1. INTRODUCTION

1a. OVERVIEW

Economic growth can be defined as a continuous or sustained increase in gross domestic product or goods and services of a country. Generally, economic growth over long periods of time has been associated with a rise in standards of living of people, reduced unemployment and poverty and increased wealth for the country as a whole. So, economic growth is of much importance for a nation. Growth theories dealing with the factors which can drive economic growth of nations have come a long way. Growth theories have moved on from emphasis on free trade by Adam Smith and David Ricardo, to importance of savings and investment in Harrod-Domar growth models, to population growth and exogenous technological progress in the Solow model. Solow (1956) predicted that economic growth occurs in the long run due to factors which are fully exogenous to the model.

However, growth theorists, especially in the late 1980’s were dissatisfied with the assumption that economic growth depends on factors which are totally exogenous and thus, new growth theories or endogenous growth models came into existence in which the long-run growth rate was determined by factors within the model with fundamental importance given to human capital and technological change. Lucas (1988) and Rebelo (1991) concluded that it is the average level of human capital which matters and growth rate of human capital determines rates of technological change and productivity growth. Romer (1990a), on the other hand, argued that it is the stock of human capital embodied in skilled labour which matters, with skilled labour employable in R&D activity not substitutable by unskilled labour. Further, it is the employment of this human capital in the R&D sector which brings about technological progress which drives economic growth in the long run. So, whatever be the path through which economic growth is achieved in these new growth theories, one common point is the crucial dependence of economic growth on human capital.

According to Donald (2002), human capital can be defined as “the education and training embodied in a human person that gives rise to increased future income”. It includes acquired abilities, skills and knowledge. Investment in human capital can be achieved through investment in education and health facilities.
Recent economic studies generally try to find the importance of human capital on economic growth by incorporating some indicators of human capital in growth regressions. There have been lots of studies which have included proxies of the educational component of human capital in empirical studies. Usually proxies like enrolment rates or average years of schooling (sometimes even included separately for primary, secondary or tertiary education or included according to sex) are included in growth regressions and many of these studies have obtained strong positive impacts of human capital on economic growth rates (e.g. Barro, 1991, 1992, 1999, 2001, 2003; Barro and Sala-i-Martin, 1995, 2004; Krueger and Lindahl, 2001; Papageorgiou, 2003; Jones and Schneider, 2006). The problem with these studies is that the proxies of human capital used in these studies measure the quantity of schooling and not the quality. Quality of education helps in the development of productive abilities in individuals, which can help either in the use of existing technology in the production of goods and services or in research and the development of new technology. For example, some formal level of education in two countries may correspond to different productive abilities if quality of education is different. High quality education prepares individuals for the outside world in a manner which helps individuals to achieve their own goals as well as contribute towards the society and economy. The dimensions which are included in the concept of quality in education are learners who are healthy and motivated, process of learning through good teachers and best techniques, good content reflected in the relevant curricula and acquisition of knowledge in terms of literacy, numeracy and basic skills of life, environments which are healthy and safe, and good governance and unbiased resource allocation in the education system. Thus development of skills and productive abilities through education can be achieved not only through increase in the quantity of education but also through improvement in educational quality. Therefore, if human capital is an important determinant of economic growth, improvement in overall quality of education should boost economic growth rates of countries.

However, the major problem in testing this proposition is that though there is obviously a wide variation of quality of education across countries, there is an absence of any clear-cut measure of educational quality. Studies have used different proxies of quality of education, for example test scores in some common examination (Hanushek and Kimko, 2000; Barro and Lee, 2001a; Bosworth and Collins, 2003;
Hanushek and Woessmann, 2010a) or earnings of labour force after completion of a certain level of education (Card and Krueger, 1992). But the problem of using earnings as a measure of quality is that earnings or performance in the labour market depends on many external factors other than schooling. The most commonly used proxy of quality of education in cross country studies are internationally comparable test scores. However, these test scores are often taken from different sources and observations relate to different years for different sets of countries and so, in empirical studies, data are combined to form a large data set of cognitive skills. Data for many countries relate to test scores in science, mathematics and reading of a relatively small set of sampled students from sampled schools. Further, test scores reveal the quality of schooling received by students in current years and are not necessarily indicative of the quality of schooling received by the present workforce.

In the present study, an attempt is made to complement this approach by developing a measure of quality of education which can address these inadequacies by measuring the quality of education received during the schooling of the present workforce (i.e. persons who are currently working and not in schools anymore) indirectly through their reading proficiency (Chapter 2). While the measure developed in some sense partial because it relates only to reading proficiency, reading skills are equally required for economic development along with knowledge of science and mathematics because reading proficiency creates the basis of an efficient work force that can understand instructions and do their duty well. Also, there are strong correlations between growth rate of real GDP and reading scores (Barro and Lee, 2001a). Reading proficiency cannot be captured by literacy rates or average years of schooling because just being literate does not instill reading skills in individuals- for that a good quality education is required. So, in this study, we have measured reading skills or proficiency of the working population indirectly through its impact on the per capita circulation of newspapers in an economy. This is useful as a measure of reading proficiency because a major section of the population (even in developing countries for which test scores may be unavailable or where a small fraction of the population appear for these examinations) can be covered as wide access to and distribution of newspapers is present in almost every country. Also, circulation of newspapers can be related not only to the ability to read but also the inclination to read, and this factor can be related to quality education since, one develops the desire
to read with good quality of education. This, apart from the fact, that an individual develops greater inclination to read with greater reading skills (the ability to read).

Once a measure of quality of education has been developed, the question which necessarily arises is what determines the quality of education. The answer to this question is also crucial if quality of education is to be a subject of policy. There have been various studies dealing with the determinants of quality of education as measured by test scores and these studies have obtained several variables which can affect quality of education. Important variables include family income, parents' education, school inputs, pupil-teacher ratio, community inputs etc. (e.g. Barro and Lee, 2001a; Krueger, 1999; Angrist and Lavy, 1999; Finn and Achilles, 1990; Heyneman and Loxley, 1983; Summers and Wolfe, 1977).

Our attempt to indirectly measure the quality of education in terms of its impact on the per capita circulation of newspapers also provides an indication of which of these variables might be significant in affecting the reading proficiency of the workforce through its effect on the quality of education. The effect of quality of education on the reading proficiency of the working population, measured by per capita circulation of newspapers, was investigated in terms of the influence of a range of possible variables affecting quality (family factors and schooling resources during schooling period of the present workforce) after controlling for the quantity of education of the present working population (Chapter 2). Since circulation of newspapers is also influenced by factors other than schooling quality, those factors are also controlled for in this study. The significant determinants of quality of education in our study are parents' education and government expenditure on education. These factors turned out to be important in increasing reading proficiency of the workforce.

There have been some studies on the determinants of quality of education in India also. In case of micro level studies relating to specific regions in India, some important variables affecting quality of education turned out to be school inputs, family wealth, caste, students' innate ability (Kingdon, 1996a, 1996b, 1998a). The all India National Achievement Surveys by NCERT (2008) which considered only school-related variables, found community participation and more number of teachers to be important. These studies also considered test scores (from tests in numeracy and literacy conducted by them) as measures of quality of education.
Our next concern in this study was to find the determinants of quality of education across districts in India (Chapter 4). We did a district level study for the entire country to get generalized results (not obtained in region specific studies), and we also included family and social factors in addition to school inputs (in contrast to the NCERT study) to analyse their effects on student achievement. Availability of comparable test scores across districts in India is difficult as school boards which conduct examination are different across different states and so the data are not comparable. So, in this study to find determinants of quality of education across districts in India, we have used percentage of students getting more than 60 percent marks in class VIII for each district divided by the percentage of students getting more than 60 percent marks in class VIII in the state to which the district belongs as a measure of quality of schooling, assuming that the mode and standard of evaluation in districts across a state will be similar on an average. Data of District Information System for Education, NUEPA have been used in this study. Analysis has been done initially for all the districts considered and subsequently region-wise analysis has also been done. Our analysis indicates that parents’ education and small class size are beneficial for student achievement and the proportion of enrolment of SC/ST students in total enrolment has a negative impact on student achievement at the all India level and also across regions in India. In cases of the Northern states, we additionally find that, increase in the proportion of students enrolled in private schools improves student achievement. Only in the Southern region does pupil-teacher ratio have a negative and parents’ family status a positive effect on student performance.

There is an existing literature on the effect of quality of education on growth rates of countries. Studies representing quality of education with test scores in cross country studies have obtained significant positive impacts of quality of education on economic growth (e.g. Hanushek and Kimko, 2000; Bosworth and Collins, 2003; Jamison, Jamison and Hanushek, 2007; Hanushek and Woessmann, 2010a). It is therefore of interest to whether the result is corroborated in case of the quality measure developed in the current study, in terms of reading proficiency of the present workforce. Therefore, an objective of the present study was to check whether the quality of education as measured by its impact on reading proficiency of the working population has an effect on the economic growth of nations independent of the effect of quantity of education (Chapter 3). For this we chose two growth regression exercises in the literature which found significant effects of quantity of education on
growth (Barro, 1992 and 2003). Our measure of quality of education was included in both the settings (for our sample of countries) to enquire whether quality of education was important in explaining growth rate of countries. The results of our analysis indicate that some of the important variables in explaining growth rate of economies are initial GDP, fertility rate, investment ratio, macroeconomic and political stability. Most importantly, after controlling for other factors, it was found that the quality of education significantly influences growth rates (except in one specification where both quality and quantity of education are both insignificant). The variable representing quantity of education was insignificant in all cases, even when quality variable was not included in the analysis. But the quality variable was significant even in presence of quantity variables.

Till now we have considered issues of quality relating to human capital in terms of the average effective level of learning in an economy for any given quantity of schooling. However, issues relating to quality of human capital can also enter into discussion of growth in another important way. A given value of the aggregate stock of physical capital can correspond to two quite different stocks of physical capital, that is, physical capital stocks of different quality. Similarly, a given aggregate value of the stock of human capital can correspond to quite different quality composition of human capital- the stock, for example, may be made up of low level of skills embodied in a large number of relatively unskilled workers or high level skills embodied in a small number of relatively skilled workers. An important question which therefore arises is whether quality composition of human capital is important for economic growth or not and if so, in what way does the quality composition of human capital affect economic growth (Chapter 5).

There are contradictory views in the literature regarding the nature of the relationship between human capital and growth. Lucas (1988) gave importance to the rate of accumulation of the total stock of human capital over time whereas Nelson and Phelps (1966) gave importance to stock of human capital as influencing growth through the rate of diffusion of new technologies. Again according to Romer (1990a) it is the stock of skilled labour in R&D sector which boosts technological progress and this drives economic growth. In this present study we enquire whether the stock or accumulation of human capital affects long run growth rates, whether quality composition of human capital is important or is it only the average level of human capital that matters in influencing growth and how the quality composition of human
capital affects the nature of technological change, that is, what the relation tells us about the primary mechanism through which the technological change affects long run growth.

Several empirical studies have been done on the nature of relationship between human capital and growth rates and there are contradictory results (e.g. Romer, 1990b; Benhabib and Spiegel, 1994; Krueger and Lindahl, 2001; Pritchett, 2001). Again there are lots of studies in the literature which concentrate on the relationship between quality composition of human capital and growth (e.g. Gemmell, 1996; Barro, 1991, 2001; Petrakis and Stamatakis, 2002), but these studies fail to link the choice of human capital variable to a theoretical understanding of how human capital can affect economic growth. Though the mechanism through which human capital affects economic growth through technological change, has also been considered by Papageorgiou (2003), our focus and methodologies differ. The results of this study indicate that the quality composition of human capital is important but only secondary and primary education variables turned out to be important rather than tertiary indicating that technological change and growth are affected by the stock of human capital through diffusion of technology rather than through R&D activity in the economy.

The organization of this chapter is as follows: Section 1b reviews the literature regarding both the theoretical and empirical aspects of the relationship between human capital and growth. Section 1c discusses the data set on educational attainment used in this study. Section 1d deals with the literature regarding quality of human capital, including its definition, determinants and consequences of increased quality of human capital.

1b. REVIEW OF LITERATURE- HUMAN CAPITAL AND GROWTH

i) Relationship between Human Capital and Growth - Theoretical Approaches:

The notion of economic growth has evolved substantially over the years. Importance to free trade was given in the theories of Adam Smith and David Ricardo as a means to achieve increased growth rates. The Harrod-Domar growth models
(1939; 1946) implied that the increase in savings and investment rates and the productivity of capital was important for boosting growth rates. These models assumed a fixed coefficient production function in which capital and labour are always used in a constant ratio and the parameters determining rates of growth of both capital and labour were exogenously given. An important implication of this was that there is increasing unemployment of labour or capital when there is faster growth of either of these inputs.

In 1950's, Robert Solow tried to rectify the limitation of Harrod-Domar models by assuming that the capital-output ratio (which entered into the determination of the rate of growth of capital) was flexible due to the possibility of substitution between factors of production. Solow’s model assumes diminishing returns to capital. This implies poor countries with less capital will grow faster because investment in capital will produce higher returns compared to rich countries with more capital which will lead to conditional convergence¹. Due to diminishing returns to capital, economies will reach a state when more increases in capital won’t result in any increase in output per unit of labour. So, in this steady state, growth in per capita incomes can only happen through exogenous technological progress and in steady state, output per unit of labour grows at the rate of technological progress. Important determinants of growth in this model are the exogenously determined rates of technological progress and population growth. But the limitation of this model is that long run growth rate is determined by factors which are completely exogenous to the model. Also, it is difficult to include technological change in neoclassical theory, “because the standard competitive assumption cannot be maintained. Technological advance involves the creation of new ideas, which are partially non-rival and therefore have aspects of public goods” (Barro and Sala-i-Martin, 1995, page 11).

In order to find the determinants of long run growth, rather than assuming that growth is determined by exogenous factors, Romer (1986) and Lucas (1988) based on studies by Arrow (1962), Sheshinski (1967) and Uzawa (1965), pioneered a generation of endogenous growth models in which growth was determined by factors

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¹ The conditional convergence hypothesis states that if countries possess the same technological possibilities and population growth rates but differ in savings propensities and initial capital-labor ratio, then there should still be convergence to the same growth rate, but just not necessarily at the same capital-labor ratio. So it can be said that the conditional convergence hypothesis asserts that countries might differ in their steady-state capital-labor ratios and can thus differ in consumption per capita, but as long as they have the same population growth rate, then capital, output, consumption, etc. will eventually grow at that same rate.
within the model. In these models technological change was assumed to be endogenous and much importance is given to human capital.

Human capital consists of acquired abilities, skills and knowledge of individual workers. It is rival and excludable. According to Gary S. Becker (1993), "expenditures on education, training, medical care, etc., are investments in capital. However, these produce human, not physical or financial, capital because you cannot separate a person from his or her knowledge, skills, health, or values the way it is possible to move financial or physical assets while the owner stays put" (page 16).

Mankiw, Romer and Weil (1992) tried to find out the implications of the Solow model when human capital was included in the production function. The predictions of the Solow model, that increase in savings has a positive influence and population growth has a negative influence on growth rates had been initially examined in this study. From their growth regressions for the period 1960-85 relating to a maximum of 98 countries, Mankiw, Romer and Weil (1992) found that the predictions of the Solow model were correct, but they concluded that the magnitude of the effects of savings and population growth on rates of growth of economies were too large to be realistic. So they augmented the Solow model by incorporating accumulation of both human and physical capital in the model. Human capital accumulation was proxied by the percentage of 'the working-age population that is in secondary schools' and this was added to the regression. Human capital was also found to be significant along with savings and population and growth, though their effects were reduced. Mankiw, Romer and Weil (1992) concluded that "these three variables explain almost 80 percent of the cross-country variation in income per capita" (page 421).

Nelson and Phelps (1966) had considered human capital in their growth model before the development of endogenous growth models. According to this theory, it is the stock of human capital which drives economic growth through its effect on innovation and technical progress. Also, there can be sustained growth in the economy with one-time increase in the stock of human capital. There is no need of continuous growth in human capital.

In endogenous growth models, presence of human capital helps in continuous growth of economies even in absence of exogenous technological progress because presence of human capital implies there are no diminishing returns to reproducible factors including human capital.
In Lucas’ (1988) growth model, growth depends on how individuals at each time point allocate their time between current production and learning which increases their productivity in the future. This model assumes that production of human capital does not require any physical capital. The relationship between the fraction of non-leisure time devoted by an individual to learning \((1-u)\) and the accumulation of human capital \((h)\) in the model is given as:

\[
\dot{h} = \delta h(1 - u), \quad \delta > 0 \quad \text{............... (1.1)}
\]

So, rate of growth of human capital is:

\[
\frac{d\log(h)}{dt} = \delta (1 - u) \quad \text{............... (1.2)}
\]

So, if all the time is devoted to the accumulation of human capital, then \(\delta\) becomes the maximum achievable growth rate at which human capital can grow. The rates of growth of output and human capital in steady state depend upon \(\delta\) and the determinants of equilibrium \(u\) in steady state. So, in Lucas’ model, growth rate of economies depend on increase in human capital, either through influences on technology or by affecting the effective labour\(^2\) which can be used with existing production technology. However, in this model it is the average level of human capital which matters, that is, highly educated workers can be perfectly substituted by less educated workers, embodying an equal amount of human capital.

R&D theory and imperfect competition was introduced in endogenous growth theories by Romer (1990a). In Romer’s model, the aggregate output is produced by human capital allocated to final output, physical labour and physical capital. Physical capital comprises of producer durables which are produced in the intermediate goods sector with the help of foregone output and new designs. Designs are produced in the research sector with human capital and existing knowledge. The designs or ideas require high cost to produce initially but once discovered, they can be consumed or reproduced at almost no cost. Again, consumption of ideas is non-rival but can be excluded though patents. So in this case, principle of marginal cost pricing, as in perfect completion, is violated.

The rate of growth of aggregate stock of designs gives the rate of technological progress. It is implied from the model that technological progress will

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\(^2\) Effective labour is a weighted sum of the number of workers. The weight assigned to each worker is an increasing function of that worker’s educational attainment.
be greater if more human capital is employed in the research sector and this increases growth. So in this model, technological change takes place explicitly from R&D activity and it is the total stock of skilled workers which is important for growth and not the overall stock of human capital and skilled workers cannot be substituted with sufficient number of unskilled workers.

Jones (1995) argued that in spite of much increase in R&D over the years, much increase in growth rate did not occur as predicted by Romer (1990a) and so on since population growth is important for increase in economic growth. Jones (1996), in his model, considered three sectors- human capital or education, new intermediate goods or ideas and a consumption good. Skills are produced by education which helps in the production of intermediate goods or ideas which are used in the production of the consumption good. Skills of individuals are necessary to invent new ideas as well as to adopt the ideas already present (which are freely available once invented). The major differences of the Jones model (1996) from the previous theories is that growth cannot be sustained with growth in physical and human capital if there is no population growth (which is exogenous). But if there is a positive rate of growth of population, greater the productivity of human capital in the research sector, greater is the growth rate of the economy in the steady state.

Temple (2001a) pointed out that from the new growth theories, it can be inferred that human capital created ideas and this determined long run growth rates. He also pointed out that it is not necessary to create policies to directly help in R&D activities; even indirect help of subsidizing education can lead to R&D in future and can thus help to improve growth rates as well.

Thus, from the new growth theories, it is evident that human capital helps in increasing productivity of both capital and labour and helps in production of technology through R&D or adoption of technologies through knowledge spillovers. All these factors contribute in increasing growth rates of economies. Thus it can be concluded that human capital is one of the major determinants of economic growth across countries, since investments in human capital ultimately leads to increased growth rates in the future.
ii) **Relationship between Human Capital and Growth - Empirical Findings:**

Recent research on growth theories places much importance on empirical studies to find a relation between theory and data. There is a large literature on growth which deals with growth regressions containing human capital variables, beginning with, for example, from Barro (1991), Barro and Lee (1993), Barro and Sala-i-Martin (1995) and so on. These regressions generally deal with data of various countries to find significant relationships between growth rate of countries and factors representing human capital like educational or health variables and other factors like government expenditure, investment, openness etc.

Health and education are two different dimensions of investments in human capital. Several empirical studies have been done on the relationship between economic growth and human capital variables represented either by educational indicators or health indicators.

a) **Relationship between health and economic growth:**

A consensus in academic circles is that differences in health conditions are an important cause of the difference in income across countries and improvement of health conditions drives economic growth.

Many cross country studies have been done to find the direct effect of health on economic growth, by including a health indicator in growth regressions, along with other control variables. Barro (1996) showed in his study for a maximum of 100 countries for the period 1960-90, that initial level of log life expectancy at birth affected growth rate positively. Barro (1996) concluded that decline in mortality rates helped to reduce fertility rates also, and thus had a positive impact on growth rates. Barro and Sala-i-Martin (1995) also used initial log of life expectancy at birth as an explanatory variable in growth regressions. Their study dealt with 87 countries for 1965-75 and for 97 countries for 1975-85. This study also predicted a strong positive relation running from life expectancy at birth to growth.

Similarly, Bloom, Canning and Sevilla (2004), found a significant positive impact of life expectancy on growth rates for a cross section of countries over the
period 1960-1990. The study showed increase in one year of life expectancy could lead to an increase of 4 percent in output.

Sachs and Warner (1997a) also found that increase in life expectancy had a positive effect on growth rates in their study of 83 countries over the period 1965-90. Increases in life expectancy had positive effects on growth rates until life expectancy became very high (above 65 years), after which the effect was almost zero. Sachs and Warner (1997b), in their study of about 80 countries over the same period aimed to analyse the growth rates of African economies, also found the same result and concluded that low life expectancy was one of the causes of low growth rates in African countries.

Barro and Sala-i-Martin (2004) in a study of 72 countries for 1965-75, 86 countries for 1975-85 and 83 countries for 1985-95 found a significant negative relation between reciprocal of life expectancy at age one (representing the probability of dying) and economic growth indicating that better health leads to increased growth rates. A strong negative relationship between reciprocal of life expectancy at age one and economic growth was also found by Barro (2003) in a study of 87 countries for the period 1965-95.

Aghion, Howitt and Murtin (2010) included both stock and growth rate of human capital proxied by initial level and growth rate of life expectancy in their growth regressions, following both Nelson and Phelps (1966) and Lucas (1988), controlling for initial GDP. In their study of 96 countries for the period 1960-2007, they obtained strong positive relationships between both initial stock and growth rate of life expectancy and economic growth.

Bhargava et al (2001) used the adult survival rate in growth regressions. In the study for 92 countries over the period 1960-95, it was found that adult survival rate affected growth rate of low income countries significantly. In case of the poor economies, increase in adult survival rate by 1 percent, increased growth rate by about 0.05 percent.

Gallup and Sachs (2001) used a different indicator of health. They used a malaria index in cross country growth regressions for the period 1965-90. Results showed that the rate of growth of countries was hampered due to increase in malaria. Also, it was found that a reduction of 10 percent in incidence of malaria resulted in 0.3 percent higher growth.
Chapter 1: Introduction

All these studies, though different in methodology and data set, have found a significant impact of health indicators on economic growth. Besides, it was also found that life expectancy is one of the robust determinants of economic growth. Sala-i-Martin (1997a, 1997b) did a cross country study for the period 1960-92 and ran more than 32000 regressions to find robustness of variables generally included in growth regressions. He kept three fixed variables in all their regressions (initial GDP to find the effect of conditional convergence and initial life expectancy and initial primary enrolment rate to find the effect of human capital on growth). These were included as they were robust determinants of economic growth in previous literature and initial levels were taken to avoid endogeneity. Initial life expectancy turned out to be a significant determinant of growth in about 96 percent of the regressions. So, it might be said that health is an important ingredient of human capital, which has a significant impact on economic growth.

b) Relationship between education and economic growth:

Schultz (1961) said, “Many paradoxes and puzzles about our dynamic growing economy can be resolved once human investment is taken into account” (page 3). Nowadays, there are several empirical studies regarding the relationship between education and economic growth, and different indicators have been used in different cross country or country specific studies to represent human capital.

Several studies like Barro (1991), Chen and Feng (2000), Loening (2005) have used enrolment rates to represent human capital in growth analysis. Barro (1991) in a cross-country study of 98 countries for the period 1960-85, found strong significant impact of initial primary and secondary school enrolment rates on growth rates of GDP. Chen and Feng (2000) and Loening (2005) did country specific studies of China and Guatemala respectively. Chen and Feng (2000), in the study of 29 provinces of China for the period 1978-89, found significant positive effects of higher school enrolment on economic growth rates of China (primary enrolment was not taken as primary education was mandatory in China). This study also indicated that international trade and private enterprises might be beneficial for China. Similarly,

3 Twenty-one variables passing Sala-i-Martin's (1997a, 1997b) “Two Million Regressions” test and the three fixed variables included in all regressions are given in Appendix 1.1.

4 Details of the variables used in the articles discussed in this section are given in Table 1.
Loening (2005) analysed the effects of primary, secondary and tertiary enrolments in Guatemala for the period 1951-2000. Results showed that primary education followed by secondary education were important for economic growth rather than tertiary education. The problem with using enrolment rates as a proxy for the stock of human capital is that they represent levels of education (investment in human capital) for the present generation of children and not for the present working age population.

Hojo (2003) initially used secondary enrolment ratio as an indicator of human capital to find its effect on log differences in output. The study related to 94 countries for the time period 1960-84. He found school enrolment rate to be negatively related to growth. So, Hojo (2003) calculated the country effects from the estimated equation. Islam (1995), (who advocated the use of panel data in growth regressions), found the country effects to be a measure of productivity levels of a country. Hojo (2003) therefore regressed this calculated productivity level on proxies of educational attainment (either years of secondary schooling or secondary enrolment ratio) and some control variables like government consumption to GDP, black market premium, property rights, terms of trade, life expectancy or fertility rate. In this case, both the educational variables were positively significant. Since higher productivity is related to higher growth, Hojo (2003) concluded that education affected growth rate positively but indirectly through its effect on productivity.

Average years of education or schooling was used by several studies to find the effect of human capital on growth. Barro and Lee (1993) constructed a data set on educational attainment containing data relating to male and female population with no schooling, primary, secondary and higher schooling along with data on average years of schooling for 129 countries (1960-85). They ran preliminary growth regressions and concluded that average years of male education had positive effects on economic growth. Barro (1992) in a study of 73 countries for the period 1960-85 also found strong positive effects of average years of schooling (for persons 25 years and above) on economic growth. Loening (2005) had also considered average years of schooling in addition to enrolment rates. He found an increase of 1 percent in average years of schooling increased growth rate by 0.33 percent. Hassan and Ahmed (2008) in a study of 39 Sub-Saharan African countries for the period 1975-2005 considered both enrolment rates and average years of schooling. He considered five human capital variables in alternate specifications- average years of schooling, literacy rate, primary and secondary enrolment rate and a product of average years of schooling and life
expectancy. All five human capital variables turned out to be significant determinants of economic growth.

Instead of average years of total schooling, several studies like Barro (1999, 2001, 2003), Barro and Sala-i-Martin (1995, 2004) have considered average years of male secondary and higher schooling as an indicator of human capital in cross country growth regressions. Barro (1999) in a study of 100 countries for the period 1960-95, Barro (2001) in a study of 100 countries for the period 1965-95 and Barro (2003) in a study of 87 countries for the period 1965-95, found a strong positive effect of male schooling at secondary and higher level on economic growth. Estimation in these three studies was done using three-stage least squares with differences with the independent variables used. Primary and female schooling were insignificant. According to Barro, this was due to the fact that there was no utilization of females in the labour market of many countries and thus female education turned insignificant in growth regressions.

Similarly, Barro and Sala-i-Martin (1995) found significant positive impacts of average years of male secondary and higher schooling on economic growth, controlling for other factors. This study related to 87 countries for the period 1965-75 and 97 countries for the period 1975-85. Primary schooling was insignificant and female schooling was negatively significant. According to Barro and Sala-i-Martin (1995), the possible reason behind negative significance of the female schooling variables, “is that a large spread between male and female attainment is a good measure of backwardness; hence, less female attainment- especially at higher level- signifies more backwardness and accordingly higher growth potential through the convergence mechanism” (page 431-32). Stokey (1994) argued that the negative significance of female schooling variables was due to rapid reductions in gender gap in fast growing East Asian countries and usage of initial period data of educational variables increased the gender gap and thus the negative effect. Barro and Sala-i-Martin (2004) extended the analysis till 1995 (72 countries for 1965-75, 86 countries for 1975-85 and 83 countries for 1985-95). This study found positive significance of male secondary and higher schooling and insignificance of primary and female schooling.

However, contrary to the results of Barro and Sala-i-Martin (1995, 2004) and Barro (1999, 2001, 2003), Knowles, Lorigelly and Owen (2002) found positive effects of female education on growth. In their study of 73 countries for the time period
1960-99, it was found that the average years of female schooling (of persons 15 years and over) had positive significant effects on economic growth rates and male average years of education was insignificant. Similarly, Klasen (2002) in a study of 109 countries for the period 1960-92 included four human capital variables in growth regressions- average years of total schooling in 1960, female to male ratio of average years of total schooling in 1960, average absolute growth in average years of schooling and female to male ratio of the growth rates in average years of schooling. All these four variables were positively significant in growth regressions, when other factors were controlled for. The result also supported the view that increased female education helped to boost growth rates. According to Klasen (2002), this happened due to direct positive effects of higher education of mothers on both quality and quantity of education of their children and due to indirect effects of reduced fertility rates, such as the increased savings due to reduction in the dependency burden.

There are divergent views in the literature regarding the relationship between education and economic growth. Lucas (1988) pointed out that it is the rate of accumulation of human capital that matters in increasing growth rates of economies, whereas Nelson and Phelps (1966) argued that it is the stock of human capital which is important. Romer (1990a) concluded that the greater the stock of human capital employed in the R&D sector, the greater is the rate of technological progress which drives economic growth. In almost all the studies considered so far, stocks of human capital measured either in terms of enrolment rates or average years of schooling were found to be important for economic growth. But there are some studies in the literature which deal specifically with this debate as to whether it is the stock of human capital which is important for growth or whether it is the growth rate in human capital which is important.

Kyriacou (1991) studied the effects of both stock and growth of human capital on economic growth by using a standard Cobb-Douglas production function. The study related to 111 countries for the time period 1970-85 and this study used a measure of human capital based on average years of schooling and enrolment rates. The results indicated that the stock of human capital affected growth rate positively but growth rate of human capital was insignificant. Kyriacou (1991) concluded that a country should possess a minimum level of human capital in order to affect economic growth and since initial stock of human capital affected technological progress as shown by Romer (1990a), initial average years of schooling should be considered
instead of its growth rate in growth regression to capture the effect of technological progress on economic growth.

Bebhabib and Spiegel (1994) also studied the effects of growth rate of human capital on the growth rate of output when human capital enters as a factor of production in a Cobb-Douglas production function. This study related to 78 countries from 1965 to 1985 and used Kyriacou’s (1991) measure of human capital. The results showed that growth of human capital was not an important determinant of economic growth. In an alternate model when stock of human capital was included instead of the growth rates of human capital, it turned out to be a significant determinant of economic growth, when initial income was also included in the regression analysis. This study concluded that human capital affected economic growth through technological progress. Temple (1999) pointed out that in Benhabib and Spiegel’s analysis (1994), presence of outliers made growth rate of human capital insignificant. He showed when a smaller set of 64 countries (by eliminating outliers) was considered, the growth rate of human capital turned significant.

Krueger and Lindahl (2001) also tried to find the validity of Benhabib and Spiegel’s (1994) results. Their analysis also dealt with 78 countries for the period 1965-85. Data were taken from World Values Survey, Barro and Lee (1993) and Kyriacou (1991). They found a positive relation between growth rate of human capital and economic growth provided measurement errors were corrected for (which was done by using longer time periods of 10 or 20 years instead of 5 years to calculate growth rates to capture the real effects of changes in education).

However, in Pritchett’s (2001) analysis of 91 countries for the time period 1960-85, change in schooling measure (a measure based on wage increment associated with a year’s schooling and number of schooling years) had no significant impact on economic growth. Temple (2001b) tried to examine Pritchett’s (2001) results on the basis of data for 78 countries for the period 1965-85. Using both ordinary least squares and least trimmed squares, he found no significant impact of change in average years of schooling on economic growth. He concluded that stock of human capital might be more important for economic growth.

Gemmell (1996), in a study of OECD countries for the period 1960-85 used a measure of human capital based on both the stocks and annual growth rates for all the three levels of education- primary, secondary and tertiary. Both the stocks and growth
of tertiary education turned out to be important for explaining growth rates. Primary education was important only for less developed countries.

Papageorgiou (2003) considered the channel through which the stock of human capital can affect economic growth. Both primary and post primary mean years of education was included in the analysis of economic growth of 80 countries (divided in 3 sub samples of high-income, middle-income and low-income countries) for the period 1960-87. Human capital is both an input in production as well as technical progress. Contribution of human capital as a production input is assumed to be proportional to growth rates of human capital measured by growth in mean years of primary education. The component of technical progress due to innovation was assumed to be proportional to mean years of post primary education and the component of technical progress due to imitation was assumed to be proportional to the technological gap proxied by the ratio of output per worker in the technological leader country (Switzerland) and any country $i$. In case of low income countries, it was found that human capital affected economic growth as an input in production and through imitation of technology. For high income countries, it was found that human capital affected economic growth through imitation and innovation.

Again, there are some empirical studies in the literature which looks into the causal relationship between human capital and economic growth. In an analysis relating to India for the time period 1966-96, Self and Grabowski (2004), through Granger causality test, found that both primary and secondary education for females caused growth but in case of males, only primary education was found to be important. Similarly, Asteriou and Agiomirgianakis (2001) studied the causality between primary, secondary and tertiary enrolment rates and GDP for Greece for the time period 1960-94. The results of the Granger causality test suggested that causality ran from primary and secondary education to GDP but in case of higher education, there was reverse causality.

There are also some studies in the literature which use some measures of human capital other than enrolment rates or average years of schooling. Dewan and Hussein (2001) studied growth 41 middle income developing countries for the period 1965-97. They represented human capital with the public investment in human capital, that is, public spending to improve human capital. The results indicated that increased public spending on human capital drives economic growth.
Petrakis and Stamatakis (2002) represented human capital in growth regressions by completion rates of primary, secondary and tertiary education. Eight countries were considered for each the three groups- advanced, developed and less developed- for the two time periods 1977-82 and 1989-94. The results indicated that the importance of higher education increased with increase in level of development.

Jones and Schneider (2006) used data on IQ from Lynn and Vanhanen (2002) as a measure of human capital. Their study was carried out for a maximum of 51 countries for the time period 1960-92. The explanatory variables were the 21 variables which passed the Sala-i-Martin (1997a, 1997b) robustness tests. Each regression included 7 explanatory variables- IQ, 3 variables always kept in Sala-i-Martin’s regressions and any 3 variable out of the 21 variables passing the robustness tests. So Jones and Schneider ran 1330 regressions in total. IQ turned out to be positively significant in all the regressions (even when OECD countries were excluded) and thus the results indicated that IQ had a strong positive impact on growth.

So, from a review of these empirical studies, it is clear that there is a significant positive influence of human capital, measured in terms of educational attainment, on growth rates of economies. However, studies have also pointed out that there are certain possible problems with the empirical studies linking human capital to growth. Sianesi and Van Reenen (2003) and Bils and Klenow (2000) indicate the possible presence of reverse causality (that is, growth stimulates education) and this possibly produces biased results when human capital enters as an explanatory variable in growth regressions.

Krueger and Lindahl (2001) and Bils and Klenow (2000) also pointed out that presence of omitted variables in growth regressions produces bias in the estimated results. According to Krueger and Lindahl (2001), development of educational systems also influences other policies which also help in driving economic growth and this creates the omitted variable bias.

Also, according to Krueger and Lindahl (2001), De La Fuente and Doménech (2006) and Cohen and Soto (2007), much bias is created in the estimated relationship between human capital and growth due to unreliable educational data.
Table 1: Effect of Quantity of Human Capital in different Growth Regressions

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Article</th>
<th>Year/Countries considered</th>
<th>Human capital variable capital considered and results</th>
<th>Other variables considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Barro, 1992</td>
<td>1960-85, 73 countries</td>
<td>Average years of schooling of persons aged 25 years and above- positively significant</td>
<td>Initial GDP, Govt. Consumption/GDP, revolutions and coups, investment /GDP, fertility, openness*tariffs, black market premium</td>
</tr>
<tr>
<td>3.</td>
<td>Barro, 1999</td>
<td>1960-95, 100 countries</td>
<td>Average years of schooling of adult males at secondary and higher level- positively significant, Average years of schooling of adult females at secondary and higher level, average years of primary schooling - insignificant</td>
<td>Initial GDP, (initial GDP)^2, Govt. Consumption/GDP, investment /GDP, fertility, rule of law, democracy, (democracy)^2, growth rate in terms of trade</td>
</tr>
<tr>
<td>4.</td>
<td>Barro, 2001</td>
<td>1965-95, 100 countries</td>
<td>Average years of schooling of adult males at secondary and higher level- positively significant, Average years of schooling of adult females at secondary and higher level and average years of primary schooling- insignificant</td>
<td>Initial GDP, (initial GDP)^2, Govt. Consumption/GDP, investment /GDP, fertility, rule of law, growth rate in terms of trade, international openness, inflation</td>
</tr>
<tr>
<td>5.</td>
<td>Barro, 2003</td>
<td>1965-95, 87 countries</td>
<td>Average years of schooling of adult males at secondary and higher level and reciprocal of life</td>
<td>Govt. Consumption/GDP, investment /GDP, fertility, rule of law, democracy, democracy,</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>expectancy at age 1-</strong></td>
<td><strong>(democracy)^2</strong>, change in terms of trade, openness ratio, inflation rate</td>
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<tr>
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<td>--------------------------------------------------------------------------------</td>
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</tbody>
</table>
| 6. | Barro and Sala-i-Martin, 1995 | i) 1965-75, 87 countries  
   ii) 1975-85, 85 countries | Average years of schooling of adult males at secondary and higher level and life expectancy at birth - *positively significant*,  
   Average years of schooling of adult females at secondary and higher level - *negatively significant*, average years of primary schooling - *insignificant*  
   GDP, public spending on education, black market premium, political instability and growth rate in terms of trade |
| 7. | Barro and Sala-i-Martin, 2004 | i) 1965-75, 72 countries  
   ii) 1975-85, 86 countries  
   iii) 1985-95, 83 countries | Average years of schooling of adult males at secondary and higher level and reciprocal of life expectancy at age 1- *Significant (positive and negative respectively)*  
   Average years of schooling of adult females at secondary and higher level and average years of primary schooling - *insignificant*  
   Initial GDP, Govt. Consumption/GDP, investment/GDP, fertility, rule of law, democracy, (democracy)^2, change in terms of trade, openness ratio, inflation rate |
   (human capital measure - Kyriacou, 1991)  
   Change in physical capital, change in labour and initial income |
| 9. | Chen and Feng, 2000 | 1978-89, China-29 provinces | Higher school enrolment rate - *positively significant*  
   Initial GDP, initial crude birth rate, presence of state owned enterprises, inflation, average of exports and imports as percentage of provincial GDP |
   Investment by GDP, openness, inflation,
<table>
<thead>
<tr>
<th>Chapter 1: Introduction</th>
<th>African countries</th>
<th>rate, primary and secondary enrolment rate, life expectancy at birth*average years of schooling-*positively significant (in alternate specifications)</th>
<th>interest rate and population</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Klasen, 2002</td>
<td>1960-1992, 109 countries</td>
<td>Average years of total schooling in 1960, female male ratio of average years of total schooling in 1960, average absolute growth in average years of schooling, female male ratio of average absolute growth in average years of schooling – <em>all 4 positively significant</em></td>
<td>Initial GDP, average compounded rate of population growth, average compounded rate of labour force, openness and average investment</td>
</tr>
<tr>
<td>13. Knowles, Lorgelly and Owen, 2002</td>
<td>1960-99, 73 countries</td>
<td>Average years of female schooling aged 15 years and above-<em>positively significant,</em> Average years of male schooling aged 15 years and above-<em>insignificant</em></td>
<td>Investment/GDP, adjusted growth of labour force, shortfall in life expectancy of birth from 85 years, initial GDP, Halls and Jones (1999)-measure of technical efficiency</td>
</tr>
<tr>
<td>14. Krueger and Lindahl, 2001</td>
<td>1965-85, 78 countries</td>
<td>Change in schooling-*significant (when longer time periods of 10 or 20 years taken and income included) and initial schooling-<em>positively significant</em> (human capital measure- World</td>
<td>Initial income, change in physical capital, change in labour force</td>
</tr>
<tr>
<td>No.</td>
<td>Author(s) and Periods</td>
<td>Data</td>
<td>Description</td>
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<tr>
<td>15.</td>
<td>Kyriacou, 1991</td>
<td>1970-85, 111 countries</td>
<td>Stock of Human capital-positively significant, Growth of human capital-insignificant (human capital-own measure based on average years of schooling and enrolment rates)</td>
</tr>
<tr>
<td>16.</td>
<td>Loening, 2005</td>
<td>1951-2002, Guatemala</td>
<td>Primary and secondary enrolment rate and average years of schooling-positively significant, tertiary enrolment rate-insignificant</td>
</tr>
<tr>
<td>17.</td>
<td>Papageorgiou, 2003</td>
<td>1960-87, 80 countries</td>
<td>Growth in mean years of primary education- important for low income countries (human capital affecting growth rate through input production), mean years of total education and mean years of post primary education-proxies innovation and important for high income countries, ratio of total factor productivities (proxied by income) between the technological leader country Switzerland and country i-proxies imitation of technology and is important for growth rate of all countries</td>
</tr>
<tr>
<td>18.</td>
<td>Petrakis and Stamatakis, 2002</td>
<td>1977-1982 and 1988-94, 8 countries each for advanced, developed and</td>
<td>Completion rate of primary, secondary and tertiary education as percentage of labour</td>
</tr>
</tbody>
</table>
### 1c. DATA SET ON EDUCATIONAL ATTAINMENT

A measure of educational attainment across countries is required if we want to quantify the relationship between education and economic growth. One of the most widely used data set on educational attainment is the Barro-Lee data set and this data set has been used in our analysis also.

Data on school attainment were collected from UNESCO (and some other surveys) and consistent time series data on educational attainment were formed at the national level by Barro and Lee (1993). The data related to male and female adult population aged 25 and over with no schooling, primary, secondary and higher education. Average years of education was calculated as well. The data set considered 129 countries at 5-year period intervals over the period 1960-85. This was further extended by Barro and Lee (1996) to the year 1990, and data were also provided for the population aged 15 and above. In these data sets, the missing data of countries were filled up with school enrolment figures by a perpetual inventory method\(^5\).

\(^5\) Each country has information of at least 1 year which helps in connecting the enrolment rates.
However, Krueger and Lindahl (2001) criticized the Barro-Lee data set (1993) on the grounds that the enrolment rate data collected by UNESCO might not be reliable.

So, in 2001, Barro and Lee updated their data set, addressing the existing drawbacks, extending the data till 1995 and giving projections till 2000. To fill in the missing data, they used enrolment rates which were adjusted for repeaters, and thus this measure could mirror the inflow of new students who have passed school, in the present educational stock more correctly. Also, the change in school length over time for countries was taken into consideration.

The Barro and Lee (2001b) data set was a further improvement over the earlier data sets. Kyriacou (1991) also used census data to calculate educational attainment as Barro and Lee (1993) and to fill in the missing values, Kyriacou (1991) used regression analysis of educational stocks on lagged flows. But the problem was, for accurate measures, the estimated relation should be stable, which is not always the case.

Data sets of Lau et al (1991) or Nehru et al (1995) used school enrolment rates to calculate school attainment which requires long period data and absence of which could lead to measurement error.

Another way to measure educational stock is with the help of earnings or employment outcomes which can be related to schooling. Pritchett (2001) had used this methodology to calculate educational attainment. But this measure may not be accurate due to significant correlations between schooling and ability and earnings also depend on external circumstances other than schooling. Also in his calculations, Pritchett (2001) used data on average years of schooling from both Barro and Lee (1993) and Nehru et al (1995).

The Barro and Lee data set (1993, 2001b) has been widely used and cited in different studies (e.g. Easterly and Levine, 1997; Halls and Jones, 1999; Sachs and Warner, 1995; Dollar and Kraay, 2002; Glaeser et al, 2004; Aghion and Howitt, 2006).

However, questions were also raised about the Barro and Lee (2001b) data set on educational attainment. According to De La Fuente and Doménech (2006) and Cohen and Soto (2007), the time series variations of educational data of some countries in Barro and Lee's data set seemed doubtful and this created bias in
estimated growth regressions and the data set did not consider the mortality rate or age groupings of individuals which could affect average years of schooling.

Consequently, De La Fuente and Doménech (2006) and Cohen and Soto (2007) formed their own data sets on educational attainment in order to bring out improved data sets compared to Barro and Lee (though published later, these data sets were available much earlier). However, after analyzing all the three data sets, Bosworth and Collins (2003) commented that, “there is substantial evidence of measurement error. However, none of the alternative approaches yield a convincing way to choose between or to combine information from the available schooling proxies” (page 144).

However, recently, Barro and Lee (2010) have addressed these criticisms and updated their data set. This data set contains data on educational attainment for the period 1950 to 2010, according to sex and 5-year age intervals. The data set relates to 146 countries. Also, the data set uses recent census and survey data. Survival or mortality rates by age and education have also been incorporated. In terms of reliability ratio\(^6\), Barro and Lee (2010) estimate is greater than that of Cohen and Soto (2007) and same as De La Fuente and Doménech (2006)\(^7\).

Barro and Lee (2010) data set has already been used and cited in several empirical studies (e.g. Hanushek and Woessmann, 2010b; Park, 2010; Ozier, 2011). In this present thesis also, the Barro-Lee data set (2001b, 2010) has been used and the version used was the most recent available at the time of analysis.

1d. REVIEW OF LITERATURE- QUALITY OF HUMAN CAPITAL: DEFINITION, DETERMINANTS AND CONSEQUENCES

\(i\) Definition:

Quality and quantity of education are totally different concepts. Just measuring the length of stay of a student in school or noting whether he or she is enrolled in a school does not represent the quality of schooling the student is

\(^6\) Reliability Ratio: “As used by Krueger and Lindahl (2001) in checking quality of schooling data, the reliability ratio gauges the fraction of the variability of a (unobserved) true variable in the total variability of the variable measured with error” (Barro and Lee, 2010, page 13).

\(^7\) Calculations as per Barro and Lee (2010).
achieving in the process of education. Many studies (e.g. Barro, 1991, 1999, 2001; Mankiw, Romer and Weil, 1992) have used enrolment rates or average years of schooling to determine the effects of human capital on economic growth. But enrolment rates or average years of education are imperfect measures of the educational component of human capital because they measure quantity of schooling and not the quality.

According to the EFA Global Monitoring Report 2005, UNESCO (2004), quantity of schooling actually depends on the quality. Students become eager to enroll or to attend classes in schools depending upon the available quality of education. Even parents decide to send their children to school after calculating the benefits depending upon the quality of learning provided in schools. High quality education helps the children to achieve their own goals as well as makes them responsible citizens who can contribute to the well being of the society and the economy.

The EFA Global Monitoring Report 2005, UNESCO (2004) emphasizes that, “education is a set of processes and outcomes that are defined qualitatively. The quantity of children who participate is by definition a secondary consideration: merely filling spaces called ‘schools’ with children would not address even quantitative objectives if no real education occurred. Thus, the number of years of school is a practically useful but conceptually dubious proxy for the processes that take place there and the outcomes that result. In that sense, it could be judged unfortunate that the quantitative aspects of education have become the main focus of attention in recent years for policy makers (and many quantitatively inclined social scientists)” (page 28-29). So, the overall developmental goals of education are reflected in quality of education rather than in quantity. Thus the dimension of quality of education should be given more importance.

Two important United Nations conference declarations deal with the quality of education. The Jomtien Declaration in 1990 and, more particularly, the Dakar Framework for Action in 2000 accepted that universalization of education can only be achieved through quality education. One of the goals of the Dakar Framework deals with the provision of good quality primary education. Another one deals with improvements in overall education quality so that students achieve better learning outcomes ‘especially on literacy, numeracy and essential life skills’. The Dakar Framework affirmed that quality is the most important aspect of education and it determines enrolment of students, the length of their stay in the schools and their
achievement. So, the new definition of quality included these dimensions: learners (healthy and motivated students), processes (skilled and competent teachers with the best of techniques), content (relevant curricula) and systems (good governance and unbiased resource allocation). But no dimension was given relative importance in the agenda.

Even though there is a general consensus that provision of good quality education is important, there is no common definition of quality. UNESCO’s definition deals with clear determination of important characteristics of quality of education which can help in fulfilling the instrumental goals of education. Other organizations dealing with education have similar formulations. Though there are differences in the approaches, two important common characteristics of these formulations can be identified. First, cognitive development is one of the important objectives of education and it can be said to be an indicator of quality of education. This can be measured but ways of increasing quality (in terms of cognitive achievement) are different across nations and improvement of results is quite difficult. The second aspect deals with the role of education which can bring about creative and emotional development among learners so that they get inclined to support objectives of peace, citizenship and security, and cultural values are passed on to future generations. There are different approaches to fulfill these objectives in different countries and the extent of achievement of the second aspect is more difficult to measure.

UNICEF strongly emphasizes what might be called desirable dimensions of quality, as identified in the Dakar Framework. According to UNICEF (2000), "Children have a right to an education, a quality education. Quality education includes:

- Learners who are healthy, well-nourished and ready to participate and learn, and supported in learning by their families and communities;
- Environments that are healthy, safe, protective and gender-sensitive, and provide adequate resources and facilities;
- Content that is reflected in relevant curricula and materials for the acquisition of basic skills, especially in the areas of literacy, numeracy and skills for life, and knowledge in such areas as gender, health, nutrition, HIV/AIDS prevention and peace."
- Processes through which trained teachers use child-centred teaching approaches in well-managed classrooms and schools and skilful assessment to facilitate learning and reduce disparities.
- Outcomes that encompass knowledge, skills and attitudes, and are linked to national goals for education and positive participation in society.

This definition allows for an understanding of education as a complex system embedded in a political, cultural and economic context” (page 4).

ii) **Determinants:**

According to the EFA Global Monitoring Report, UNESCO (2011), “the quality of education remains very low in many countries. Millions of children are emerging from primary schools with reading, writing and numeracy skills far below expected level” (page 1). So in this present scenario important determinants of quality of education should be identified, so that they can be improved in order to provide quality education to all. According to Hanushek (2005), “one of the challenges in understanding the impact of school quality differences in human capital has been simply knowing to measure quality” (page 270). Various studies represent quality with the help of different indicators, for example, test scores of some common examination or earnings of labour force after completion of a specified level of education. With these indicators the literature identifies a number of factors as determinants of quality of education. These factors include family characteristics like family income, parents’ education and race or school characteristics like class size, pupil teacher ratio skills of teachers, infrastructural facilities of the school etc.

Card and Krueger (1992) represented quality by earnings of students after completion of education. They studied factors influencing quality of education for men born between 1920 and 1949 for 49 states in USA. Individual log weekly earnings for 1979 were used as the dependent variable. Earnings were higher for individuals who attended schools with lower pupil teacher ratio and higher salaries of teachers. Family income and education of parents had no significant effect on earnings. Better educated teachers and higher fraction of female teachers influenced earnings positively. But the problem with this measure is that labour market performance depends on many external circumstances rather than solely on schooling.
Another indicator of schooling quality used extensively in the literature is test scores of some common examination. Studies have used test scores to represent quality and found determinants of this quality measure.

Summers and Wolfe (1977) studied the effects of social and genetic characteristics of pupil (e.g. family inputs, IQ, race), school characteristics (class size, quality of teachers) and peer group characteristics (e.g. proportion of high achievers, proportion of blacks) on student achievement. The study related to 6227 sixth grade students of 103 elementary schools of Philadelphia School district, USA in 1970-71. Student achievement was measured by difference of 6th grade score on IOWA Test of basic skill and 3rd grade score, that is, the change in scores over the 3rd grade year was used. Female students performed better. IQ had a positive effect on student achievement. Non black student had an additional positive effect in terms of IQ. Good qualification of teachers affected student achievement positively, increase in class size affected student achievement badly. It was also found that low achievers (in terms of scores), students with low family income and black students had improved levels of achievement with improvements in school inputs.

Konstantopoulos (2006) also did a study on the determinants of student achievement in USA for the period 1972-92. Data related to 3 surveys in the considered time period for high school senior students. Quality was measured in terms of mathematics, science and reading scores. Important variables positively affecting quality in terms of test scores were school affluence, high student attendance, schools with high proportion of attendance, schools with high proportion of students going to college and low drop outs rates. Achievement was lower for students in schools in southern region. Family effects (parents’ education, occupation and income) increased student achievement and this effect was increasing over time. Males performed better in science tests.

Krueger (1999) studied the effects of class size on student achievement in USA on the basis of ‘Tennessee Student/Teacher Achievement Ratio Experiment, known as project STAR, beginning 1985-86 and with 1160 kindergarten students. Quality of education was measured in terms of percentage obtained in Stanford Achievement Test and Basic Skill Test for classes KG, 1, 2 and 3. The result showed that when a first grade student shifted to a smaller class, performance improved on an average by about 4 percentile points. Also, student performance improved by about 1 percentile point every year for students in small size classes (13-17 students)
compared to students who were in regular size classes (22-25 students). Lower class size had the maximum positive effect on test scores on minority students and students on free lunch.

Almost similar results were obtained by Finn and Achills (1990), who did a similar study based on randomized trials in Tennessee dealing with 6500 kindergarten students. Quality of schooling was measured by mathematics and reading scores in Stanford Achievement Test and Basic Skill Test. In this study also it was found that students of class 1 benefitted in terms of both mathematics and reading scores if they were in small size classes. Students who were in smaller classes in both class KG and 1 had higher test scores and also growth in reading scores were higher in class 1 compared to regular classes. Minority students benefitted from small size classes. According to Finn Achilles (1990), lower class size had positive effects on student achievement because teachers' satisfaction might be greater, teachers might give more attention to students in small size classes and also pupils might become more involved in learning process.

Angrist and Lavy (1999) estimated the effect of class size on the reading (Hebrew) and mathematics scores of elementary school children in Israel. Data related to the national testing programme in Israeli elementary schools. Tests were conducted for 4th and 5th grade students in June 1991. Instrumental Variables were constructed for class size by using functions of Maimonides rule. The results showed that increased class size affected student achievement negatively, when pupil background and enrolment were controlled for. The effect of class size was maximum for mathematics and reading scores for class 5.

In terms of cross country studies, Heyneman and Loxley (1983), analysed the determinants of students achievement for 29 countries in Africa, Asia and Latin America and the Middle East. Student achievement was measured in terms of science scores in internationally comparable tests for 13-14 year olds. Learning was low for students in primary schools in low income countries as compared to high income countries. The effect of family income on student achievement was less for low income countries. But the effects of school and teacher quality on student achievement in primary schools were higher for low income countries.

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8 Shin and Raudenbush (2011) also found that reduction in class size helped to improve reading, mathematics, listening and word recognition test scores from kindergarten to class 3.

9 The 12th century rabbinic scholar Maimonides proposed a maximum class size of 40.
One of the most extensive cross country studies on determinants of schooling quality is by Barro and Lee (2001a). Educational quality was measured by test scores, repetition rates and some dropout rates. This study extended the data set of Hanushek and Kimko (2000) and considered 58 countries for the time period 1964 to 1991. Test scores comprised of science, mathematics and reading scores in tests conducted by the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Educational Progress (IAEP). Independent variables included school resources (pupil-teacher ratio, expenditure per student, teachers’ salary, length of school year) and family inputs (family income, parents’ education).

The education production function used was as follows:

\[ Q_{ijt} = \alpha_{ijt} + \beta_1 F_t + \beta_2 R_t + \epsilon_{ijt} \]

where, \( Q_{ijt} \) is the test score in subject \( i \) (mathematics, science, and reading) for students of age group \( j \) (10- and 14-year-olds) in year \( t \) (1964, 1970-72, 1982-83, 1984, and 1990-91), \( F_t \) represents the vector of family factors (income and schooling), \( R_t \) represents the vector of school resources (pupil-teacher ratio, average teacher salary, educational expenditure per pupil, school length) and \( \epsilon_{ijt} \) denotes unmeasured factors.

The result of the basic regression was:

\[
Q = \alpha + 3.19X_1 + 1.33X_2 - 0.15X_3 + 1.62X_4 + 0.01X_5
\]

(3.00) (4.93) (2.44) (1.81) (0.46)

where, \( Q \) = Test Score, \( X_1 \) = Log GDP per capita, \( X_2 \) = Primary education of adults, \( X_3 \) = Pupil-teacher ratio, \( X_4 \) = Log of average teacher salary and, \( X_5 \) = length of school days

Family background, as measured by parents’ income and education had positive effects on student achievement. High pupil-teacher ratios had strong negative effects on student achievement. Average teacher salary and the length of the school term also had weak positive effects. Also it was seen that per capita GDP was insignificantly related to science and mathematics scores but there was a significant positive relation between per capita GDP and reading scores. Both family and school characteristics emerged as important factors to affect quality of education, as measured by student achievement in this study.

There is also a wide variation in quality of education across India. Banerji (2000) argued on the basis of field studies in slum communities in Mumbai and Delhi that learning or enrolment in schools had more to do with the quality of schools than
with the economic conditions of the family. Rampal (2000) also concluded on the basis of survey of ‘educationally backward Hindi speaking states’ that enrolment is not low due to unimportance of education but due to the poor quality of schools, because even poor parents felt that it was important for both boys and girls to be educated. Kingdon (2007) also found that though there is universal primary school enrolment and literacy rate is rising in India, there are lots of drawbacks in the present educational status of India. Attendance in primary schools is low in states like Uttar Pradesh and Bihar and also participation in secondary schools is low. Student achievement is low in both primary and secondary schools. Infrastructural facilities are not good in schools. All these facts tell us about poor schooling quality in India.

These have been some studies relating to determinants of quality of education for India. Kingdom (1994) conducted a sample survey of 30 schools in urban Lucknow in Uttar Pradesh in 1991. The data related to 902 children aged 13-14 years studying in class VIII. Data were collected for all the children enrolled in any one section of class VIII for all the schools considered. Tests were conducted for numeracy and literacy. Questions were on the basis of tests prepared for Knight and Sabot (1990) by Educational Testing Service, Princeton, NJ. Information was also collected about the schools and about the teachers who taught the students who gave the tests. On the basis of this survey, Kingdon (1996a) did an analysis of student achievement and private and public schooling using unordered multinomial logit model. The study analysed the important determinants of schooling quality as measured by mathematics and reading scores. Private schools performed better in terms of student achievement. Innate ability of the students (measured by Raven’s Progressive Matrices test\(^\text{10}\)), child’s educational aspirations (reflecting parents’ motivation) and family wealth affected student scores positively. Higher age and more number of siblings affected student achievement negatively. Boys had better achievement compared to girls.

Further Kingdon (1996b) did a study of determinants of student achievement and as well as teachers’ pay and Kingdon (1998a) did a study of the effects of schools on student achievement. The studies used number of estimation methods like the treatment effects model using non-linear two stage least squares or ordinary least squares. Kingdon (1996b) and Kingdon (1998a) also found determinants of student

\(^{10}\) Raven's Progressive Matrices are multiple choice tests of abstract reasoning, originally developed by Dr. John C. Raven in 1936.
achievement on the basis of Kingdon's (1994) survey. Variables which emerged as important in affecting student achievement were school resources, length of instruction time, management type of schools (private schools performed better) and cognitive skills of the teachers. Parents' wealth and innate ability of the students as measured by Raven's Progressive Matrices test, also affected student achievement positively. Variables which did not affect student achievement significantly in these studies were class size and teachers' training, experience and years of education.

National level data on learning achievement was first collected by Pratham (educational NGO) in 2005, through Annual Status of Education Report (ASER). The aim was to find the progress of basic level of learning in rural areas. These reports have come out from 2005 to 2010. These surveys are household level surveys. Data are collected from households in villages (selected from village listing in Census 2001) from each district. Apart from household related questions and about schools in which the children go, tests (basic reading and arithmetic) are conducted of children aged 5 to 16 in the households. The reports indicate that the children have difficulty in reading and solving arithmetic problems and there is a lot of variation across states. Pratham (2011) indicates through linear probability model that learning outcomes are not determined by infrastructural facilities or pupil-teacher ratio. It is concluded that "the point is to make sure that policy makers don’t get mired in chasing targets of school infrastructure and forget about the real meaning of the word “education”. To reap the demographic dividend we need a well-trained and productive labor force which will be possible only if we hunker down today and improve the quality of education in our schools" (Pratham, 2011, page 10).

The National Policy on Education 1986 emphasized periodical achievement surveys at different stages of school education to assess the health of the education system in India. In 2000, the Ministry of Human Resource Development launched Sarva Shiksha Abhiyan (SSA) for achieving universalization of elementary education. For this, NCERT launched three Baseline Achievement Surveys at Classes III, V and VII/VIII. About 20-25 percent of total districts in the country were selected for these surveys. In the survey related to learning achievement of Class V children, 84322 students, 14810 teachers and 6828 schools across 266 districts of 33 states/UTs were covered. Details regarding Mathematics, Environmental Studies (EVS) and Languages of Class V students were covered in the survey.
Given the extensive data on schools collected through school questionnaires, researchers at NCERT (2008) created a composite set of indices to reduce the number of school related variables through Principal Component Analysis. The indices considered were Institutional facility index (IFI) comprising availability of map, charts, globes, blackboard, science, & mathematics kits etc., Human Resources Index (HRI) including percentage of female teachers and pupil - teacher ratio, Infrastructure Index (II) including availability of playground, number of classrooms, mat & furniture, toilet & drinking water, electricity facility etc., Auxiliary Facility Index (AFI) including availability of TV, computer, musical instrument, electric connection, etc., Community Participation Index (CPI) and Incentive Schemes Index (ISI) which considers availability of incentive schemes like midday meal, scholarship, free textbooks etc.

The estimated equations obtained were:

\[ \text{Mean achievement (EVS)} = 43.711 + 0.263\text{IFI} + 0.232\text{IFI}^* + 0.226\text{AFI}^* + 0.544\text{HRI} + 1.203\text{CPI} + 0.733\text{IS} \]
\[ \text{Mean achievement (Math)} = 41.70 + 0.242\text{IFI} + 0.277\text{IFI}^* + 0.212\text{AFI}^* + 0.376\text{HRI} + 0.24\text{CPI} + 0.195\text{IS} \]
\[ \text{Mean achievement (language)} = 49.49 + 0.371\text{IFI} + 0.222\text{IFI}^* + 0.78\text{AFI}^* + 0.761\text{HRI} + 1.31\text{CPI} + 0.146\text{IS} \]

* Significant at 0.05 level, ** Significant at 0.01 level

IS represents Inspection of Schools

The results indicated that all the variables (except IS) significantly affected the mean achievement in all the three subjects. It was found that community participation and more number of teachers has maximum impact on the achievement of students.

So from these studies, it is seen that differences in schooling quality across and within countries are considerable and can be explained in part by a set of quantifiable explanatory variables.

**iii) Consequences:**

Although the quality of schooling varies substantially across countries, it is difficult to find a comparable measure of quality for a broad number of countries. Various studies have used different proxies to represent quality of education in country specific studies or cross country studies. One of the most commonly used
measures is the proxy of academic achievement, for instance, test scores of some common examination. Schooling quality as measured by test scores can positively affect economic outcomes, in terms of increased earnings or increased economic growth rate of countries.

We first look into some studies indicating a positive effect of increased quality of schooling (as measured by test scores) on subsequent earnings.

Based on the National Longitudinal Study of the High School Class of 1972 and High School and Beyond of 1980 in the USA, Murnane, Willet and Lavy (1995) estimated whether basic cognitive skills (measured by mathematics score) were important for wage determination. Wage data related to the period of six years after high school graduation. The impact of increased cognitive skills on subsequent earnings was more for both males and females in 1980 compared to 1972. Increased mathematics score was a strong predictor of wages six years after high school graduation in 1980.

Again, Lazaer (2003), based on the National Educational Longitudinal Study of 1988 in USA of students in grade 8 and follow up in 1999 for earnings, found that cognitive achievement measured in terms of sums of scores in reading, mathematics, history and science had a positive effects on earnings later. A change in the score between class 8 and end of high school (four years later) was also considered. Here, both the sum of scores and change in scores representing learning and more occurrence of learning respectively had a positive significant impact on subsequent earnings.

McIntosh and Vignoles (2001) did a study of the effect of quality of schooling on earnings in UK. The data of the National Child Development Study (continuing survey of people born between 3rd and 9th March of 1958) of 1995 and the International Adult Literacy Survey, 1995 were used. Numeracy and literacy skills were used to predict earnings and both the skills emerged as important variables. However, numeracy skills were more important to increased earnings, and increase in literacy skills also increased the probability of being employed.

In order to find a relationship between schooling quality (as measured by scores in literacy tests) and subsequent earnings in Canada, Green and Riddell (2003) used data of International Adult Literacy Survey of 1994 and analysis was done only for male paid workers. Results indicated a strong positive effect of literacy scores on subsequent earnings and also the effect of years of schooling on earnings was greatly
reduced when literacy score was considered. These results suggested that an increase in literacy score of 20 point is equal to the impact of about 1 year of extra schooling.

Behrman et al (2005) studied the relation between earnings and quality and quantity of primary and middle schooling in rural Pakistan (based on a survey in 1989). Increasing quantity of schooling or improving the quality of schooling had the same effect in terms of increased cognitive skills in rural Pakistan. Higher cognitive skills increased subsequent earnings. Skilled educated workers even from low quality schools earned more than uneducated ones. Increasing quantity of schooling or improving quality emerged as alternate means to increase earnings.

Now, we consider studies which have looked into the impact of increased quality of education (as measured by internationally comparable test scores) on economic growth rates.

Barro (1999) in a study of 51 countries (data about test scores were available in 51 countries out of the sample of 100 countries considered in the analysis) for the period 1960-95, found positive effects of internationally comparable science, mathematics and reading scores on economic growth. The impact on growth rates was strongest for science scores. Similar results were also obtained by Barro (2001) in a study of 43 countries (data about test scores were available in 43 countries out of the sample of 100 countries considered in the analysis).

One of the most important studies relating to schooling quality and economic growth is of Hanushek and Kimko (2000). In this study, schooling quality was represented by cognitive achievement as measured by mathematics and science test scores in internationally comparable tests (The International Association for the Evaluation of Educational Achievement and International Assessment of Educational Progress). The study dealt with the period 1960-90. The broad framework used by Hanushek and Kimko is as follows:

\[ g_i = X\beta + \gamma QL_i + \epsilon_i \quad \text{................. (1)} \]
\[ R_i = W_i \delta + \eta g_i + \mu_i \quad \text{................. (2)} \]
\[ QL_i = Z\alpha + R_i + \nu_i \quad \text{................. (3)} \]

Equation (1) shows that growth depends on labour force quality (QLi) and some other factors (Xi). Equation (2) shows that resources devoted to schools and production of human capital (Ri) depends on growth rates (gi) and some other factors.

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11 Details of the variables of the articles discussed in this section are given in Table 2.
Chapter 1: Introduction

(W_i) and equation (3) shows that labour force quality depends on resources devoted to schooling and some other inputs (Z_i).

Resources devoted to schools and human-capital production (R_i) included primary-school enrollment rate, average years of schooling, pupil teacher ratio in primary schools, recurring expenditure on education/GDP, total expenditure on education/GDP, and annual population growth (year 1960 to 1990). Labor-force quality (QL) included scores of international tests of student achievement in mathematics and science that were conducted from 1960 to 1990 for 31 countries.

Since it was impossible to estimate the complete system of equations with the available data, a direct estimation of equation (3), the human capital production function was done. It was assumed that when u and v were uncorrelated, consistent estimates were obtained from estimation of equation (3). It was assumed that there was no variation of international level of ability of students across countries. The study included estimates of several variants of equation (3). Variation in school resources, pupil teacher ratios, total expenditure per student etc. did not have a strong effect on test performance. The effect of the level of education of the parents which was proxied by quantity of schooling of the adult population was positively significant. There was a negative relation between population growth and achievement.

The estimates of equation (3) were used to construct an expanded set of labor-force quality measures, QL, which combined “observed quality with predicted quality for all countries without observed test data but with data on the right-hand-side measures” (Hanushek and Kimko, 2000; page 1194). In this way, the number of countries considered was expanded to 78. The estimate of labor-force quality measure, QL, was then used as an explanatory variable for average annual growth rate in real per capita GDP in equation (1). The other variables used were per capita income in 1960, average years of schooling and annual population growth (years 1960 to 1990, number of countries-78).

The results showed that the initial per capita income was statistically significant and negative indicating significant conditional convergence with higher initial income resulting in lower growth rates. Quantity of schooling though positive, was statistically insignificant. The measures of labour force quality were statistically significant. A one standard deviation change in quality resulted in a little greater than one percent difference in growth rates.
Bosworth and Collins (2003) estimated the quality of education measure following the procedure of Hanushek and Kimko (2000) with the help of the data from World Development Indicators (2002). The study related to 84 countries for the period 1960-2000. The quality variable emerged to be significant, in growth regressions when other variables were controlled for. The variable representing quantity of education (average years of education) turned insignificant when quality was included in the specification. However, the quality variable turned out to be insignificant in one specification when quality of government institution was included.

Ramirez, Luo, Schofer and Meyer (2006) also studied the effects of educational quality on growth for two time periods 1970-90 and 1980-2003, using test scores data of 38 countries from Hanushek and Kimko (2000). They found positive effect on growth rates but the effect weakened when the ‘Asian Tigers’ (Hong Kong, Singapore, South Korea, and Taiwan) were removed from the data set and also for the second time period when many Asian countries were in the phase of slow growth.

Again, Jamison, Jamison and Hanushek (2007) estimated the effects of education quality (as measured by average of mathematics score in all the tests in which the countries participated) on economic growth for a maximum of 54 countries for the period 1960-2000. In this study also, quality variable was significant but quantity (average years of education) was insignificant. However, inclusion of variables indicating country differences in the model, that is, fertility rate, openness and fraction of land in the tropics, reduced the effect of quality. A one standard deviation increase in test scores led to 0.87 percent higher growth rates compared to a little higher than 1 percent in Hanushek and Kimko (2000). However, inclusion of the three country difference variables reduced the effect to only 0.45.

Altinok (2007) used mathematics, science and reading scores as measure of quality for about 105 countries (taken from the data base of Altinok and Murseli, 2007). The study related to the period 1965-2005. Using different methods of estimation (10-year-interval panel regressions with time fixed effects and with different controls, OLS with country fixed effects and generalized method of moments), they predicted a positive effect of quality of education on growth rates for a large number of countries.

Appleton, Atherton, and Bleaney (2008), in a study of maximum 51 countries for the period 1960-2004 (5-year periods) used lagged test scores instead current
values of test scores. They found a positive significant effect of lagged mathematics, science and reading test scores on subsequent growth rates of economies.

Hanushek and Woessmann (2008) also found a positive effect of quality of education (average of mathematics and science scores of tests held between 1964 and 2003) on rates of growth. Growth regressions were carried out for 50 countries for the period 1960-2000. In this study also, quantity of education (average years of education) turned insignificant by inclusion of quality. However, inclusion of variables to capture the institutional framework of a country, that is, openness and an index for protection against appropriation to measure security of property rights reduced the effect of quality on growth. It was still significant but the magnitude of the effect decreased.

Hanushek and Woessmann (2009), used the same measure of educational quality as Hanushek and Woessmann (2008) for the analysis of 50 countries for the time period 1960-2000, and using different methods of estimation like cross country regressions with controls, instrumental variable method and limited information maximum likelihood estimator (instrumenting test scores by institutional features of schools), they concluded that quality of education (arising from good institutional quality) was important for economic growth.

Hanushek and Woessmann (2010a) also used the same framework as Hanushek and Woessmann (2008) to analyse the growth rates of countries for the period 1960-2000. This study looked into the sample quality of the internationally comparable tests. Some problems relating to the sample are enrolment (it may be the case that a percentage of children of the required age range for the tests are no longer enrolled), exclusion (some schools in the remote areas etc. may be excluded from samples) and non-response (some schools and students selected for the tests may not appear for the tests). These biases are positively related to test scores. So, in this study, a total of 50 countries were included out of which in 45 countries, the data about sample quality (enrolment, exclusion and non-response) were present. When the variables relating to the biases were included in the model, they were insignificant but quality was significant. Even when estimation was done only for the countries for which sample information was present, quality was significant. Quantity of schooling (average years of education) was insignificant.

Thus it can be seen that direct measures of labor-force quality from international mathematics and science test scores are strongly related to growth rates
of real per capita GDP in cross country regressions. The results indicate that quality of schooling is an important determinant of human capital.

Table 2: Effect of Educational Quality (test scores) in different Growth Regressions

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