

AN ABSTRACT OF THE THESIS OF

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Studies suggest that higher investment in human capital boosts economic growth by increased productivity. Education is considered to improve human capital, but it takes relatively long to achieve progress in education. Literacy of female population holds particular importance as it has both direct and indirect effect on growth. Apart from individual productivity, female literacy has positive effect on reducing fertility, improving health and nutrition of family and education of future generations. Using cross country data and panel regression, this study intends to explore how the gender gap in education at different levels of attainment affects GDP growth. This study found that female education, especially secondary education, is positively associated with economic growth. It found mixed results for the impact of gender gap on economic growth. In recent times, national development strategies of many countries have been expanded to focus on social development issues like health, education, environment and gender equality along with GDP growth. But, countries with very limited resources have to prioritize the investment policy. This study will be helpful for policymakers to redefine the budgetary policy to maximize the return in both monetary and non-monetary terms and thus address the persistent issues of poverty and inequality.

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**Gender Discrimination in Education and Its Impact on Economic Growth: A
Cross Country Panel Study**

By

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I understand that my essay will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my paper to any reader upon request.

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1.0 Introduction

National policy across the world focuses on economic growth. Economic growth is a measure of material wellbeing which allows a country to ensure access to food, shelter, health care, education and other basic necessities for its citizens. It is true that economic growth alone does not guarantee social wellbeing, political freedom, human right or justice, which are considered important indicators of sustainable development. Nonetheless, growth helps a country to acquire resources that are necessary to bring about the desired change in a society. Education, on the other hand, helps to develop human capital stock and contributes in the economic growth by improving productivity of the workforce. The direct impact of education is enhancing the level of skill of the labor force of the country. At the same time, education generates externalities that include improved health condition and low fertility. These externalities are more commonly associated with female education. An educated mother teaches children and other family members basic hygiene and nutrition (Klasen & Lamanna, 2009). She is also capable of using the available resources of education and healthcare more efficiently for her children. These acts have been proved to be immensely beneficial to improve average health condition of the children and this eventually improves the wellbeing and productivity of the country. That is why, the association between economic growth and education has received profound attention of researchers over the years. The positive association between growth and education is proved to be an important criteria for allocation of resources in education and this is especially important for the developing countries where resources are very scarce.

While low level of female education hinders economic prosperity, a gender gap in education aggravates the outcome. The gender gap is a consequence of several socioeconomic and policy

factors and it is a common phenomenon across the globe with varying degree. But, systematic discrimination against women in terms of education is strikingly predominant in the poorest countries (Dollar & Gatti, 1999). Educational gender gap undermines the potential of a girl and prefers to invest in a boy's education who is less able. This affects the economic growth adversely by suboptimal use of merit pool, low productivity and less than optimal return on the investment in education. For instance, the Asia and Pacific region is losing US\$16 billion to US\$30 billion annually as a result of the gender gap in education (ILO & ADB, 2011). In many developing countries, affordability and social practices are not in favor of educating girls. Moreover, if there exists a large entrance barrier to the job market, both families and individuals do not feel motivated to pursue education for girls. There has been a world-wide movement to eliminate this gender gap in education. Recent reports showed some progress especially in primary education as 69% of countries were expected to reach gender parity by 2015 (UNESCO, 2015). But the poorest girls are still out of the reach of primary education program. Rich countries have a better trend in primary and secondary education, but at tertiary level the gender gap is still prominent (Duflo, 2011)

The advocates of endogenous growth models believe that economic growth can be achieved by endogenous factors like education and human capital and they support policies that allow investment in these sectors. Increasing spending on education would undoubtedly improve average educational attainment of the country, but it may not achieve success in eradicating gender gaps. It is possible to find growth in both male and female education with the existence of gender base disparity (Duflo, 2011). It would take specific policies targeted to improve female literacy to eradicate the gender gap. Moreover, if we consider diminishing marginal return of education, then investment in female education should bring higher marginal return as they currently have low

educational attainment due to a gender gap (Knowles et al, 2002). This article attempts to add to that literature of education policy and resource allocation with an emphasis on developing countries that have been troubled with resource limitation and the specific investment of it.

While we are discussing the impact of education on economic development, there are two aspects of education that we should think about - quantity and quality of education. For quantity, average years of education, enrollment rate and percentage of population with certain level of education are common proxies used in literature (Barro, 1996; Bils et al, 2000; Self, 2004). The choice of years of schooling depends on the expected return of education (Aghion et al, 2009). Average years of schooling treats one year of additional primary education similarly as one additional year at university, unless attempts are made to segregate the total average years of education into different levels of education (Aghion et al, 2009; Self et al, 2004). According to EFA (Education For All) Global Monitoring Report, 2015 of UNESCO, there are 58 million children still out of school globally and around 100 million children do not complete primary education. For countries with very low level of educational attainment, improving average years of schooling or enrollment rate is undoubtedly more important in the short run. On the other hand, though it is intuitive that the return of education varies greatly with the quality of education, the measure of academic standards across the world is complex. In absence of any universally practiced evaluation standard, it is difficult to compare the educational quality and its contribution to economic development using cross country data. Some studies have used the government expenditure in education as a proxy for educational quality. But public expenditure again depends on the development stage of any particular country (Ranis et al, 2000), as developed countries are able to spend more on education.

The most critical issue lies in the causal mechanism between education and economic growth. Education enhances economic growth by accumulating human capital and economic solvency allows countries to increase public expenditure in education and human capital. The endogeneity between these two variables are obvious and both notions have found support from a growing body of empirical studies. Moreover, if the investment in education depends on the future return of education, then there is also probability of endogeneity. People will invest more in education if higher income is expected and higher income would make individual and society more able to invest in education. While both causal links have significant empirical supports, this paper intends to focus on the causal mechanism that runs from gender gaps in education to economic growth. In order to address the endogeneity issue, time lag between education and economic growth is incorporated by using the educational attainment of the adult population. Using data on educational attainment at primary, secondary and tertiary levels, this paper uses the growth effects of gender gaps at different levels of education to explore the mechanisms that may affect the impact of education on growth.

2.0 Literature Review

How education affects growth

First let us look at the impact of education on economic growth. Education helps to increase productivity, creativity and capacity of the workforce and enables them to contribute positively in enhancing economic growth (Ranis et al, 2000). Though both physical and human capital are necessary factors of production, human capital tends to be more difficult and time consuming to acquire than physical capital. Therefore, a country that starts with a high ratio of human to physical capital tends to grow rapidly by adjusting upward the quantity of physical capital (Barro, 2001).

Prichett (2012) mentioned that average wage increases for more educated people and due to this fact, average income should grow as more individuals are educated. Moreover, as the fraction of educated population increases, low income people become capable of finding better economic opportunities and this should have a positive impact in increasing their income (Ranis et al, 2000). It may reduce the income inequality by increasing the average earning of the low income group. Education can also improve per capita income by reducing population growth (Ranis et al, 2000). Education builds skilled labor force and increases participation in labor force by fostering democracy, good governance and gender parity (Barro & Lee, 1999; Gylfason, 2001). These positive externalities of education make the argument even more favorable for positive association between education and economic growth.

Different level of education contributes to economic growth in a different manner. Barro (1998) found that growth can be predicted by secondary and tertiary level of education, but not by primary level. It was then suggested that as primary education is a prerequisite for higher education, being statistically insignificant does not undermine its importance. Primary education raises the productivity of workers by increasing basic skills and health and this change can be observed in fairly short span of time. Skilled labor also attracts higher investment and growth in exports. Secondary education helps to acquire managerial capacity whereas tertiary education helps development, selection and adaptation of suitable technology (Self et al, 2004; Aghion et al, 2009). The strong effect of secondary and higher schooling suggests a paramount role for the diffusion of technology. Due to the diminishing return of capital stock, technological progress plays an important role in producing intermediate goods that boost economic efficiency and productivity in the long run. As higher income countries have shifted their economic activities from labor based industries to knowledge based industries, tertiary education helps economic growth through

technological innovation and improvement. Moreover, increased productivity of any firm derived from technological progress also generates externality by improving productivity of the related firms (Ranis et al, 2000). Another study suggests that ‘given the level of GDP, a higher initial stock of human capital signifies a higher ratio of human to physical capital’ (Barro, 2001, P.14). Higher level of human capital facilitates the utilization of superior technologies from leading countries. This channel is likely to be more pertinent to schooling at the secondary and higher levels. Moreover, secondary and tertiary education also influence the major legal and financial government institutions (Ranis et al, 2000). For the stated effects of different level of education, poor countries are likely to be more benefitted from primary and secondary education. For countries with higher income levels, tertiary level of education is more significant for economic growth (Aghion et al, 2009). Countries initially favoring growth and overlooking human development often performed poorly in long run. On the contrary, countries with better human capital and poor economic condition were able to achieve long run sustainable growth (Ranis et al, 2000). So, literacy should be given priority in national policy to acquire human capital.

Gender gap in education: compulsion or choice?

Next comes the question why the gender gap in education is important to consider for economic growth and its causal mechanism. The effect of an educational gender gap on the economic growth has received extensive attention in literature. Before focusing on the empirical evidences of the effect of gender inequality in education on economic growth, let us focus on some probable reasons behind this gender bias in education. It is found that in low and middle income countries girls are less likely to attend school and this is particularly true for the poorest children. Though there is a visible progress in educating girls under the Millennium Development Goals, the poorest girls still

lag behind the poorest boys (UNESCO, 2015). Poorer households show more differential attitudes towards girls due to lack of financial ability (Duflo, 2011). One common presumption is that existence of market failure leads to suboptimal investment in education of school-age girls and the market failures, that affect female attainment adversely, are predominant in the early stages of growth (Dollar and Gatti, 1999). From a private point of view, this market failure can be caused by lack of information as parents may lack the proper long term valuation of education. Parents care about the total household income and have high aspiration for their boys. In many developing countries, boys take care of their parents in old age or at least they are expected to do so. This is particularly true in countries where government provided social security is minimal. It is not that parents do not recognize the potential of education in increasing income. They want both boys and girls to get married to an educated person. In patriarchal society, girls become a part of the groom's family. So, families welcome an educated daughter-in-law as this has potential to increase household income. On the other hand, they expect their girl to get married to an educated, well earning man. But as marriage will move a girl to a different economic entity, parents seldom consider educating girls as a profitable decision for the household (Dollar and Gatti, 1999). Therefore, parents with inadequate means prefer to invest in their boys, even though the girls possess similar or better abilities. When this becomes a common trend in a society, no one finds the incentive to change his decision as long as everyone else's decision is unchanged. Thus, gender discrimination reaches at a Nash equilibrium (Lagerlof, 2003).

Apart from private decisions, investment in education is sometimes below the socially optimal level. Often the positive externalities of girls' literacy are not explicitly evident. Female education, like male education, increases productivity, opportunity to be employed in formal labor market, individual income and contributes in the current economy. Moreover, an educated mother

contributes in children's wellbeing. Improved health and education of children secure productivity of the next generation and thus contribute in the future economic growth (Fig-1).

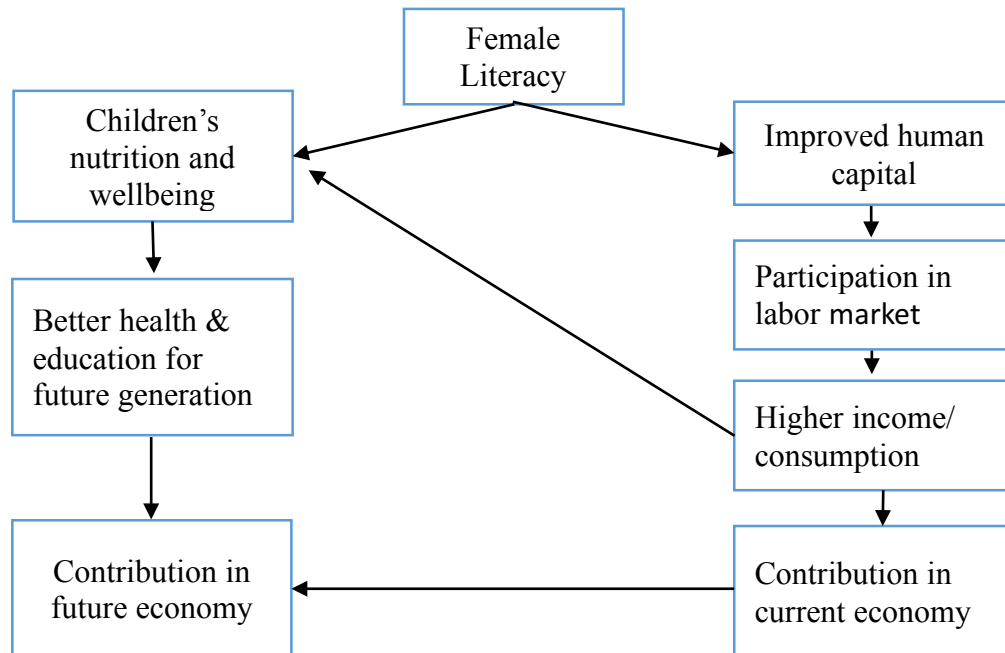


Fig 1: Causal link between female education and economic growth

If the indirect effects are not considered while evaluating the impact of female education, the return of the investment in female education may seem unattractive. Future expected wage can be considered as a direct return of investment in education and the gender disparity in wage may be one of the main reasons for enrolling less girls into schools. The wage gap is primarily due to gender based discrimination and it is a region specific phenomena (UNESCO, 2015). As male and female labor are not perfect substitute of each other and investment in male education has better social return, investment in female education is in general smaller. Lower investment in girls' education is an inefficient economic choice and this results in slower growth of any country (Dollar and Gatti, 1999).

Third, socio-cultural environment like religious orientation, discriminatory inheritance law or early marriage also discourage investment in female education (UNESCO, 2015). Social practices, like dowry, causes discrimination against girl. If the dowry for an educated groom is higher in a society, then enrollment rate of boys is likely to be higher than the girls (Lahiri et al, 2007). In this case, educational decisions by families depend on the gender of the children. Though a high gender gap in education results in low economic growth, some people or societies find themselves content with low female academic attainment. Due to their preference to uphold the traditional role of women or social customs, they are ready to give up economic progress and this is a price they are willing to pay as individual or as a society (Dollar and Gatti, 1999).

Finally, availability and accessibility of schools also play an important role in the gender gap. In developing countries specially, often schools lack basic facilities like secured classrooms, drinking water and sanitation facilities (UNESCO, 2015). Girls do not feel motivated to attend school, if these basic necessities are not met. In summary, the gender gap in education is a result of economic, social, cultural and above all national policy provisions.

How the gender gap in education affects economic growth

Growth in education is considered to build human capital stock and thereby influences the economic growth in a positive way. However, male and female education have different effects on economic growth (Knowles et al, 2002). The direct effect of education is same for both male and female which is increased productivity and therefore higher physical capital investment. But lack of female education has also indirect effects on economic growth. It lowers the average level of human capital (direct effect) and negatively impacts investment in physical capital and population growth (indirect effect). In addition to that, female education has positive effect on lowering

fertility and child mortality (Klasen, 2002; Summers, 1994; World Bank, 2001 as cited by Klasen, 2002). It also improves life expectancy and health condition of family and increases education of the next generation which is mostly due to the enhanced knowledge, income and empowerment of female (Lagerlof, 2003; Ranis et al, 2000; Mitra et al, 2015).

The gender gap in education prevents a country from achieving the optimal human capital stock. Using cross country panel regression, Klasen (2002) studied the effect of gender inequality in education on long term economic growth. He suggested that due to gender discrimination some girls will not get the chance to be educated, though they are gifted with more intellectual aptitude compared to boys. For any given level of female education, a large gender gap in education results in preferring boys with less ability to a girl with more potentials. As a result, a country will be deprived of potential human capital and the marginal return of education would be low due to low human capital. If both boys and girls were given equal chance of education, the female population would have higher chances of getting well paid jobs and this higher return in terms of wage would alter individual's choice in investing in girl's education. Thus, low human capital will result in low economic growth.

Lagerlof (2003) suggested that as gender equality increases, women's time becomes more expensive and then families decide to substitute quality in children for quantity of children. This reduction in fertility influences female participation in formal labor force and results in higher bargaining power of women (Mitra et al, 2015). Higher human capital also reduces mortality and this usually precedes reduction in fertility. Therefore, initially population growth increases with per capita income. Later the mortality rate reaches a static point and fertility still continues to fall. This demographic transition ultimately results in low population growth and raised per capita income. In summary, "if gender equality increases linearly over time, per capita income growth

rate tends to rise slowly in the beginning and then accelerate” (Legerlof, 2003, P 404). Let us stretch this idea a bit more in the same line. If the gender gap in education has negative impact on female productivity, labor participation and wage, it reduces the bargaining power of female labor force. As this wage discrimination persists, individual choice of investing less in female education persists. This vicious cycle continues unless addressed by policy intervention.

Knowles et al (2002) run a model for least developed countries and found that the female education is highly significant variable on output of worker, whereas the male education is negative and merely significant. They concluded that female education has a statistically significant positive effect on labor productivity whereas the role of male education is less clear. Giving diminishing return to each factor, a gender balanced distribution of education will help to achieve higher per capita income. The gender gap in education would also limit the female participation in the formal labor force and raise inequality in wage (Klasen, 2002).

The effect of gender inequality in education depends on the developing stage of any country. For developing countries, women’s access to education and economic opportunity are more important for growth, while developed countries benefit more from gender equality of economic and political outcome (Mitra et al, 2015). In an agro based economy, families prefer to educate boys as it bears high return to have one adult literate in family. Having a second educated adult member have relatively low economic return in terms of income (Dollar & Gatti, 1999). But the families would miss the positive externalities of female education as a result of their decision. In industrialized wage-based economy, preference of male literacy as a substitute of educating more capable women would result in lower than optimal return for both family and society. Consequentially, it would affect the growth adversely (Dollar & Gatti, 1999).

Gender inequality at different level of education has different association with growth. Using both enrollment rate and average years of education as proxy of education, one study found strong positive correlation between primary education and growth in India and for females the results remain similar (Self et al, 2004). In spite of low female enrollment rate and accumulation of human capital stock, female education at all level showed very strong positive and predictive result on growth. On the other hand, both the proxies showed causal impact of secondary female education on growth. It also found evidence of a causal impact of female tertiary education on growth which was absent in general or among male population.

Though a large body of well accepted literature has found that increasing gender disparity in education slows down growth for a given level of income, this finding is not uncontested. It was found that growth is positively related to the starting level of average years of school attainment of adult males at the secondary and higher levels. However, growth is insignificantly related to years of school attainment of females at these levels or to years of primary attainment by either sex (Barro, 1996; Barro, 1998). Second, the weak effect of female schooling suggests that women's human capital may not be well exploited in the labor markets of many countries. Due to lower participation in the formal labor market, female education at various levels is not significantly related to subsequent growth. But these findings do not undermine the indirect effects of female education to improve growth rate by reducing fertility, child mortality and overall health and nutrition.

Simultaneity and other measurement issues

The relationship between economic development and education has always faced endogeneity issues (Klasen, 2002; Barro & Lee, 1996; Goetz & Hu, 1996). Several studies focused on both

causal chains- education to economic growth and economic growth to human capital for a given sample and time period (Ranis et al, 2000; Bils et al, 2000) and found both the causal links to be true, though these works through different channels. The connection between human development and economic growth is likely to be influenced by higher investment rate, equal distribution of income and appropriate economic policy. In the growth to human development chain, public expenditures in health and education, particularly for women, are important. On the other hand, investment rates and income distribution are important in the human development to growth chain (Ranis et al, 2000).

To address the endogeneity problem, several estimation methods were adopted by earlier studies. One approach is to incorporate a time lag between the dependent and independent variables. Klasen (2002) used total years of schooling of adult population as a measure of education and argued that the growth in average years of educational attainment of adults is unlikely be a result of more investment of the same period. Economic growth should enable a country to invest more in education in later period and this should bring positive improvement in future level of education of that country. So, growth in educational attainment in any period must be a result of earlier investment in education. This time lag between investment in education and economic growth influences the causality in one direction. Other approaches to address endogeneity problem include the use of Arellano Bond dynamic regression and instrumental variables (Mitra et al, 2015; Lutz et al, 2009; Knowles et al, 2002).

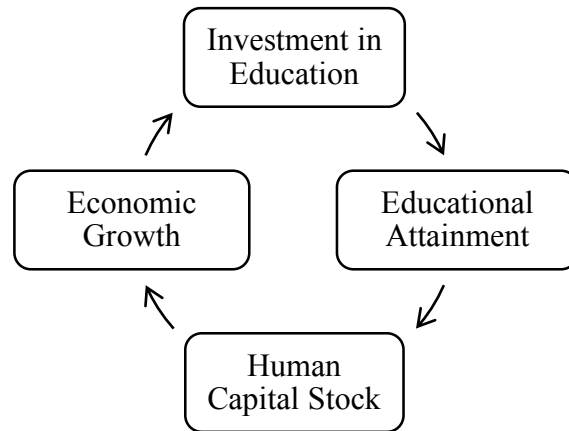


Fig 2: Endogeneity between education and economic growth

Studies on education and growth relationship vary greatly in the model specification, sample selection, measurement criteria and estimation methods. The difference in the significance and impact of variables is primarily due to variation of models and countries included in the sample. For example, a simple restricted model found positive association between education and growth, but the impact was largely drowned when control variables like trade openness, fertility rate of property rights were included (Hanushek et al, 2007). Similarly Knowles et al (2002) used GMM and long-time averages of data and intended to figure out the long run steady–state relationship between the gender gap in education and output per worker. The association between levels of female education and labor productivity varied greatly, when life expectancy and technology were included in the model. Several studies mentioned that the multicollinearity between included variables can also drown the significance (Lutz et al, 2009; Knowles et al, 2002). Temple (1999) suggested that the countries included in the sample alter the output remarkably. By excluding few outlier countries, this study found that log difference in human capital is positively related with growth. Another important factor is measurement error in educational data that alters the interpretation to a large extent (Hanushek et al, 2007).

3.0 Method

3.1 Theoretical Model and Variable Selection

As discussed above, the association between education and economic growth has varied across studies mostly due to model specification, interpretation of the productivity function, measurement error and reverse causality. Earlier works showed that gender equality in education boosts economic growth through a direct channel of increased productivity. This paper extends the previous researches in two ways. First, it shows the impact of the gender gap at different levels of education using a larger sample and longer time span and then, it tries to focus on the impact for developing countries.

For a given level of initial per capita GDP, growth rates are enhanced by higher initial schooling (Barro, 1996). Female educational attainment at any point reflects the human capital stock for female at that period. In the estimations below, the dependent variable is the growth rate of real GDP per capita, measured by difference in log term, over the previous period. The measure of education is average years of schooling for female population over 25 years. Educational attainment of the adult female population would create a time lag between economic growth and investment in education. Any adult who is contributing in current economy has finished his primary education at least fifteen years ago. Therefore, the present economic state of any country, either boost or decline, will not be able to alter the investment made in education of the adult population. This time lag establishes the casual link from education attainment to economic growth and addresses the endogeneity problem.

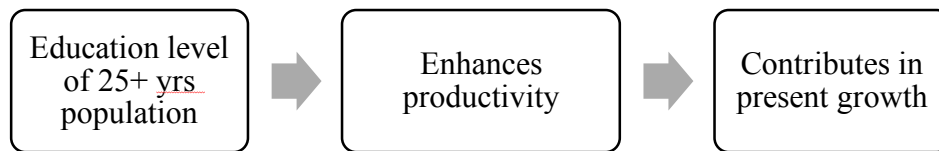


Fig 3: Time lag in variables creates causal flow from education to growth

The difference between male and female years of schooling was used as a measure of the gender gap in education; for any given level of adult female education, the higher the gap the lower should be the expected growth. The education variable was further divided into primary, secondary and tertiary levels. Results were obtained for developing countries as well as for the full sample of countries to allow for comparison. The full sample consists of 143 countries and the developing countries sample consists of 89 countries. Countries, designated as upper middle, lower middle and low income by World Bank, were included in the developing countries sample.

The first set of controls included the lagged term of natural logarithm of real GDP per capita (in 2005 constant prices) at the end of the previous period. Growth is negatively related to the initial level of real per capita GDP for given values of control variables (Barro, 1996). A negative coefficient was expected for this variable, which would indicate that poorer countries grow faster than the richer countries, following the conditional convergence theory. Study also suggested that higher life expectancy, lower fertility, better maintenance of the rule of law, and improvements in the terms of trade help economic growth for any given level of education (Barro, 1996). That is why, investment, measured by gross capital formation (GCF) as a percentage of GDP, openness in constant prices (% in 2005 constant prices), life expectancy at birth, and population growth were included as control variables. To control for governance, polity indicators were included. This was done by including dummy variables for democracy and autocracy with anarchy as the baseline.

Investment is expected to boost economic growth by increasing productivity. As the modern industrialized production system has become dependent on specialization and technology, extensive capital spending is very important to increase productivity and national income. Even if the agro-based economy is considered instead of the industrialized economy, capital is required to build and maintain basic infrastructure and human capital. So, a positive coefficient was expected for gross capital formation.

Trade openness is the ratio of exports plus imports to GDP and has a significantly positive effect on growth. Openness helps to promote international trade and foreign investment and it was expected to have a positive association with economic growth.

Life expectancy at birth is a proxy for long and healthy life. It is an indicator primarily for health status, but broadly for the quality of human capital. A healthy labor force would be more productive for any given level of education. So, a positive correlation between life expectancy and economic growth was expected. High rate of population growth would hinder the formation of capital and create pressure on natural resources. It also causes dependency on active labor force and reduces the per capital income. That is why, population growth was expected to be negatively associated with economic growth.

3.2 Econometric Model

OLS estimation is used to examine the effect of gender gaps in educational attainment and their effects on economic growth.

$$Growth_{it} = \alpha + \beta_1 fem_edu_{it} + \beta_2 Ineqinedu_{it} + \beta_3 \ln(GDPp.c.)_{it-5} + \beta_4 GCF_{it} + \beta_5 Opennnness_{it} + \beta_6 Popgrth_{it} + \beta_7 Lifeexp_{it} + \beta_8 Democ_{it} + \beta_9 Autoc_{it} + \eta_i + \varepsilon_{i,t}$$

3.3 Data

The study used panel data for education, economic performance and country characteristic on 143 countries over the period of 1950 to 2005 with a five year interval. Countries were selected primarily on the basis of data availability with no predetermined characteristics. However, representation of countries with different income and economic growth was also kept in consideration. Out of the 143 countries, 54 countries belong to high income group; 36 countries belong to upper middle income group and 53 countries are from lower middle or low income group according to World Bank classification (Appendix-A).

Table 1: Statistical Summary of Variables

Variable	All Countries (N=143)		Developing Countries (N=89)	
	Mean	Std. Dev.	Mean	Std. Dev.
Fem_primary schooling (avg years)	2.953	2.107	2.027	1.677
Fem_secondary schooling (avg years)	1.201	1.278	0.781	1.032
Fem_tertiary schooling (avg years)	0.156	0.227	0.09	0.151
Log GDP growth pc	0.0022	0.0103	0.0017	0.011
Population Growth	0.0195	0.0162	0.023	0.013
Gender inequality_primary level	0.572	0.592	0.688	0.598
Gender inequality_secondary level	0.356	0.369	0.323	0.34
Gender inequality_tertiary level	0.08	0.098	0.053	0.071
GDP per capita (in 2005 \$)	9235	11589	3578	3602
Life expectancy at birth (years)	62.72	11.45	57.14	10.54
Gross Capital Formation	22.37	8.25	21.22	8.92
Trade Openness	70.53	55.35	70.26	50.42

The educational data (years of schooling of female population over 25 years of age) was used from Barro & Lee data (version 2.1, 2013). The economic performance indicators (log of real GDP per capita and growth in real GDP per capita measured in difference of log, investment, average openness and population growth) are from the Penn World Table (PWT version 6.3). The World Bank database was used for life expectancy at birth. Governance dummies were constructed by using the polity score from Regime Authority Characteristics and Transitions Dataset. Democracy dummy was 1 for polity scores from +5 to +10; else it was zero. Autocracy dummy was 1 for polity scores from -5 to -10 and zero otherwise. The baseline dummy was anarchy and polity scores ranging from -4 to +4 is considered 1 for this dummy and zero otherwise.

When compared between full sample and subset of countries, average years of education for adult female population was lower for developing countries. Average years of female primary, secondary and tertiary education in developing world was 2.027, 0.781 and 0.09 years and the same for all countries was 2.953, 1.2 and 0.156 years.

The gender gap at primary level was higher in developing countries with a value of 0.688 years. But for secondary and tertiary level, the average gender gap in developing countries were lower than world average. In developing countries, very low proportion of population has access to higher education. Probably only the few who are financially able and willing to spend for education get enrolled for higher education in those countries. This decision is likely to be less affected by gender and depends more on affordability. Average per capita GDP for developing countries was almost one third of the world average (3578\$ to 9235\$). This indicated that the world average was affected by the extremely high GDP of the rich countries. Gross capital formation and openness variables had similar values for these two group of countries.

4.0 Results

To check the robustness of the model, the first criteria was to select between fixed effect and random effect model. As discussed earlier, social, religious and cultural norms influence female participation in education. This study does not include any proxy for cultural and social norms of any country, primarily due to unavailability of a suitable measure. These factors are generally time invariant for any country. That is why, fixed effect model is preferred to control for these time invariant country specific variations. A hausman test was conducted for the unrestricted model and the test gave significant result. This justified the use of fixed effect model. Next, time stationarity within panels were checked with a Fisher test. The unit root test indicated time non-stationarity and a time trend was included to rectify the problem. A likelihood ratio test yielded significant results and indicated the existence of panel heteroscedasticity. To address the panel heteroscedasticity, country clustered standard errors were used and the outputs were marked as VCE (Variance Covariance Matrix of Estimator) in Table 2 and 3. Using unit clustered standard error also rectified spatial correlation present in panel data. Finally, a Wooldridge test was conducted to identify serial correlation within panels. To rectify the serial correlation, the regression was estimated using a fixed effect linear model with Auto Regression (AR(1)) disturbance and the outputs were marked as AR(1) in Table 2 and 3.

Results obtained from regressions using unit clustered standard errors and auto regression disturbances gave similar numerical indications for independent variables of major interest. For both regressions with data for all countries, average years of female primary education was not a significant variable. One additional year of secondary education for females boost GDP growth by 0.3 percentage points, and the result was highly significant at one percent level of significance.

One additional year of tertiary education for females was associated with 0.9 percentage points of GDP growth in the VCE model, and the result was highly significant.

Table 2: Regression for All Countries' Per Capita GDP Growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	VCE	VCE	VCE	AR(1)	AR(1)	AR(1)
Fem_Primary_Schooling	0.0002 (0.706)			-0.0003 (0.714)		
Fem_Secondary_Schooling		0.0028 (0.003)			0.0029 (0.001)	
Fem_Tertiary_Schooling			0.0093 (0.011)			0.0076 (0.015)
Initial GDP (Lag)	-0.002 (0.055)	-0.003 (0.012)	-0.003 (0.032)	-0.002 (0.033)	-0.003 (0.003)	-0.003 (0.015)
Gender inequality in education	-0.0025 (0.077)	0.0001 (0.97)	0.0038 (0.322)	-0.0021 (0.085)	0.00001 (0.997)	0.0011 (0.808)
Gross Capital Formation	0.0001 (0.074)	0.0001 (0.024)	0.0001 (0.037)	0.0001 (0.002)	0.0002 (0.000)	0.0002 (0.001)
Trade Openness	-0.0001 (0.018)	-0.0001 0.013	-0.0001 0.014	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)
Population Growth	-0.2197 (0.004)	-0.2287 (0.002)	-0.2309 (0.001)	-0.2526 (0.000)	-0.2558 (0.000)	-0.2573 (0.000)
Life expectancy	-0.0002 (0.167)	-0.0001 (0.303)	-0.0002 (0.125)	-0.0002 (0.018)	-0.0002 (0.042)	-0.0003 (0.010)
Democracy	-0.0006 (0.598)	-0.0004 (0.747)	-0.0005 (0.678)	-0.0002 (0.885)	0.0002 (0.884)	0.0001 (0.940)
Autocracy	0.0001 (0.99)	-0.0003 (0.845)	-0.0003 (0.802)	0.0008 (0.415)	0.0006 (0.543)	0.0006 (0.539)

Note: P-value within parenthesis, N=143.

Initial GDP was negatively related to economic growth and the coefficients are highly significant¹. For female primary education-growth models, one percentage point increase in initial GDP was associated with an approximately 0.2 percentage point decrease in growth in per capita GDP. For both secondary female education - growth models and tertiary female education –growth model, a one percentage point increase in initial GDP was negatively associated with approximately 0.3 percentage point growth in per capita GDP.

Gender inequality in primary level education was found to be statistically significant and negatively related with economic growth. For primary education, a one year difference between male and female average years of schooling was negatively associated with 0.25 percentage point of economic growth and the results were statistically significant at one percent level of significance. For secondary and tertiary level, gender inequality was not significant for any regression. Gross capital formation was highly significant for both the regressions and all levels of education but the impact was not very substantial. One unit increase in gross capital formation was associated with 0.01 to 0.02 percentage point of growth in per capita GDP. The variables openness and population growth were significant for both VCE and AR models and for all levels of education. However, the coefficients of openness had negative signs and indicate very small effect (0.01 percentage point) on economic growth in this model. One percent growth in population was associated with 0.2 percentage point reduction in growth. Life expectancy was significant only in AR model. The coefficients varies from -0.0002 to -0.0003. One year increase in life expectancy

¹This model specification is based on the conditional convergence theory that poorer countries grow fast. Another set of OLS regressions was run for models including a lagged quadratic term of per capita GDP. The coefficients of the initial per capita GDP was not significant in any of these regression. However, coefficient of other variables of interest bears similar value as the original model. So the quadratic term was not included.

would decrease the growth by 0.02 percentage point, if everything else is held constant. Neither of the dummies for governance was significant in any regression.

Table 3: Regression for Developing Countries' Per Capita GDP Growth

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	VCE	VCE	VCE	AR(1)	AR(1)	AR(1)
Fem_Primary_schooling	0.0022 (0.013)			0.0017 (0.154)		
Fem_secondary_schooling		0.0029 (0.063)			0.0038 (0.012)	
Fem_Tertiary_Schooling			0.0001 (0.979)			0.0015 (0.794)
Initial GDP (Lag)	-0.0043 (0.010)	-0.0041 (0.015)	-0.0034 (0.045)	-0.0046 (0.004)	-0.0048 (0.002)	-0.0040 (0.011)
Gender inequality in education	-0.0009 (0.506)	0.0019 (0.358)	0.0100 (0.186)	-0.0012 (0.472)	0.0022 (0.358)	0.0042 (0.675)
Gross Capital Formation	0.0002 (0.048)	0.0002 (0.042)	0.0001 (0.111)	0.0002 (0.002)	0.0002 (0.001)	0.0002 (0.004)
Trade Openness	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)	-0.0001 (0.000)
Population Growth	-0.2763 (0.000)	-0.2872 (0.000)	-0.2871 (0.000)	-0.2739 (0.000)	-0.2817 (0.000)	-0.2806 (0.000)
Life expectancy	-0.0001 (0.701)	-0.0001 (0.707)	-0.0001 (0.453)	-0.0002 (0.122)	-0.0002 (0.158)	-0.0002 (0.088)
Democracy	-0.0003 (0.806)	0.0000 (0.982)	0.0000 (0.975)	0.0003 (0.832)	0.0007 (0.582)	0.0004 (0.744)
Autocracy	-0.0002 (0.896)	-0.0004 (0.767)	-0.0003 (0.856)	0.0009 (0.478)	0.0006 (0.608)	0.0008 (0.532)

Note: P-value within parenthesis. N=89.

The same regressions were repeated for a subset of 89 developing countries (Table 3). Average years of female education at all level displayed a positive relation with growth for developing

countries, but only primary and secondary level of education were found to be statistically significant. The VCE model showed that one year of female average primary education would boost economic growth by 0.22 percentage points. Average year of female schooling at secondary level was very significant for both regressions and one year of additional female education at secondary level was associated with 0.3 to 0.4 percentage point growth in per capita GDP. However, the gender gap was not statistically significant at any level of education.

As in the all countries model, Initial GDP for developing countries has a negative correlation with growth and the coefficients were highly statistically significant. For both the primary female education - growth models and secondary female education –growth models, the coefficients for initial GDP varied from 0.004 to 0.005. For the tertiary female education - growth model, one percentage point increase in initial per capita GDP was negatively associated with approximately 0.3 to 0.4 percentage point growth in per capita GDP.

Gross capital formation was highly significant for both the regressions and all levels of education but with a small coefficient of 0.0002. One unit increase in gross capital formation was associated with 0.02 percentage point of growth in per capita GDP. The variables openness and population growth were significant for all level of education. However, the coefficients of openness had negative signs and indicated very small effect on economic growth in this model. One percent growth in population was associated with approximately 0.3 percentage point reduction in growth. Governance dummies were not a significant variable for any model or any level of education.

5.0 Discussion

Average years of female education was significant at secondary and tertiary levels for all countries model. For developing countries, average years of female schooling at primary and secondary level

was significant. Female schooling at secondary level has slightly greater impact on economic growth in developing countries than all countries model. One year of additional secondary education is associated with 0.29 to 0.38 percentage point economic growth in developing country. On the other hand, one year of additional secondary education is associated with 0.28 to 0.29 percentage point economic growth for all countries. Though a substantial number of studies have found that primary and secondary female education and gender equality in education are important catalysts for economic growth, especially for developing countries, the statistical significance of coefficients depends largely on the model specifications and included control variables (Hanushek et al, 2007). The all countries data showed a negative relation between the gender gap in primary education and growth. However, for developing countries, inequality in education was not a significant parameter at any level of education. This result may be derived due to multicollinearity between gender inequality and GDP. That is why, pairwise correlation was determined and the result indicated that multicollinearity was not an issue with gender inequality variables.

Other possible explanations may lie in the definition of the variables. Children, though enrolled in schools, also work to support families. Average years of schooling does not account for the out of school learning or the quality of education one gets at school. Here assumptions are made that there is no gap in the academic career of individual, which may not be true. The other important issue may be related to the data reporting. In any macro analysis, the standard of data reporting is a critical factor as it is largely varied among countries. Moreover, labor force participation channels the positive effect of education towards economic growth. Gender equality in education primarily increases the productivity of female and brings equal opportunity to be employed. But if the labor market is currently not utilizing or underutilizing women work force, then even gender equality in education will not be able to bring expected economic growth.

In developing countries, due to over prevalence of informal activities like household chores and subsistence farming, GDP growth remains underreported. This inherent constraint of the definition of GDP may be why the regressions failed to find a significant relationship between formation of human capital and economic growth. Moreover, immigration of skilled and unskilled labor force is a common trend in many developing countries. Migration of skilled labor force would affect the overall productivity. High rate of immigration among the college and university graduates may inhibit technological innovation and adaptation in any country.

According to the convergence growth theory, initial level of income is also considered to slow down the growth rate of any country. The regression for both the samples showed a negative association between initial GDP and economic growth. Due to diminishing return to capital, poorer countries are more benefitted from the increasing income and investment. The data showed that 1 percentage increase in the initial per capita GDP was related to approximately 0.5 percentage point decrease in the GDP growth for developing countries which varies between 0.2 to 0.3 percentage point for all countries sample.

Overall investment and openness are considered to boost economic activity and hence economic growth. This study found both the variables significant but the effects was very small. Gross capital formation is positively associated with growth. Therefore, for any given level of human capital, investment would increase growth. On the contrary, openness is found to be negatively associated with growth for any given level of human capital. Openness or low trade barrier promotes growth through channels of fiscal and monetary policies, exchange rate system, prevailing administrative corruption and overall political and bureaucratic environment of any country. The relationship between openness and economic growth also depends on the development stage of the economy.

Developing economies may adopt an inward looking economic approach to protect infant industries and temporary trade barriers may prove to be beneficial for those economies. This study has not considered any variable for trade policy and bureaucratic efficiency, which might have led to an unexpected result for all countries. In addition to that, the literature suggests trade liberalization may retard the growth of poor countries (Lutz et al, 2009). So, for poor countries the result holds expected sign. The dummy variables for governance- democracy and autocracy, are not significant in any regression model. One possible source for that could be the existing multicollinearity between educational attainment and governance². It might also be true that the causality leads from income growth to democracy (Lutz et al, 2009).

Technology is a major factor in economic growth which has not been considered in this paper. The literature suggests that technology contributes to economic growth through the channel of human capital. Human capital speeds the adoption of technology (Bils & Klenow, 2000). If the labor force is not skilled enough to take the advantage of the advanced technology, then investing more in the technology may not actually contribute to the growth. Moreover, no appropriate proxy to account for the technology in a panel study was available. Considering these two factors, technology is kept out of the scope of this paper. Future research can take this challenge of incorporating technology in their analysis.

6.0 Conclusion

Human capital is considered to be a very important factor of development. Education for all the members of the society helps to build human capital and increases productivity. Different levels

² Another set of regressions were run for the models without the governance dummies and the results found were very similar both in value and sign to the results found from the models with the dummies.

of education have different outcomes. As primary and secondary education are more helpful to increase the stock of skilled labor force, higher education helps to create, select and adopt suitable technology that promotes the overall productivity. Along with this, male and female members of the society disseminate their knowledge differently. Apart from building skilled work force, female education has positive externality. An educated mother plays an important role in the health and wellbeing of the future generations. For all these reasons, reducing gender gaps in education and ensuring girls' education has been a priority for nations and international organizations.

Gender inequality in education has received attention in the literature as well. Though a significant number of studies has supported the theory that gender inequality hinders economic growth, some studies have not found evidence to support the claim. The results depend on many factors. Cross country and micro analyses have found different results. It also depends on the countries included in the sample and their developing stage. This study found a significant positive association between female education and economic growth at secondary and tertiary level of education for all countries sample. On the other hand, for developing countries only primary and secondary education found significant correlation with economic growth. Gender inequality in primary education was found to be affecting growth adversely for all countries sample. But educational inequality in developing countries did not find any support.

Apart from the data and regression method, country specific labor market and trade conditions also affect the outcome. Increased participation of women in education would not bring the expected outcome if they do not get chance to be employed in the formal labor market. Unfortunately, there exists gender based wage gap even at professional and executive level (ILO & ADB, 2011). This would also act as a discouraging factor for female education. The indirect effect of female education will definitely have positive consequences, but the current measures of economic growth

will not be able to capture the informal contribution of woman. Moreover, this study primarily focused on the quantity of education and not the quality. Quantity is, undoubtedly, important in the short term, but the quality of education at formal educational institution would be important in the long run.

Though the gender gap derived a mixed result in this study, the association between female education and growth was significant. Governments should focus on ensuring accessibility and affordability of education for girls. Universal primary and secondary education should be given ultimate priority. First, countries have to mobilize more funds for female education. This is a task not only for the government, but should be a combined effort of private and public sector. In developing countries, several non-government organizations are working for female education. In many developing countries, girls cannot attend school only because they cannot afford to go to school. Even if the schools are made free, there are other costs associated with attending school that the poor families find hard to bear. Financial assistance in form of cash or kind is proved beneficial in those cases. Abolition of fees, take home rations and schooling feeding programs have found success in many countries in recent time (UNESCO, 2015). Cash transfers in form of scholarship or stipend can also attract out of school students. Cash transfers should be conditional on school attendance and performance of the student. This will ensure enrollment as well as effective learning of poor students.

Second, developing countries find it difficult to fund programs to attract and retain female students in the schools. Low income countries depend on foreign aid and assistance to carry out incentive programs. While granting aid, donor organization should give guidelines on how the funds should be used. If funds are not spent specifically for promoting education and removing the gender gap, then the result will not be optimal.

Third, the issue of social mobilization should also be given importance. Cultural and religious preferences of societies restrict female participation in education. Even though the adverse impact of depriving girls from education is acknowledged, this is a price some societies are ready to pay. In these situations, ensuring access to education will not be an easy task, if these discriminatory social norms and practices are not altered. Long term national policies are required to promote social movement. Initiatives to include local religious organization and leaders may help to remove this obstacle to some extent (UNESCO, 2015).

Investment in building schools and appointing teachers is important to match the created demand for education. These are very cost intensive programs. So, studies should be carried out at national and local levels to identify marginalized groups where this investment would get maximum return. Non-formal schooling is also proved to be effective in many countries. In Bangladesh, non-formal schools run by the NGO BRAC have been credited with the success of increasing enrollment of girls (UNESCO, 2015). Above all, without political sincerity and administrative efficiency, any of these stated policy initiatives would fail to bring any positive changes. Human capital is difficult to build, but with long term planning and coordinated effort, female schooling will succeed to reduce the gender gap, build optimal human capital and attain desired economic growth.

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Appendix A

High Income Countries (N=54)		Upper Middle Income Countries (N=36)	
Argentina	Latvia	Albania	Kazakhstan
Australia	Lithuania	Algeria	Libya
Austria	Luxembourg	Belize	Malaysia
Bahrain	Malta	Botswana	Maldives
Barbados	Netherlands	Brazil	Mauritius
Belgium	New Zealand	Bulgaria	Mexico
Brunei Darussalam	Norway	China	Mongolia
Canada	Poland	Colombia	Namibia
Chile	Portugal	Costa Rica	Panama
China, Hong Kong	Qatar	Cuba	Paraguay
China, Macao SAR	Republic of Korea	Dominican Republic	Peru
Croatia	Russia	Ecuador	Romania
Cyprus	Saudi Arabia	Fiji	Serbia
Czech Republic	Singapore	Gabon	South Africa
Denmark	Slovak Republic	Iran	Thailand
Estonia	Slovenia	Iraq	Tonga
Finland	Spain	Jamaica	Tunisia
France	Sweden	Jordan	Turkey
Germany	Switzerland		
Greece	Taiwan		
Hungary	Trinidad & Tobago		
Iceland	United Arab		
Ireland	United Kingdom		
Israel	Uruguay		
Italy	USA		
Japan	Venezuela		
Kuwait	Vietnam		

Lower Middle Income Countries (N=33)		Low income Countries (N=20)
Bangladesh	Pakistan	Afghanistan
Bolivia	Papua New Guinea	Benin
Cameroon	Philippines	Burundi
Republic of Congo	Republic of Moldova	Cambodia
Cote d'Ivoire	Senegal	Central African Republic
Egypt	Sri Lanka	Democratic Republic of the Congo
El Salvador	Sudan	Gambia
Ghana	Swaziland	Haiti
Guatemala	Syria	Liberia
Guyana	Tajikistan	Malawi
Honduras	Ukraine	Mali
India	Yemen	Mozambique
Indonesia	Zambia	Nepal
Kenya		Niger
Kyrgyzstan		Rwanda
Lao		Sierra Leone
Lesotho		Togo
Mauritania		Uganda
Morocco		Tanzania
Nicaragua		Zimbabwe