Role of Higher Education in Economic Growth in Pakistan

Thesis

Dated: August 6th, 2019.

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CERTIFICATE

This is to certify that this thesis entitled: **"Role of Higher Education in Economic Growth in Pakistan"** submitted by Mr. Zahoor Ahmad Khan is accepted in its present form by the Department of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Economics**.

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Dedicated to

All the out of school children (OOSC) and those who could not and cannot attain higher education for they are an eternal source of inspiration for me. Finally my humble efforts are dedicated to everyone around who motivated me to work hard and smart.

Table of Contents

List of Figures

List of Tables

Abstract

This study is designed to track a direct link between higher education and economic growth in Pakistan from 1985 to 2017, backed by literature. In addition, we investigate a long run and causal relationship between higher education and economic growth using annual time series data. This is done so by the application of Johansen Cointegration and Granger Causality. To do so, the impact of higher education enrolment on economic growth is analyzed. The thesis also gives an insight into the history of higher education and research in the country and its trend during the given period. Furthermore, the research also provides implications for policy purpose to develop higher education and hence improve productivity, growth and living standards.

Chapter 1

Introduction

1.1. Background

Higher education has been turned vitally important asset and immensely prized in an era of rising intellectual abilities. It can engender great philosophers, innovators and scientists who could bring forward sustainable solutions to some of the most pressing problems the world is facing now. High living standard and social mobility has been a dream for the people of both developed and underdeveloped countries and it is evident that developed countries have achieved this breakthrough by democratizing education and scientific knowledge. The developed countries are still in the pursuit of the dream. Actually this is the diverse research in the great institutes of the world that has provided great facilities for political ideologies that have resulted in shaping the fortunes of nations and innovative ideas that could boom businesses.

According to Lockheed, Jamison and Lan (1980), a wide portion of research on education and its impact on economic growth elucidate their strong positive correlation. On the other hand, there is significant decline being witnessed as a result of high drop out ratio from schools (Seebens and Wobst, 2003).

In addition, if we talk about the modern growth theory, it also elaborates that investment in human capital and economic growth are positively related. This is also evident from empirical evidence which generally highlight that human capital has a statistical significant and positive relation with GDP per capita. According to Artadi and Sala-i-Martin (2003), had the primary school enrolment PSE in African countries been

good like that in OECD countries, then the average growth rate of per capita income in a year in Africa would have been 2.37 percent and not 0.9 percent as recorded in the last four decades or in other words, the growth rate would be twice than what the per capita GDP had been for the past 40 years. This is the importance of higher education.

Though it is clear from the literature than investment in human capital positively effect the growth in the income per capita, it is not however clear which level of education actually has the positive impact over growth.

Some researchers however argue that it is higher education that positively impacts the growth of economy (Hones and Hall 1999; Romer 1990; and Phelps and Nelson 1996) while others are of the view that primary education contributes prominently to economic growth in countries that are least developed (Petrakis and Stamatakis, 2002; McMahon, 2002). If there is a rise in education attainment with rise in level of income, it should not surprise you that tertiary/higher education becomes more significant for economic growth as income level rises. Having said that, it would be evident that higher income countries would have attained universal primary education whereas least developed countries would be looking into increasing both higher and lower levels of education.

1.2. Motivation of the study:

The primary motivation behind this study is to see the impact of higher education on the growth of the economy. And It has been argued that the most appropriate and purpose oriented strategy to achieve economic growth in the long run is to promote higher education and enhance the facilities for research and development. Investment in

human capital contribute to the GDP, improve skills which provide employment to working age population, ensures income equality, helps in reducing poverty and improving the living conditions of the general population. However, time series data as well as literature is very limited to elucidate this scenario in Pakistan.

Numerous studies have been conducted around the world at regional and country level to investigate the importance of school education. However, the case of higher education in Pakistan is not really explored in detail, and it looks pretty imperative to dive into details of the study. Therefore, there is an urgent need to study the impact of higher education, research and development in Pakistan that in turns determines the economic growth of the country.

1.3. Objective of Study

- The first objective of my study is to establish a theoretical relationship between economic growth and higher education in Pakistan, backed by literature from 1985-2015.
- To evaluate empirically a long run and causal relationship between economic growth and higher education in Pakistan.
- Finally to investigate the historic trend of higher education in Pakistan and its role in the economic growth of the country.

A detailed study of previous researches from around the world elucidates that higher education does have some significant impact on economic growth of a country. The launch of different schemes and initiatives in third world countries to improve higher education have been instrumental in the acceleration of economic growth. So I am

focusing on a broad overview of the correlation between higher education and economic growth in the country which could be instrumental in the precise policy formulations in the country for the uplift of education and intensifying the prospects of growth in days to come.

1.4. Organization of the study:

This thesis has been organized into six chapters. Chapter 2 contains review of literature about the study. Chapter 3 deals with sources of data and data. Chapter 4 deals with analytical framework of the study. Chapter 5 depicts empirical results. Finally, chapter 6 concludes the study and outlines policy implications.

Chapter 2

LITERATURE REVIEW

2.1. INTRODUCTION

Since development economics focuses on the importance of education as one of the major factors in the economic development of a nation, Solow (1956, 1957) iterated the same thing that a mere rise in the capital and labor could not explain economic growth. The concept that human capital besides capital and labor also affects the economic growth was presented by Lucas (1998) in his endogenous growth model and education as a source of human capital accumulation. According to Lucas, education is a way of accumulation of human capital and besides labor and capital was regarded as a factor of production. This means that the educational attainment of the labor force could lead to more efficiency in terms of productivity and hence an appreciated economic performance at aggregate level (Chaudhry, Iqbal, Gillani 2009).

There is this general perception that the sole purpose of education is to engender a developed human capital but education cannot alone do that thereby diverting our attention to social activities and other actions that could possibly lead to human capital accumulation. Fogel (1994) iterated that besides education, Physical strength, better health and skills contribute and are instrumental to the level of accumulated human capital.

Barro(1991) conducted a research with a sample size of 98 countries between 1960-1985 and found out that growth rate and the initial level of human capital which was measured by rate of school enrolment had a positive relation. In addition, he reported a negative relationship between GDPP and initial school enrolment in the short run. Mankiw *et el* (1992) measured human capital accumulation by education level and reported significant role of education to human capital accumulation, upon extending Solow's model.

Moreover, Lee and Barro in 1993 researched about the rate of schooling success at primary, secondary and tertiary level of education in adult population in 129 countries from 1960 to 1985 and reported a positive and direct relationship between GDP growth and education.

In the same way, Spiegel and Benhabib in 1994 came up with the results that the years of education of the working population have no significant effect on the rate at which the per capita output grow. However, level of human capital substantially do effect per capita income positively.

After Lucas (1998) had developed the endogenous growth model that reflected human capital one of the factors of production and education as a way of accumulation of human capital, Gutema and Mekonnen (2004) also found out that education positively influences growth rate of the economy.

McMahon (1987), Voon (2002) and Horii *et al* (2007) elucidated the link between tertiary education and its impact on economic growth. In addition, McMahan (1987) reported a long term positive effect of about seven and a half years of higher education on income growth. Voon (2002) described it in terms of investment and argued that the more

the level of higher education as a result of elevated investment, the stronger will be its growth impact on economy. However Horii *et al* (2007) argued that rise in higher education does raise the earnings of individuals, however its long run impact on economic growth is ambiguous.

But the existing empirical literature which focuses on the impact of education on economic growth incorporate many issues as well. There could be use of for example different kinds of variables as proxy variables for human capital. According to data, researchers like Khalifa (2008), Chandra and Islamia (2010) and Pradhan (2009) used public educational expenditure as proxy variable for human capital. In the same way, Maksymenko and Rabbani (2009) used average years of schooling and Agiomirgiannakis and Astoria (2001) and Babatunde and Adefabi (2005) use enrolment rates in all level of education as proxy variable for Human Capital.

According to Perrakis and Stamatakis (2002), the extent to which education affects economic performance of a country is determined by how developed the country actually is. It is the primary and secondary education that benefits the low income countries however the high income and developed countries are much benefited by higher education (research and development).

The fact that human capital through education has a positive and enormous contribution to development has been well documented. Majority of the literature and research on higher education and productivity reveal a positive correlation between the two (Lockheed, Lan and Jamison, 1980). In the same way, high dropout ratio from universities and schools is responsible from decline in human capital and ends up

hampering growth of the economy and the process of development (Seebens and Wobst, 2003).

McMahin (1998) researched with cross-country comparision on East Asia using panel data and measured human capital by rates of gross enrollment GER and reported that expenditure in secondary education and higher education had been instrumental in accelerating economic growth in the long run.

Two periods are of significant importance regarding economic growth which are firstly the era between 1950s and 1960s and secondly the late 1980s and 1990s. Physical capital emerged as a major factor that contributed more towards economic growth back then which is something Neo Classical growth theories are all about. According to Neo Classical theorists, a rise in the physical capital triggers the growth of the economy. In the growth models put forward by Solow in 1956, Coupmanes and Cass in 1965 and finally by Romer in 1987 and Barro in1990, both technological progress and population were determined exogenously.

However research on the first period growth theories failed to put forward an economical answer which could help in the quest for achieving economic growth that is sustainable. In the second period, it was the skill acquisition of human capital and knowledge-that paved the way towards achieving a sustainable economic growth.

In the growth models by Romer in 1986 and 1990, and Lucas in 1988, it is elucidated that education as a variable is one of the major players in the growth of economy. In addition, Levine and Renelt (1992) summarized that education happen to have an extra significant and positive impact on economic growth.

Investment is human capital especially in the young population through provision of good schooling is a significant contributing factor of the growth of economy in the long run. Schooling according to research is consistently found to have enhanced both productivity and earnings of individual. *Emadzadeh et al* (2000) researched to inspect the link between higher education and growth of economy in Iran and found significant results. Nafisi and Nili (2003), Mohamadi in 2006, Memernejad and Komijani in 2004 and Dargahi and Gadiri (2003) researched and found out significant results in explaining positive correlation between education and growth in long run in Iran.

Chatterji (1998) argued that proxy variables like primary, secondary and tertiary enrolment rates could be used to measure human capital. In countries where school enrolement rate is high, the progress in terms of achieving high per capita income happens to be high because productivity tend to increase rapidly with high enrolment rates (Klenow and Bils 2000). Development of a country depends on the economic performance and the economic status of the economy of the country. Labour productivity is a significant factor that boosts the country's economy and labour productivity in turn is defined by education. Moreover, Seebens and Wobst (2003) stated that rise in education level attained by individuals, in the long run, leads to an increased household income and hence high economic growth.

2.2. Historical trends: Higher Education and its Role in Economic Growth in Pakistan

Pakistan came into existence in 1947, with an initial literacy rate of not more than 10% and only 10,000 primary schools but only one university and that too in Punjab so

education had been pretty freaking in general and higher education in particular around the country which was one of the reasons of such a slow economic growth of the country. After implementation of reforms and various policy measurers, a rise in the literacy rate was observed in the country with 29.5% in 1980s, 40.7% in 1990s, 52.7% in 2000s and 57.4% in 2008-09 respectively which of course improved the economic condition of the country a bit but even this rise in literacy rate was super lower than what the Millennium Development Goals' literacy rate is.

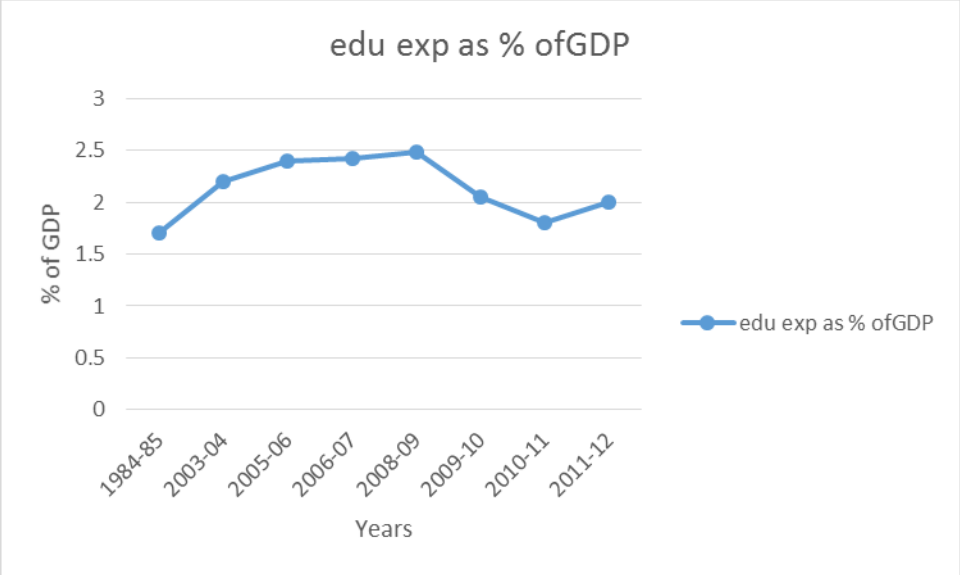
The declaration of National Education conference NEC which was the first documented move towards defining education goals and policies in the country back in 1947 showed that government is committed and curious about education. According to [Khalid and Fayyaz (2006)], in the past 71 years there have been eight national education policies for education and in addition to that, several committees and commissions have been put to work by some governments, an effort to changes the structure of education in Pakistan and formulate efficient policies but the targets set up every time have stayed vague up to date.

However the government could feel the need for higher education and research very well and initially had planned to improve literacy rate to more than 85% by 2015 but it never happened due to various reasons. In addition, the expenditure on education in general and higher education in particular had been pretty down and had been far below what UNESCO sets for a country. According to UNESCO, the minimum a country should spend on education should be at least 4% of its GDP but the maximum Pakistan has been spending on education is no more than 2.49% as of 2012 and details are tabulated below.

Table 1: Education Expenditure as Percentage (%) of GDP

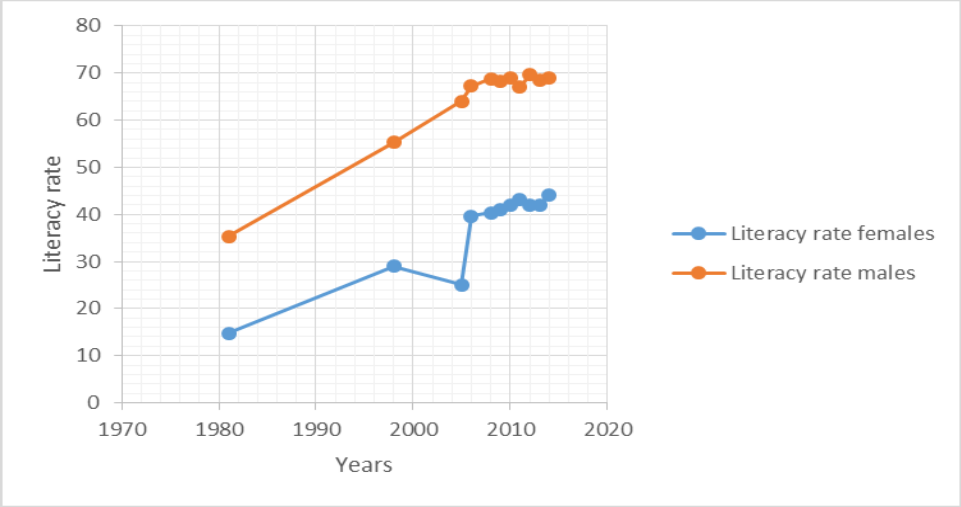
1984-85	2003-04	2005-06	2006-07	2008-09	2009-10	2010-11	2011-12
1.7	2.2	2.4	2.42	2.49	2.05	1.8	2.0

Source: Country report 2013 by Ministry of Education and Training



In addition, according to UNESCO, Pakistan has amongst the widest education inequalities around the globe with as many as one quarter of 7-16 years old never been to school and the situation at higher level is yet more when it comes to gender ration of higher education attainment.

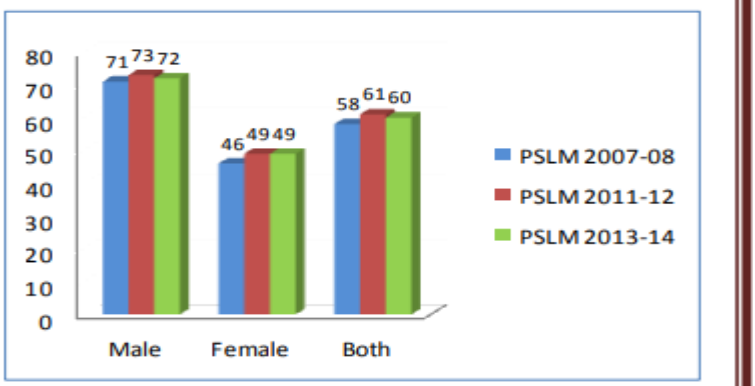
This varied from region to region, gender and wealth status. Girls from the poor families were the most disadvantaged around the country when it comes to higher education. An example of district Swat with only 1 out of 3 girls been going to schools. Higher education was next to zero. According to Pakistan Bureau of Statistics, only 7.8 percent of adult women in erstwhile FATA were literate compared to 45 percent of men.



Source: UNESCO

More than half of the population with aged 10 and onwards have never been to schools. It was 61% in 2011-12. According to data from various issues of PSLM, 82% female in urban areas of the country and 61% in rural areas have ever attended school as compared to 40% of urban and 20% of rural females. Regarding males all the four provinces have shown a similar increasing trend.

Figure 2.1: Population that has Ever Attended School



Source: PSLM

2.3. Higher Education led Growth:

However, this has been pretty obvious that a rise in higher education and research and innovations leads to economic growth and this is the reason higher education commission has been working crazy and has been pretty instrumental in launching various schemes and scholarship programs under which students around the countries are given free education till PhD and the schemes are focused to a great extent on the unfortunate people from backward areas of the countries like former FATA and Baluchistan.

The country is bestowed with highly abled manpower but the scarcity of good research and development facilities and funds, highly educated people leave the country to find better lives abroad and thus this lead to brain drain. In order to stop the brain drain, government has been taking steps to improve faculty and promote research facilities and labs availability in higher education institutions around the country. For this provincial, government has launched scholarships schemes and programs on federal and provisional level. According to data from HEC, around 3237 scholars have been enrolled in PhD programs in different universities recognized by HEC around the country from in the past four years under HEC PhD scholarship program. Moreover, 2600 scholars were sent to complete their PhDs from foreign universities under PhD scholarship in 2007 to 2008.

Different universities have been established across Pakistan with the collaboration of countries like Germany, Australia, China and finally France at a total cost of 164.8 billion rupees. Moreover, to support high quality research and innovation a number of central research labs have been set up in different institutions across the country.

Higher education has been considered as one of the main and leading instrument in forming the economic base of the country in long run. But the condition of higher education has been a pity for so long in Pakistan. It has been just few years back from now that people in the cities have started getting enrolled in graduate level studies in universities and colleges. This has pushed up the research and development as well.

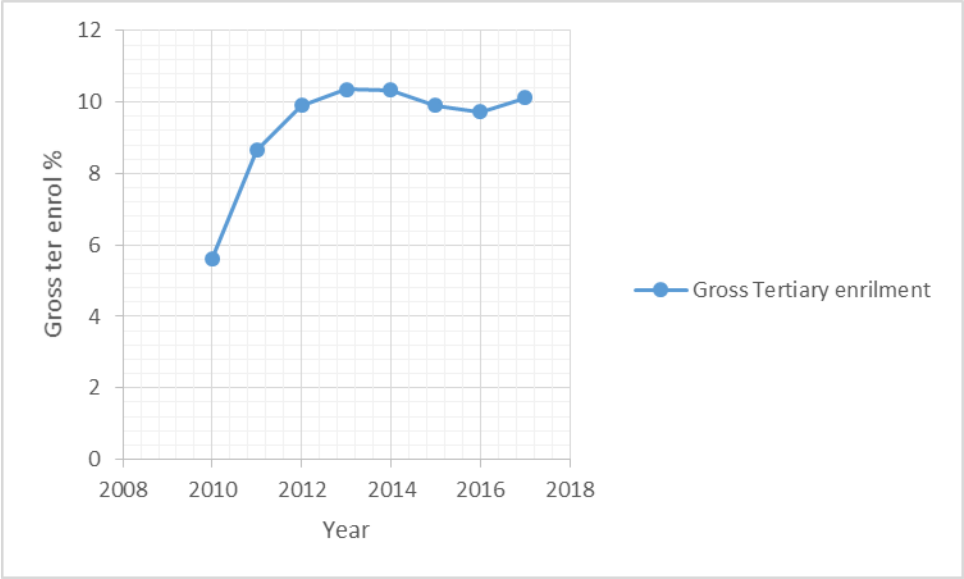
But the government is attempting every possible effort to expand both quality and quantity of education in general and higher education in particular. This could only be done if the government enhance the facilities in the educational institutions and do so within minimum possible time. Compared to a 45% literacy rate in 2001-2002, the literacy rate improved by 10 points reaching 55% in 2006-2007 which is a big jump in a span of six years. [Source: Pakistan Integrated Household Survey PIHS (various issues)].

In addition, tertiary education enrolment increased at tremendous rate in the last seven years reaching from a gross 5.6% in 2010 to 10.11% in 2017.

Table 2: Gross tertiary enrolment (%) from 2010 to 2017 in Pakistan.

2010	2011	2012	2013	2014	2015	2016	2017
5.6048	**8.6522**	**9.9149**	**10.3541**	**10.3382**	**9.9100**	**9.7335**	**10.1188**

Source: World Bank and WDI



So to achieve a sustainable economic growth, it is imperative to carry on initiating programs that leads to poverty alleviation and give rise to improves social and economic infrastructure especially education. Pakistan has been facing a chaotic unsustainable economic growth since independence and along with factors like inflation, mounting foreign debt, increasing fiscal deficit and debt servicing, low standard higher education and absence of research and development facilities is primarily responsible for the scenario. The importance of higher education in case of developing countries could be understood in two ways. Firstly, it is education which bestow people with the ability to make decision which instill or give rise to gender equality. Secondly, higher education and investment in research and development give rise to more sustainable solutions to pressing problems and hence to sustainable development.

Primarily, there are already well established links between tertiary education (research and development) and economic growth. Tertiary education give rise to more employment and increased wages as a result of improved skill. Economic growth, level

of productivity and per capita rise in income are closely linked to higher education. In addition to this, the ever rising sheer significance of knowledge and skill based process in economic growth have increased both the cost associated with education deficit and the premium of education.

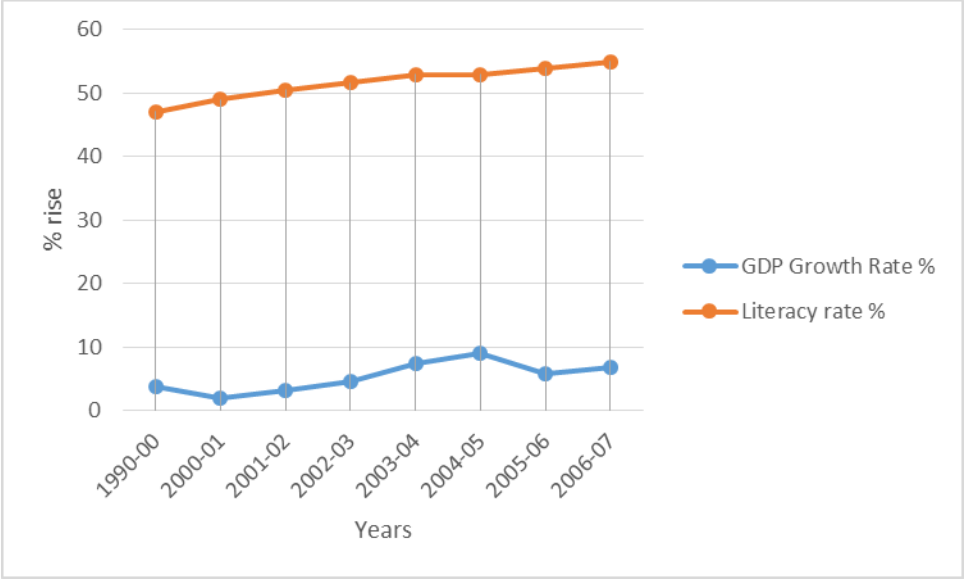
But according to data from HEC, various programs have been launched to provide scholarships to students perusing higher education in government universities to ensure their smooth graduation and the entry into the labor market. In addition, for international doctorates and post-doctorates, Pakistan in collaboration with US has launched US-PAK Knowledge Corridor under the HEC banner which provides opportunities to students from Pakistan to peruse their masters and PhD studies and research in best universities in the US. This has enabled numerous individuals graduate from the best research oriented institutions and play a role in the upbringing of the economy of the country.

According to World Bank and UNESCO, this is an open secret that the more productive the individuals of a society are, the more advanced and constructive the country will be with a high DGPP. From 1980 till today, there has been a rise in the literacy rate of Pakistan as a result of various policies in the country and this is one reason of a rise in the GDP of the country. The following table from 2002 till 2008 shows the trend of rise in GDP as a result of rise in the literacy rate of a country.

Table 3: GDP Growth rate vs. Literacy rate

Year	Growth rate as % of GDP	Literacy rate in %
1999-00	**3.9**	**47.1**
2000-01	**2.0**	**49.0**
2001-02	**3.1**	**50.5**
2002-03	**4.7**	**51.6**
2003-04	**7.5**	**53.0**
2005-06	**5.8**	**54.0**
2006-07	**6.8**	**55.0**

Source: Data is taken from WDI and UNESCO Yearbook (various issues).



The table and graph shows that there is a rise in the GDP of the country with every rise in the literacy rate of the country. In January 2019, Pakistan vows to increase

its literacy rate from 58% to 70% in a period of four years till 2023 by making possible the provision of cheap but quality education to the people of the country. Special allocation of funds for improving higher education and research has been the main goal of the current government (Pakistan Education Ministry).

CONCLUSION

The higher education led growth proves that despite the initial slow and low standard progress of higher education, steps taken by the government and higher education commission since 2002 have been instrumental in giving rise to high literacy rate, skilled labor and innovative individuals in the economy who have been able to perform productively thereby imparting growth to the economy. This is something that is proved by data from World Bank and Pakistan Education Statistics. There has been a rise in the standard of living, GDPP and employment besides rise in productivity and industrialization.

CHAPTER 3

DATA AND VARIABLES

3.1. Introduction

This study aims to inspect the effect of higher education on economics growth in Pakistan. In order to achieve this objective, time series annual data is collected covering the period from 1985 to 2017. To meet the objectives of the study secondary data is mined from different reliable sources whereas variables are constructed according to economic theory

3.2. Data Sources

We have used time series data covering the period from 1985-2017 for this study. Data is mined from Economic Survey of Pakistan (various issues), WDI, UNESCO, PSLM and State Bank of Pakistan records. The variable K_t, represents gross fixed capital formation which is also a proxy variable for physical capital. Y_t, is aggregate output and real GDP is used as proxy variable to measure economic growth. L_t, represents labor fore which is actually the overall size of employed people a year. H_t represents higher education and is defined by the size of enrolled students in university programs.

According to study (1985-2017), the following variables have been taken which are instrumental in assessing the impact of higher education on economic growth of Pakistan.

Dependent Variable

Gross Domestic Product per Capita GDPP:

GDP per capita represents the total GDP of the country divided by the total number of population of the same country. It is taken as dependent variable. Some of the data points were missing that have been generated through trending. This variable is used to figure out the exact impact of higher education and other independent variables upon economic growth.

Independent Variables

Tertiary Education Enrolment TEE:

Higher education enrolment tells us about the higher education enrolment rate in the country. I have obtained the data from 1985 to 2015.

Higher Education Expenditure HEX:

Higher education expenditure as percentage of GDP shows the portion of overall GDP in percent that is spent on higher education in the country. Data is taken from World Bank and Pakistan Education Statistics.

Trade Openness:

It includes both exports and imports which are components of international trade.

- Export is function of international trade whereby good and services produced in one country are sold to other countries for benefits and inflow of money. It is in other words an inflow of credit to the economy from the economy of the country purchasing the goods and service. Tariffs and subsidies can lead to huge export led growth.

- Imports are the purchase of goods and services by a domestic economy from a foreign economy. It is in other words an outflow of credit from the country and inflow of credit to the country that is selling the goods and services.

Gross Capital Formation:

Capital formation is a term used in macroeconomics to describe net accumulation of capital during an accounting period for a specific country. It actually refers to the addition of capital goods such as tools, transportation assets and equipment and electricity. Capital accumulation is important because it helps scale the overall production in a country as country needs capital goods to accelerate the production of goods and services. Production normally tend to decline and dwindle when a country does not replace its capital goods as they cross the capacity of efficient production. An economy would be able to grow its aggregate income faster if the pace of capital accumulation is accelerated.

Table 4: Variables and data sources

Variable	Definition	Source
Gross domestic product per capita	Represents real GDP/size of population	World Bank
Tertiary education enrolment	Higher education enrolment tells us about the enrolment rate in the country.	World Bank
Higher education expenditure	Expenditure on higher education as a percentage of GDP	World Bank
Exports	Good and services sold to other countries for money.	World Bank
Imports	Good and services purchased from other countries for use.	World Bank
Gross capital formation	Net accumulation of capital during an accounting period for a specific country.	World Bank

Chapter 4

Analytical Framework

4.1. Introduction

We provide a comprehensive detail of estimation methodology and econometric model is presented to empirically inspect the role of higher education in economic growth of Pakistan. This study employs time series data that cannot be handled as ordinary data due to time trends in the series. Due to which the regression results become spurious. Therefore, for the estimation of time series data we will pursue the following strategy.

First of all, time series properties of the variables are tested so section 4.3 deals with the brief description of Unit Root tests. The estimation technique used in our analysis Johansen Co-integration is discussed in section 4.4. Whereas, Granger Causality is discussed in section 4.5 while Vector Error Correction Model (VECM) has been elucidated in section 4.6. Finally, section 4.7 summarizes the chapter.

4.2. Specification of Econometric Model.

Studies related to economic growth normally begin with the model presented by neoclassicals called the neoclassical model. This model was originally presented by Solow in 1956 and later on extended by Mankiw, Romer, and Weil in 1992 in which they included human capital. This model is generalized as follows:

$Y_t = A_t K_t \alpha H_t \beta L_t 1 - \alpha - \beta e_{1t}$ While t = 1, 2…

Here, Y_t represents the aggregate output of the economy. At shows the productivity of each factor of production. Kt represents the real capital stock, L_t defines the employed labor force, Ht denotes higher education enrolments at time t. e_{1t} depicts the error term of the equation.

To convert the equation into linear form, we take natural log on both sides.

$$\ln Y_t = \ln A_t + \alpha \ln K_t + \beta \ln H_t + \gamma \ln L_t + e^2{}_t \text{ ;} \qquad t = 1, 2\ldots$$

In this linear equation, α, β, γ (1-α-β) represents the elasticity of production with respect to capital, with respect to human capital and with respect to labor respectively. Moreover, lnAt is a constant parameter. e_{2t} represents the influence of all those variables which indirectly affect the model and not directly.

So the specification of the regression model for different variables including economic growth and higher education is given as follows.

$$Y_t = \alpha_\circ + \alpha_1 TEE + \alpha_2 GCF + \alpha_3 HEX + \alpha_4 X + \alpha_5 M + \varepsilon_t \quad t = 1, 2\ldots$$

Where;

- Y_t = Economic growth (GDPP as proxy variable for economic growth). The proxy however has already been used by Jin (2008), Peck and Abbas (2007) and Iqbal, Chaudhary and Gillani (2009).
- GCF = Gross capital formation is presented as a measure for physical capital in real terms. This proxy for net capital accumulation has previously been used by Peck and Abbas (2007) and Iqbal, Chaudhary and Gillani (2009).
- HEX = Higher education expenditure
- X = Exports
- M = Imports

- TEE = Tertiary education enrolment
- α_1 is the elasticity of GDP with respect to tertiary education enrolment. It measures the percent change in GDP for a percent change in the tertiary education enrolment keeping all other factors constant.
- α_2 is the elasticity of GDP with respect to gross capital formation. It measures the percent change in the GDP as a result of percent change in the gross capital formation, other variables being constant.
- α_3 represents elasticity of GDP with respect to expenditure on higher education. It shows the percent change in the GDP of the country due to a percent change in higher education expenditure of the country, other variables being constant.
- α_4 represents elasticity of GDP with respect to exports. Percent fluctuation in GDP as a result of percent changes in exports with the rest of variables constant.
- α_5 is the elasticity of GDP with respect to imports. What will be the percent change in the GDP of the country due to percent change in imports is shown by α_5, other variables being constant.

The sum ($\alpha 1+\alpha 2+\alpha 3+\alpha 4+\alpha 5$) provides details about the returns to scale. If the sum = 1, we have CRS that is there is the presence of constant return to scale and doubling the inputs gives a 2x output.

Since this relationship between explanatory variables and GDP is not linear and we need to convert it to a linear relationship for which we take natural log of the equation as follows.

$$\ln Y_t = \ln \alpha_\circ + \alpha_1 \ln TEE + \alpha_2 \ln GCF + \alpha_3 \ln HEX + \alpha_4 \ln X + \alpha_5 \ln M + \varepsilon_t \quad \text{(04)}$$

Now the model (04) is linear in parameter and is hence a linear regression model. Though it is nonlinear in variables Y and X, yet it is linear when you apply log of these variables. So the equation is a log-linear model with properties of Cobb-Douglas production function.

4.3. Unit Root Test

To inspect the effect of higher education on economic growth, we make use of time series data which usually suffers with non-stationarity issues, which can lead to the spurious results. This issue arises when mean and variance of the data are not constant over time and the co-variance between the time periods depends on the actual time for which it is computed and not on the lag of two time periods. In other words, results are not generalized and represent only a particular period of time. Therefore, it is essential to look into the true order of integration of time series data.

To explain that why we need to test the non- stationarity of data following arguments can be provided:

- The behavior and characteristics of time series data are profoundly influenced by the stationarity.
- Due to high R^2 values of the variables trending over time, it can lead to spurious regression results, even if they are totally unrelated.
- Due to non-stationary variables in the data, the assumption of asymptotic analysis becomes invalid. As “t-ratios” do not follow the t-distribution so we can’t take hypothesis test.

To handle this issue, many techniques and tests are suggested in literature among which "Unit Root Test" is widely used. The pioneer work on this test was done by Dickey and Fuller back in 1976. The Objective of the test is to check for the hypothesis ∅ = 1 in the following equation:

$$Y_t = \phi Y_t - 1 + \upsilon_t$$

Against the alternative hypothesis, that ∅ < 1.

To test for the unit root in data, there are many test like Augmented Dickey Fuller Test (ADF), Phillips Perron test (PP) and Dickey Fuller GLS Test available. used. However, in this study, we use Augmented Dickey Fuller Test (ADF) to test for the unit root in the data. These tests have been used because of their popularity in time series analysis.

Augmented Dickey-Fuller Test (ADF):

The econometric tool is named after David Dickey and Wayne Fuller. This test is used to check whether Unit root is present in autoregressive model or not. Dickey Fuller (DF) test is based on the assumption that the error terms are serially uncorrelated which is generally violated in complex economic models. That's why this study incorporate augmented version of this test commonly known as augmented dickey fuller test which basically relax this assumption. So we can apply ADF test for the models where error terms are serially correlated.

The three basic models for testing unit root are:

- When there is no constant and no trend:

$$Y_t = \phi Y_t - 1 + \mu_t$$

- Presence of constant but no trend:

$$Y_t = \alpha + \phi Y_t - 1 + \mu_t$$

- Both constant and trend:

$$\Delta Y_t = \alpha + \phi Y_t - 1 + \beta + \mu_t$$

ADF tests the stationarity of the variable. If the statistics of the test are lying in critical region for specific level, then the series is considered to be stationary. Moreover, it is assumed to be integrated of order zero (also known as level stationary). In other case, the series is non-stationary. The test is again conducted by taking difference and if the null hypothesis is accepted it is integrated of order 1. However even if the series is still not stationary of of order 1, the test is applied yet again and if null hypothesis is accepted after the second difference, it is then integrated of order 2 and so on.

Choice of Lag Length

Next step is the choice of lag length, which is very important in case of time dependent data. It help to achieve the normally distributed error terms with no autocorrelation and heteroskedasticity problems. There are several ways to choose the optimum number of lags such as Akike info criteria, Swartz Bayesian information criteria. The model with minimum AIC or SBC or maximum or R^2 is chosen for analysis.

4.4. Johansen Co-integration Method:

In economic theory, we considered the variables to be cointegrating if they have long run relationship between them (Rao, 2007). This cointegrating relationship can be studied using Johansen technique, Engle-Granger technique, or auto regressive distributed lag (ARDL) based on integration of the variables within the model.

If time series data is stationary at level, then we test time series data with OLS (ordinary least square) method because the variances and means of data are constant. When we have non stationary time series, then this assumption is violated and hence the results we obtain are usually biased or misleading. If variables are stationary at first difference i.e. I(I) then Johansen method or Engel-Granger method is used. But if variables have different level of integration then ARDL method is used for analysis. ADF and PP tests incorporated for time series data suggest that Johansen's technique can be used for analysis as variables are integrated to order 1 i.e. I(1).

Johansen test takes name after its pioneer Soren Johansen (1991). The test allows multiple cointegration relationship, so it is considered generally more practical as compared to Engle granger causality test, which create problems when more than two variables are used due to the possibility of multiple co-integrating relationships.

As time series data may have deterministic, stochastic trends as well as non-zero means. The cointegration equations similarly might also have deterministic trends and intercepts. The distribution of LR stats for cointegration lacks the usual X2 distribution and relies upon the assumptions regarding the deterministic trends. So in order to carry out the test properly one needs to make some assumptions regarding the trends and

intercepts. In this study, we consider case 2 and case 3 for Johansen co-integration. Here, case 2 shows the specification where the error correcting equation includes an intercept but no trend, while (VAR) model includes no intercept or trend. Similarly, the case 3 shows the specification where the error correcting equation includes an intercept but no trend, while VAR model includes an intercept but no trend.

4.5. Granger Causality

Granger Causality is an econometric tool to inspect causality between two variables in a time series. The method is a probabilistic account of causality. In order to find patterns of correlation, empirical data set is used. Causation is strictly related to the concept of cause and effect although it is not exactly the same. Two variables are causal to each other if the first cause the second. In our case, we check our time series variable for granger causality to see if one causes another.

4.6. Vector Error Correction Model:

VECMs are used to test if the long run established equilibrium is stable or not. This analysis incorporate restricted VAR technique i.e. Vector Error Correction Model. In this technique the variables are regressed on its own lags and on the lags of variables incorporated in analysis to measures the speed at which the dependent variable comes back to equilibrium after variation in other variable. In other words, VECM measures the speed of convergence.

4.7. Conclusion:

The methodology used in the empirical analyses is elucidated in the chapter. We have also thrown light as to why the study incorporates these econometrics models. So analyzing the time series trends will assist us to inspect the true and basic cause of effect of higher education inn improving economic performance Pakistan.

Chapter 5

ESTIMATIONS, RESULTS AND DISCUSSION

Introduction

This chapter is about the interpretation of empirical results which eventually explain the link between higher education and economic growth with reference to Pakistan. In the chapter, section 5.2 contains results for ADF test. While section 5.3 provides details about results of Johansen co-integration test. The results for Granger Causality and Vector Error Correction Model (VECM) are elucidated in section 5.3 and 5.4, respectively. Finally, section 5.5 provides a summary and conclusion of the chapter.

5.1. Unit root test results:

ADF is applied to investigate order of co integration of our data series. All the variables are found to be integrated of order I(1) by including the trend and intercept term.

Table 5: ADF Test Result

Variable	Level	1st difference	Order of integration
GCF	-2.541432	-5.523430	I(I)
HEX	-3.321924	-7.408934	I(I)

X	**-1.917360**	**-4.928159**	**I(I)**
M	**-1.046012**	**-4.8276902**	**I(I)**
TEE	**-1.432836**	**-6.778478**	**I(I)**
GDPP	**-0.912084**	**-5.419063**	**I(I)**
The 5% critical value for all variables is -3.5628.			

The above table 4.1 is related to our ADF results. We have six series and all these series are stationarity at first difference. We compared the values at first difference with 5% probability that is 0.05 which is same for all the variables.

- For GCF, -5.523 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.
- For HEX, -7.408 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.
- For X, -4.928 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.
- For M, -4.827 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.
- For TEE, -6778 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.
- For GDPP, -5.4190 is more than critical value -3.56 so we accept the hypothesis of stationarity at first difference.

5.2. Johansen Co-integration Results

In the light of the unit root test results given above, since each of our time series is stationary at first difference, this implies that our variables are co-integrated of order one. According to Engle-Granger (1987) if time series are stationary at same difference, it indicates the presence of a long run equilibrium.

Since all of our time series are integrate of same order that is first order, we apply Johansen and Juselis (1990) co-integration technique. The Johansen (1988) and Johansen and Juselius (1990) maximum likelihood cointegration technique tests both the existence and the number of cointegration vectors. Johansen's technique has two maximum likelihood ratio tests namely, maximum Eigenvalue test and trace test. The study proceeds to apply maximal eigenvalue and trace tests.

Table 6: Co-integration result

Hypothesis of No. of CE(s)	Eigen-value tests	Trace test	Critical value 5%	Prob.
None *	0.804475	143.6453	95.7536	0.0000
At most 1 *	0.683132	93.05120	69.8188	0.0003
At most 2 *	0.655370	57.42388	47.8561	0.0049
At most 3	0.392049	24.40004	29.7970	0.1841
At most 4	0.251309	8.972549	15.4947	0.3679
At most 5	8.14E-06	0.000252	3.84146	0.9891

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

In case of co-integration results, we compare probability of Trace test with 5% probability that is with 0.05 value. So on this basis, we do not accept the null hypothesis of no co-integration and actually reject it for three equations and thus conclude that there are three co-integrating equations after the values of trace statistics are compared with 5% probability. There is long run equilibrium between our three equations which was the first objective of the thesis. So both the results of Johenson Co integration shows that there is a long run equilibrium between higher education and economic growth in Pakistan.

Table 7: Co-integration result

Hypothesis of No. of CE(s)	Eigen-value	Max-Eigen value	Critical value 5%	Prob.
None *	0.804475	50.59407	40.077	0.0023
At most 1 *	0.683132	35.62732	33.876	0.0306
At most 2 *	0.655370	33.02384	27.584	0.0090
At most 3	0.392049	15.42750	21.131	0.2601
At most 4	0.251309	8.972297	14.264	0.2885
At most 5	8.14E-06	0.000252	3.8414	0.9891

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)
Max-Eigen test indicates 3 cointegrating eqn(s) at 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**

Same is the result in case of Maximum Eigenvalue as well as we have in this case the same three variables that have co-integration.

5.3. Granger Causality Test Results:

Granger Causality test is an econometric tool that helps inspect causality between variables in a time series. The method is actually a probabilistic account of causality. Patterns of correlation are found by the help of empirical data. It is however the idea of cause and effect that forms the base of causation, although it is not exactly the same. Causality between two variables is said to exist if one variable causes the other. In our case, we check time series variable for granger causality to see if one causes another.

Table 08: Granger Causality Test

Null hypothesis	P values	Null hypothesis	P values
EXPORTS ↛ GCF GCF ↛ EXPORTS	0.7622 0.2432	GDPP ↛ EXPORTS EXPORTS ↛ GDPP	0.7197 0.0001
HEX ↛ EXPORTS EXPORTS ↛ HEX	0.0242 0.5579	EXPORTS ↛ IMPORTS IMPORTS ↛ EXPORTS	0.7205 0.9076
TEENR ↛ EXPORTS EXPORTS ↛ TEENR	0.2094 0.0015	GDPP ↛ GCF GCF ↛ GDPP	0.0364 0.7163

HEX ↛ GCF GCF ↛ HEX	0.3501 0.4246	IMPORTS ↛ GCF GCF ↛ IMPORTS	0.0309 0.9145
TEENR ↛GCF GCF ↛ TEENR	0.2965 0.056	HEX ↛ GDPP GDPP ↛ HEX	0.7049 0.5109
IMPORTS ↛ GDPP GDPP ↛ IMPORTS	4.E-06 0.1207	TEENR ↛ GDPP GDPP ↛ TEENR	0.7445 0.0054
IMPORTS ↛ HEX HEX ↛ IMPORTS	0.5656 0.8446	TEENR ↛ HEX HEX ↛ TEENR	0.3737 0.0402
TEENR ↛ IMPORTS IMPORTS ↛ TEENR	0.6617 0.0032		
↛ **Does not Granger Cause** **5% criteria of probability**			

To see if the null hypotheses given in the table, we do the comparison with 5% P-value. The hypothesis that exports does not granger cause GCF is accepted as its value is 0.7622 which is higher than 5% p value. The hypothesis that exports does not granger cause HEX is accepted because its p value which is 0.5579 which is higher than 5% benchmark. The hypothesis that exports does not granger cause GDPP is rejected because the p-value is 0.0001 which is less than the 5% benchmark value. The hypothesis that HEX does not granger cause tertiary education enrolment is rejected on the grounds that its p-value is less that 5% probability. In the same way, the hypothesis that GDPP does not granger cause tertiary education enrolment is rejected on the grounds that its value 0.0054 which is less that 5% p-value. The details for rest of the hypotheses and if they are

rejected of accepted could be extracted from the table by comparing their p-values with 5% probability.

5.4. Vector Error Correction Mechanism Results:

We have variables that are integrated of order I(1), and there is long run equilibrium among them as well. The relationship among variables could be expressed as error correction model (ECM) if variables are cointegrated. It measures the speed of convergence and short run relationship between co integrating variables.

Table 09: VECM

Variable	Coefficient	Standard error	t-statistics
D(GDPP(-1))	-0.277319	(0.14694)	[-1.88734]
D(GDPP(-2))	(0.11327)	(0.11327)	[-4.77808]
D(GCF(-1))	-0.777938	(3.75801)	[-0.20701]
D(GCF(-2))	10.63713	(3.45856)	[3.07560]
D(EXPORTS(-1))	-0.008466	(0.00459)	[-1.84530]
D(EXPORTS(-2))	-0.008604	(0.00529)	[-1.62606]
D(IMPORTS(-1))	0.011677	(0.00190)	[6.13630]
D(IMPORTS(-2))	0.005054	(0.00290)	[1.74228]
D(HEX(-1))	-8.000391	(1.61899)	[-4.94158]
D(HEX(-2))	-3.967072	(1.49761)	[-2.64894]
D(TEENR(-1))	3.507243	(5.96170)	[0.58830]

D(TEENR(-2))	**11.50403**	**(7.38215)**	**[1.55836]**
C	**50.52317**	**(6.76483)**	**[7.46851]**
ECM (-1)	**-0.373551**	**(0.05799)**	**[-6.44184]**

According to the theory of error correction model the sign of the Error Correction Model lagged term should have a negative sign and be significant. ECM (-1) reflects how quickly the series returns to its long run equilibrium. It also describes the speed of this readjustment process. Long term association among variables is confirmed if the coefficient of the lagged ECM term is of high significance (Banerjee, 1998). From the present results, we see that the speed of adjustment coefficient is -0.37355 which is a clear evidence that if the time series diverges from its equilibrium path, it will swiftly return to its equilibrium with an adjustment speed of 0.37355. This shows that the divergence of previous time period is ameliorated with an adjustment speed of 37.355 percent per year.

5.5. CONCLUSION

The empirical results we obtained in this chapter match the results from the economic theory. We had applied unit root test which showed that all of our variables were integrated of order one. Because all of our time series were integrated of order one so we applied Johansen cointegration test to test our variables for long run co-integrating relationships. Finally we applied Granger causality test and VECM to figure out causality relationships among our variables and to find out the speed of convergence of our system. A negatively value for error correction term established that our system of variables is

stable. The results obtained showed the presence of a positive and significant relationship between higher education and economic growth in Pakistan.

Chapter 6

Conclusion and Policy Recommendations

The important feature of the study is that it has come up with the conclusion that higher education positively effects economic growth. A rise in higher education expenditure, research facilities and higher education enrolment has a positive effect on the economic growth in the long run in Pakistan. This is proved from the theoretical reasoning and from the literature cited in the thesis. In addition, to a layman, the impact could be visible in the form of rise in the standards of living, literacy rate, employment and economic growth as described by the graph below.

The results however establishes a negative correlation between higher education expenditure and economic growth in Pakistan in the short run. This is because the human development is a slow process and investing in human capital is a long term investment with returns only expected in the long term.

So the government and HEC should intensify their struggles in making the provision of higher education free for all. This will ultimately lead to a much prosperous economic performance. In the National Education Policy NEP 2017-2025, special attention should be focused on the provision of higher education and funding for research. The provision of labs for innovation should not be ignored.

There should be a separate system of online education provision for people who have access to internet but due to different reasons, cannot attend higher education institutions.

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