level of Education

Year	Type	Primary	Secondary	Tertiary
2017	Actual	0.44	0.29	.1017
2017	Required	0.30	0.26	0.37
2025	Required	0.309	0.28	0.34
2030	Required	0.314	0.30	0.31
2035	Required	0.32	0.33	0.27
2040	Required	0.33	0.37	0.20

The first two rows of Table 3.21 help in comparing the actual and required proportions of government's recurrent spending of different education levels. The comparison clearly shows that actual ratios of expenditure are higher for primary and secondary level and much less than what is required for the tertiary level.

3.6.9 Government's Recurrent Expenditure on Education in Overhead and Other Activities (GRO)

Government's recurrent expenditures on education in overhead and other activities (GRO) are calculated as a residual of government total recurrent spending on education and the sum of its recurrent spending on primary, secondary and tertiary education. It is calculated by utilizing equation 8 of the basic model and is reproduced here

$$\frac{GRO}{GRE} = 1 - \frac{GRE_1}{GRE} - \frac{GRE_2}{GRE} - \frac{GRE_3}{GRE}$$

The results are derived by the mere substitution of actual and estimated values of $\frac{GRE_1}{GRE}, \frac{GRE_2}{GRE}, \frac{GRE_3}{GRE}$ (see Table 3.21 for easy reference).

Table 3.22: Actual and required values of Government Recurrent Spending

	Government Recurrent Spending (Overhead)	
Year	**Actual**	**Required**
2017	0.17	0.07
2025		0.07
2030		0.08
2035		0.08
2040		0.10

The results indicate that the actual value of government recurrent expenditures in overhead and other activities are quite high than the required. The suggested value is 0.07, implying that less and less should be left as residual to allocate more on different levels of education.

3.6.10 Capital and Recurrent Cost Ratio (KRC)

Another important variable that defines the structure of the education system is the ratio of the government's capital expenditure to its recurrent expenditures. A higher value of this variable means that the capital expenditures are higher than previous one, that is considered better as capital expenditures can be considered as an investment in education system implying benefits over a larger period as compared to recurrent expenditures.

The association between KRC and GDP per capita is described by the equation 3.5.12. The negative association is found between GDP per capita and KRC. However, there is a relatively high intercept, 0.37 which shows that initially, this ratio needs to be high but then with an increase in GDP per capita this value gradually declines.

$$KRC = 0.37 - 0.0000151\ GDPpc \qquad 3.5.12$$

$$R^2 = 0.75 \qquad S.E = 0.055$$

The estimated values based on equation 3.5.12 are shown in the Table below.

Table 3.23: Ratio of Capital and Current Expenditure on Education

	Capital/ Current ratio (KRC)	
Year	**Actual**	**Required**
2017	0.16	0.30
2025		0.26
2030		0.23
2035		0.18
2040		0.10

Table 3.23 identifies the gap between actual and required capital/recurrent cost ratio. The actual figure of 0.16 shows that proportion of capital expenditure is less as compared to recurrent cost. The required value is 0.30 which means that the government is required to increase the proportion of capital expenditures in its overall expenditure on education. Over time, and with an increase in GDP per capita this requirement of an increased proportion of capital expenditures goes down as evident from the required future values listed in the Table.

3.7 Conclusion

The results reported in section 3.4 enable us to draw the following conclusions

- Gross enrollment ratio is below the required level for all levels of education i.e. primary, secondary and tertiary level of education
- It is found thast the numbers of enrollments are far below the required level of enrollments at each level of education.

- Wide differences exist between actual and required student-teacher ratio in primary and tertiary level of education. The actual value is closer for the secondary level of education, however, this is at the cost of low enrollments at the secondary level.
- Vast differences exist between the actual and required number of teachers in the system of each level of education.
- Analysis of the distribution of government's recurrent expenditure on different levels of education shows that Pakistan is spending more than the required proportion of its spending on education to the primary and secondary level of education that results in spending less than required proportion to tertiary education.
- It is also deduced from the analysis that the proportion of capital expenditure in overall government expenditure on education is less than required.

3.8 Policy Implication

The current study after comparing the Pakistan education system with 10 better-performing countries in terms of education and by the analysis of actual and required levels of basic variables defining the structure of the education system leads to the following policy implications.

- It is realized based on a comparison with 10 better-performing countries that Gross enrollment ratios are far below the required levels. The government should devise policies to increase enrollments at each level of education, whether it's primary, secondary or tertiary that will help to reduce the gap of the actual and required level of gross enrollment ratios. It will help in getting a better rank in HDI. To follow the norms of those countries that are better than

Pakistan in terms of education, it is required and is necessary. Only then the country can perform better in terms of education.

- It was analyzed and established that there is a need to strengthen the education system by employing more teachers at each level of education. Pakistan is lacking behind and to follow the suite of better-performing countries the government must formulate policies to increase the number of teachers in the education system at each level of education. It will help in reducing the student-teacher ratio and increasing the quality of education in the country and to reap the benefits of quality education in the country.
- The proportion of government spending on tertiary education out of its total spending must be increased that will require lowering of the proportion to primary education and also somewhat of the proportion of secondary education. It can be possible if more funds could be allocated to education and out of that increased budget if more can be allocated to the tertiary education and less to the other levels.
- It was also deduced from the analysis that most of the share in total government expenditure goes to recurrent expenditures and less is devoted to capital expenditure. In order to keep up with the norms of better-performing countries in terms of education, the proportion of capital expenditure in total government expenditure on education is required to go up.

The estimations done in the current study identifies the gaps in actual and required structure of education. It not only identifies the gaps but clearly states in numbers that what is needed. The government can use the study to set targets for the next five year plans and to analyze and its long term plan in light of this study.

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CONCLUSION

The basic purpose of the study was to analyze the impact of education in Pakistan's economy. The work is presented in the form of three distinct essays. The first essay is about analysis of the impact of education on life satisfaction of individuals in Pakistan. The second essay summarizes the impact of education on the overall economy and its major sectors that are agriculture, industry and services sectors. The third essay is about finding out the requirement of education sector in Pakistan in comparison with some better-performing countries and by forecasting the needs of the education sector for next two decades in terms of enrollments, teachers and government expenditure. The major findings of the study are summarized in this section.

The analysis carried out in the first essay identified and tested the direct and indirect effects of education on the life satisfaction of individuals in Pakistan for the first time. It helped in identifying the channels that are operative between education and life satisfaction and ones that are broken. It is observed that education plays a significant role in affecting life satisfaction. The results of analyzing the indirect effect in the full sample show that health, freedom and scale of income are the significant mediators through which education is positively effecting the life satisfaction of individuals in Pakistan. The direct effect is also found positive and significant. The channel of employment status is found insignificant between education and life satisfaction in the full sample. The deeper look in the matter shows that the path from education to employment status is significant and positive. But the path from employment status to life satisfaction is broken. It means that education is increasing the probability of getting employed but then the broken path between employment and life satisfaction hinders the effect of education to transfer to life satisfaction. The employment status is found

insignificant mediator in all other sub-samples based on gender, marital status and scale of income. The analysis is also performed for men and women separately to identify the possible differences. Different paths are found operative. For men, the channels of health, scale of income and marital status while for women channels of health and freedom of choice are found to be functional. The direct effects of education are also statistically significant and positive for both men and women. It is observed that for women all the paths from education to mediators are significant and operative but most of the paths from these mediators to life satisfaction are found insignificant. As a result, only the channels of health and freedom of choice are found significant for them. The broken paths must be mended to fully reap the benefits of education. For single persons, freedom of choice and scale of income while for married person health, freedom of choice and scale of income are significant mediators. For married persons, the total indirect effect is higher than single persons. The direct path is significant and has a positive coefficient value for married persons while for single persons it is found insignificant. It implies that education plays a more crucial role in affecting the life satisfaction of married persons than that of single. The analysis of the impact of education on life satisfaction based on the scale of income illustrates that as compared to rich and poor more channels are effective for the middle class. It is found that all indirect effects, as well as a direct effect, are insignificant in case of the rich class, that means the role of education in defining and affecting the life satisfaction of rich is not supported by the data and is found insignificant. Implying that in Pakistan education does not significantly impact the life satisfaction of the upper class. On the other hand, for the middle class, all of the indirect effects are significant except employment status. It implies that the level of education is playing a crucial role in improving life satisfaction of persons belonging to the middle class. The direct path between education

and life satisfaction for the middle class is also effective. For poor class, although only health and marital status are significant mediating effects, the coefficient of direct effect is much higher as compared to the direct path of the middle class. It means that although most of the indirect effects are insignificant for poor still education can affect the life satisfaction of the poor through its direct effect. It proclaims the policy of increased level of education for the poor and middle class to increase the level of life satisfaction in the country. Furthermore, the health channel is found significant in most of the models i.e. full sample, for both genders, poor and middle class, it implies that the good of education is effectively translating to health and then to the life satisfaction of individuals. So the policy of increased education will also lead to increased health in the country. Although, the current study is first in its nature for Pakistan and identified the broken links between education and life satisfaction the research gap remains to find the reasons for broken paths. The research is also needed to formulate appropriate policies to address these issues of broken paths and strategies to mend them to reap the full benefits of an increased level of education in the country.

The second essay was aimed at analyzing the effect of education at a macro level. The time series analysis for period 1985-2018 is performed to see the effect of different levels of education on output per employed person of the agriculture sector, industrial sector and services sector and the overall economy. The analysis of the impact of different levels of education of employed persons shows that each level of education whether its primary, secondary or tertiary have a positive effect on the output per employed person both in the short-run as well as in the long-run. It is true for the overall economy, industrial and services sector but the agriculture sector gives somewhat different results. In the agriculture sector, it is found that each level of education is negatively associated with the output per employed person. The deeper analysis showed

us that the greater negative effect of employment evades the positive effect of education in the agriculture sector. However, when the effect of education is considered on output, controlling for the effect of employment in the model, the coefficients turned to be positive. The comparison of different sectors for each level of education shows that primary education contributes more to the industrial sector. While the contribution of the secondary and tertiary level of education is highest in the case of the services sector. It implies that primary education is best utilized in the industrial sector as compared to other sectors. While secondary and tertiary education is more efficiently used in the services sector as compared to the industrial and agriculture sector. It is true both for short-run and the long-run.

The third essay attempted to compare the education sector based on some very basic statistics like gross enrollment ratios and student-teacher ratios in each level of education, with a group of better-performing countries. The composition of government expenditure on different levels of education i.e. primary, secondary and higher level of education is also compared with the practices in better performing countries. The projections are also made about these basic educational sector statistics for the next two decades. The following conclusions are drawn on the analysis performed in the third essay. Gross enrollment ratios in Pakistan is below the required level for all levels of education i.e. primary, secondary and tertiary level of education. It is found that the numbers of enrollments are far below the required level of enrollments at each level of education. Wide differences exist between actual and required student-teacher ratios in primary and tertiary level of education. The actual value of the student-teacher ratio is closer for the secondary level of education, however, this is at the cost of low enrollments at the secondary level. Huge differences exist between the actual and required number of teachers in the system of each level of education. Analysis of the

distribution of the government's recurrent expenditure on different levels of education shows that Pakistan is spending more than the required proportion of its spending on education to the primary and secondary level of education. It results in spending less than the required proportion, to tertiary education. It is also deduced from the analysis that the proportion of capital expenditure in overall government expenditure on education is less than required.