ESSAYS ON GROWTH, POVERTY AND HUMAN CAPITAL INEQUALITY

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ABSTRACT

This thesis is a collection of three empirical essays on growth, poverty and human capital inequality in a global panel.

The objective of the first essay entitled: "Volatility and Growth: The Role of Education" is to examine whether the significance of volatility-growth relationship varies according to the average years of education. Unlike the focus of the previous literature on establishing the link between volatility and growth, we attempt to establish the channel through which volatility affects growth. The main contribution of our work is that while the level of volatility negatively affects growth, the effect is mediated via education. This is true even for countries with low as well as moderately high levels of volatility. The result of the interaction term, which is the key interest in this chapter, is robust to changes in definitions of variables and specification. This finding is consistent with Canton's (2000) theoretical work.

The second essay, "Does Education Reduce Poverty in Developing Countries?" investigates the direct effects of education on poverty in developing countries using dynamic panel estimation techniques. The results suggest that higher education, developed financial system along with growth lead to significant poverty reduction. On the other hand, unequal income distribution is associated with increases in poverty. The results are robust to alternative model specification and estimation techniques. The policy implication is that poverty reduction is more effective if we focus on developing the education system instead of relying on growth and other channels, for example foreign aid or health.

The third essay deviates from the usual study of inequality and globalization. It analyzes the relationship between seven measures of globalization and education inequality using a panel of 112 countries covering the period 1970-2009. We use the KOF index of Globalization and its three different dimensions (economic, social, and political) as our main proxy for globalization. In addition, we also employ openness, Foreign Direct Investment (FDI) and freedom to trade internationally (EF Index) in our study. We find that globalization has a robust negative effect on human capital inequality, even when we control for other factors. Results suggest that education inequality increases with globalization in middle and high-income countries but the effect is the opposite in low-income countries. This is the key contribution of our study where we find a variation of impact within the developing countries in contrast to the standard Hecksher-Ohlin Trade Theory. The result also holds when we restricted the sample to specific countries and add several other covariates. In contrast, the alternative measures of globalization have no such robust effects.

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DECLARATION

The preliminary draft and short version of Chapter 2 entitled "Volatility and Growth: The Role of Education" has been presented as a Working Paper in the Department of Economics, University of Leicester under the title " Panel Data Evidence on the Role of Education in the Growth-Volatility Relationship", co –authored with Abbi M. Kedir, March , 2012 (Working Paper No. 12/04).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

This thesis is a collection of three empirical essays, which studies the importance of education and its distribution. Each chapter focuses on education and its relation to a particular topic. The first essay studies the role of education in the growth-volatility relationship. The second essay studies the effectiveness of education in reducing poverty in developing countries and finally, the third essay deviates from the previous two essays by studying the distribution of education (or human capital inequality) and its relation to globalization. The rest of this section is a brief introduction of each essay.

1.1 Volatility and Growth: The Role of Education

Theoretical and empirical research focuses on investigating the effect of volatility on output growth and economic development in recent years. Most studies find that volatility tends to decrease growth and is harmful to development. However, the channel through which this occurs is less clear. A strand of theoretical literature examines the channels through which volatility affects growth and concludes that precautionary saving and its effect on long-term investment under imperfect credit market as two important channels (Aghion and Banerjee, 2005). Only recently, theoretical work attempts to show the importance of fundamentals such as education in this link but there is no empirical support for this theoretical conjecture. Unlike the focus of the previous literature on establishing the link between volatility and growth, we attempt to establish the channel through which volatility affects growth. This aspect of the

relationship is least understood and we would like to contribute to the extant literature by examining the role of education (human capital investment).

To study the role of education in the growth-volatility relationship, we augment the standard empirical growth model by adding the interaction between education and volatility. The main contribution of this chapter is that while we confirm the existence of the detrimental effect of volatility on growth from existing studies, we show that the effect is mediated via education. This is true even for countries with low as well as moderately high levels of volatility. These findings reveal that while volatility has a mitigating effect on economic growth, the implications become drastically different once we explicitly account for education.

In particular, our evidence provides support to the predictions derived from the theoretical models of Blackburn and Galindev (2003), Canton (2002) and Varvarigos (2007, 2008). These studies argue that volatility generates a precautionary demand for investment in human capital; hence, it may actually promote a higher growth rate. The result is robust controlling for standard determinants of growth and to alternative definitions for volatility. Our finding brings an interesting insight by showing the potential channel through which education can positively influence growth. We use a large sample of developing countries in contrast to other studies that focus on developed countries or a relatively small sub-sample of both developed and developing countries. Our study is based on a panel data for 100 developing countries for the years 1970-2009.

1.2 Does Education Reduce Poverty in Developing Countries?

Poverty reduction is one of the main subjects for the 2015 United Nation's Millennium Development Goals (MDGs). As the goal of halving the proportion of people living less than $1.25 a day draws closer, poverty has been the subject of heated debate amongst economists. In the last couple of decades, there has been a significant progress in poverty reduction at the global level. However, the progress is not uniform across regions. The success is remarkable in some countries in the East and Southeast Asia region where poverty rate has fallen rapidly; on the other hand, countries in the sub-Saharan Africa region is far from reaching the goal.

Sustained economic growth has been attributed as an important factor in attaining the goal, but studies on poverty and growth have argued that growth alone is insufficient in reducing poverty. In that regard, the importance of education as the key link between growth and poverty reduction is often pointed out. The strong negative effect of education in household studies and the lack of aggregate empirical evidence motivate this chapter. Hence, this chapter examines the importance of education in poverty reduction in 72 developing countries for the period 1981-2008. In particular, it investigates the direct effects of education on poverty after controlling for growth and income distribution.

This chapter contributes to the existing literature on economic growth, poverty, education and inequality in the following ways. First, the empirical research on the effect of education on poverty is still very limited compared to the research on poverty and inequality/income distribution. Hence, this chapter provides a new empirical insight on this relationship in accordance to the World Bank's new agenda – to make human capital investment the main

policy and strategy for poverty reduction. In addition, we study the effectiveness of different levels of education and gender differences on poverty reduction. Second, previous studies have employed cross-country analyses that ignored potential endogeneity among the variables. Thus, we utilize the dynamic panel methods that precisely deal with endogeneity, omitted variables bias and unobserved country specific effects.

Finally, the chapter examines the effectiveness of economic growth in reducing poverty for the named sample countries. Different studies have employed different methods and different sample countries, hence the different growth elasticities reported. This chapter concurs with Bhalla's (2002) prediction, where the growth-elasticity for the developing countries is estimated around -3.4 or -5.0 for the $1.08 poverty line. To support our results, this chapter uses three different measures of poverty and provides robustness tests employing three different methods.

1.3 On the Relationship Between Human Capital Inequality and Globalization

Theoretical research on the link between globalization and income inequality has been remarkable in recent years, but empirical analysis is scarce. Empirical research on globalization and inequality has found insignificant effects or contradicting results with theoretical expectations. Motivated by the contrasting points of view, this chapter aims to contribute to the existing literature by attempting to prove and analyze the competence of the standard Hecksher-Ohlin trade theory by considering a channel through which income inequality and globalization is related. Thus, it attempts to tackle the inequality and globalization issue by departing from the usual convention and studying the effect of

globalization on another distribution, which is the distribution of human capital (or education inequality).

As stated by Holsinger and Jacobs (2009), this chapter has "moved beyond the questions on the inequality of wealth, to the significance of inequality in the production of human capital" (Holsinger and Jacobs, 2009:2). Education inequality is of interest because its causes and consequences are harmful to human well-being and economic development. We would like to investigate whether globalization helps to alleviate or worsen inequality in education and benefit everyone in the observed population in the same way in terms of education. Moreover, we would also like to analyze whether the benefit or loss experienced by countries differ across the level of development.

Our focus is on the impact of the composite index of globalization as well as its three different dimensions on education inequality. The analysis utilizes a new dataset on globalization indices recently developed by Dreher (2006) known as the KOF Index of globalization. In addition, for comparison with existing literature, we also examine the impact of three additional measures of globalization commonly used in previous studies (openness to trade, foreign direct investment and freedom to trade internationally). We study the relationship for a global panel of 112 countries (108 effective samples) over the period 1970-2009.

To the best of our knowledge, our study is the first to analyze the effect of globalization on educational inequality and our results show that it differs according to the level of income. The main novelty of this chapter is; we prove that the developing countries (low and middle-income countries) do not necessarily benefit from globalization, which clearly contradicts the

standard trade theory. This is because we observe the existence of variation of effects within the developing countries itself. Globalization narrows the education gap in low-income countries but it widens the gap in middle-income countries. Additionally, we also prove the importance of social and political globalization, which is often ignored in existing literature. Our results are robust to the exclusion of countries from three different regions (East Asia and Pacific, Latin America and Caribbean and Sub-Saharan Africa) and inclusion of several control variables.

CHAPTER 2

Volatility and Growth: The Role of Education

2.1 Introduction

The issue of the impact of volatility on output growth and economic development has gained interest in recent years. Researchers have been analyzing the impact of volatility from every aspect both theoretically and empirically. Frequently, studies will consider various sources of volatility; for example, inflation[1], exchange rate[2] or employment[3] but Output volatility[4] has been the focus in most studies. Overall, these studies conclude that volatility tends to decrease growth and is harmful to the prospect of development. It is also quite difficult to compare the effect of different kinds of volatility and identify which source of volatility has the most detrimental effect on growth. Nevertheless, Furceri (2010) attempts to fill in the gap and studies the impact of five different sources of volatility simultaneously[5].

Despite the fact that, traditionally, long-term growth and short-term cyclical volatility have been treated as distinct economic phenomena that should be analyzed separately, a recent strand of literature has moved away from this conventional wisdom. Theoretical and empirical

[1] For example : Heylen *et al*. (2004), Berument et *al*. (2012), Bowdler and Malik (2005).
[2] For example: Aghion et al (2009) and Demir (2010).
[3] For example: Flug *et al*. (1998).
[4] For example: Ramey and Ramey (1995), Fatas (2002) and Hnatkovska and Loayza (2005) among others.
[5] This study is based on an aggregate data from 1970-2000 and concludes that all sources of volatility are detrimental to growth with investment volatility to be the most detrimental to long run growth. The results are robust to several measures of volatility and different sub-sample of countries.

analyses have provided support and intuition behind the idea that volatility may constitute a significant part in the determination of long-term economic prospects, as these are appropriately reflected by the average rate of economic growth (Blackburn and Varvarigos, 2008). Additionally, recent analysis has also examined the factors that help to mitigate the negative effects of volatility (Chong and Gradstein, 2009).

The purpose of this chapter is to contribute to this emerging literature and revisit the channel through which the relationship between volatility and growth is mediated. To achieve the objective, we examine empirically the significance of education/human capital accumulation in the growth-volatility relationship. In this chapter, we study the joint role of education and volatility by adding volatility and its interaction term with education in the growth regression. The aim is to determine how the total effect of volatility on growth is affected by education. Thus, the focus of this chapter is twofold; to analyze the significance of education as well as the significance of volatility in the growth regression. In this regard, our study is very close to Aghion and Banarjee (2005) who study the role of financial development in the growth-volatility relationship. The study allows financial development to interact with volatility and find that financial development mitigates the negative effect of volatility and growth.

While earlier studies have employed cross country regression (Ramey and Ramey, 1995; Martin and Rogers, 2000) and time series (Caporale and McKiernan, 1996), it is of interest to present complementary evidence using a panel data approach for specific sample countries following the emerging and recent studies (Kose *et al*., 2006 and Imbs, 2007). Therefore, in this chapter, we study the joint impact of education and volatility for a large sample of developing countries in contrast to other studies that focus on developed countries or a small

sample of both developed and developing countries. We analyze the relationship in a panel dataset that allows for a dynamic specification which is important in the empirical growth study as endogeneity may arise and causality can run both ways.

There are two main reasons for restricting developing countries as our sample. First, the effects of volatility are larger in developing countries compared to developed countries. This is because developing countries are more exposed to exogenous shocks, faulty policies and structural issues (Loayza *et al*., 2007). The magnitude of volatility in developed countries is quite small and this may give small effects on growth rates. Second, developed countries have better educational system and these countries have very high educational attainment. This may bias our analysis since high human capital investment is a result of high growth rates, which indicates that developed countries have the means to combat shocks.

The main contribution of this chapter is that while the level of volatility negatively affects growth, which is in line with many studies, it has a positive and significant effect on growth via education. This is true even for countries with moderately high levels of volatility. Our main findings are summarized as follows. While we verify the assertion from the majority of existing studies (Ramey and Ramey 1995; Hnatkovska and Loayza, 2005; Badinger, 2010) who argue that volatility has a mitigating effect on economic growth, the implications become drastically different once we explicitly account for education. In particular, we find that, for a subset of low income and high volatility countries, the interaction of education and volatility has a positive and significant effect on economic growth.

The findings confirm the importance of education/human capital for moderating the detrimental effect of volatility on growth. In particular, our evidence provides support to the predictions derived from the theoretical models of Blackburn and Galindev (2003), Canton (2002), Varvarigos (2008) and Blackburn and Varvarigos (2008). These studies argue that volatility generates a precautionary demand for investment in human capital; hence, it may actually promote a higher growth rate. The results are robust controlling for usual determinants of growth and to alternative definition and alternative proxies for volatility.

The outline of the chapter is as follows. The next section is the literature review on education, volatility and growth. We present and describe the data in section 2.3. The model and empirical specifications are in section 2.4. Section 2.5 presents the estimation results and section 2.6 is the robustness check analysis. Section 2.7 details the marginal effects of volatility conditional on education. We conclude in section 2.8.

2.2 Literature Review

In this section, we briefly review the literature on the impact of volatility on growth and the impact of volatility on human capital or education. We first review the theoretical literature that study volatility, human capital and growth. Then we review the studies that emphasize the relationship between volatility and education as well as the empirical evidence on volatility and growth. Our contribution to the literature may be viewed as an integration of the two strands in assessing the effect of education and volatility in determining growth.

2.2.1 Theoretical Studies

Although the focus of this chapter is an empirical analysis, it is not trivial to understand the issue from a theoretical perspective. King *et al*. (1988) first documented the link between volatility and growth in the endogenous growth models and state that the link is not obvious. Varvarigos (2008) builds a model for policy volatility (public spending) in which he concludes that policy volatility negatively affects output growth and social welfare. In a previous study, he claims that inflation volatility enhances growth (Varvarigos, 2007). The finding agrees with Dotsey and Sarte (2000) but in contrast with Blackburn and Pelloni (2004).

Another strand of theoretical literature examines the channels through which volatility affects growth. Different approaches are featured in the literature, each with different empirical implications (Chong and Gradstein, 2009). For example, Rodrik (1999) shows domestic social conflicts and institutional ability as the channel through which volatility negatively affects growth. Aghion and Banerjee (2005) discuss two possible channels. First, it is through precautionary saving and second through its effect on long-term investment under imperfect credit market. In another study, Aghion *et al.* (2005, 2009) focus on the importance of financial development or credit constraint. Theoretically, their model predicts that volatility has negative effect on productivity growth especially when countries face stringent credit constraints. This is verified by the empirical test on a panel of countries; the interaction term between volatility and financial development is positively correlated to growth.

The empirical model presented in this chapter is theoretically based on three main papers; Canton (2002), Blackburn and Galindev (2003) and Varvarigos (2007, 2008) which focus on

education/human capital as the main channel through which the volatility effect emerges. Canton (2002) constructs a stochastic two-sector model of endogenous growth to analyze the impact of cyclical volatility on long-term growth. His model predicts that growth will be higher during business cycle fluctuations because people engage in precautionary savings and dedicate more for human capital accumulation. This is the key intuition of the model where economic uncertainty will encourage precautionary savings.

During this time, agents want to secure future income risk by investing more in human capital. Higher human capital accumulation entails a growth in the learning sector, where more labor needs to be devoted to the learning sector to achieve rapid human capital accumulation. Because human capital accumulation positively determines economic growth, growth will be higher during economic uncertainty. Model calibration shows that growth will increase by 0.46% during economic uncertainty and the transmission channel of economic growth and the business cycle is through the accumulation of human capital. Increased investment in physical capital on the other hand will only affect income level and human capital is a better guard against economic uncertainty.

The model presented by Blackburn and Galindev (2003) is a simple stochastic model in which internal and external learning behavior results in improving productivity. The study integrates both types of learning into a single framework and finds that growth and volatility are prone to be positive if internal learning mainly drives technological change. Varvarigos (2007, 2008) on the other hand, constructs a model that shows inflation is harmful for growth but inflation volatility has a positive effect on growth. The model also identifies increases in real money balances holding as a new channel in which inflation volatility exerts a positive effect on

growth. This mechanism however is quite different with the seminal paper by Dotsey and Sarte (2000) where they argue the positive effect of volatility on growth lies in the direct precautionary increase in investment.

The theoretical work demonstrates ambiguous conclusions to the sign of the volatility-growth relationship. The financial and institutional quality channels argue that volatility has adverse effect on growth. Empirical work provides support to the argument (Rodrik, 1999; Aghion *et al*., 2009 and Chong and Gradstein, 2009). The human capital channel predicts a positive relationship, hence an increase in growth. However, the role of education/human capital in the growth volatility nexus is largely ignored in empirical studies and our analyses in this chapter fills in the gap.

2.2.2 Empirical Evidence on Education and Volatility

The relations between both education and volatility to growth have been widely studied in many empirical papers. Although the consensus among the studies is that education is good and has positive significant effect on growth, as in the work of Barro (2000, 2001), Bils and Klenows (2000) and Krueger and Lindahl (2001) have shown, other studies contend that this result is not robust. Cross-sectional studies such as Kyriacou (1991), Benhabib and Spiegel (1994) and Pritchett (2001) find insignificant effect of education on growth. Similarly, panel studies fail to find the significance of education in growth regressions (Islam, 1995; Caselli *et al*., 1996; Bond *et al.,* 2001). The lack of robust positive relationship between education and growth could be due to the use of poor proxy for education or possibility of indirect effect of education on growth (Cohen and Soto, 2007). Pritchett (2000) as cited in Aghion and Durlauf

(2005) argues that there is another way to study the growth impact of an event or a variable. One approach is to analyze the sources of growth; namely investment and Total Factor Productivity (TFP).

The literature on the role of education in economic growth varies from cross sectional to time series analysis. Cross sectional regressions have been the main empirical tool probably due to limited annual data on education (Pereira and Aubyn, 2009). The analysis on education and growth is inspired by the seminal work of Romer (1986) and Lucas (1988), who introduce the theoretical framework linking the role of human capital to economic growth. Following the literature, earlier empirical studies (see for example Barro, 1991; Barro and Sala-i-Martin, 1995; Mankiw *et al*., 1992) support the hypothesis that education is positively correlated with economic growth.

The macro-empirical analysis focuses on the empirical tests using econometric modeling to study the relationship between education and economic growth. Similarly, the studies find the evidence that a country with a high population of educated people generate higher growth (Miller and Upadhyay, 2000). Many studies, however fail to show a positive correlation between output per capita and educational variables[6]. The work of Levine and Renelt (1992) verifies that the education-growth nexus is sensitive to the regression specification.

As Pritchett (2001) argues, the deficiency of the correlation between education and growth is due to the weak institutions and low quality of education in developing countries. Krueger and Lindhal (2001) support this argument; they claim that there exists some inferiority in the

[6] For example : Benhabib and Spiegel (1994) and Pritchett (2001).

educational attainment data. Thus, in order to ensure a positive correlation between output per capita and any educational measure used, the choice of theoretical model is important.

Bils and Klenow (2000) develop a theoretical model of economic growth which proves human capital of older groups positively affects the human capital of younger generations. In their model, human capital directly enters the production function and positively affects economic growth through the implementation of new technology. Their model also allows for an impact of economic growth on schooling. Growth in technological advanced leads to higher productivity and profit that eventually results in higher growth and higher investment in schooling. Pritchett (2001) uses the growth in human capital proxied by the years of schooling in his regression, which differs from Mankiw *et al*. (1992) and Barro and Lee (1991). In his study, he finds no significant impact of growth in education per worker on economic growth. Glewwe *et al.* (2007) highlight the measurement errors in Pritchett's educational variable that may bias the results.

On the other hand, studies on volatility and education have concluded that volatility is detrimental for human capital accumulation or investment. A seminal paper by Flug *et al*. (1998) pioneers this strand of literature. The paper studies the empirical relationship between income volatility and secondary school enrollment in the presence of credit constraints and income inequality. The evidence suggests that, higher volatility is associated with lower secondary enrollment for a panel of 122 countries in 1970-1992. In addition, it provides a clear channel through which unequal income distribution and imperfect credit market affect human capital investments.

Checci and Garcia-Penalosa (2004) extend Galor and Zeira (1993) model by adding uncertainty and study the empirical link between volatility and human capital stocks and its distribution. Similarly, they find that volatility undermines years of schooling and is positively related to its distribution. In contrast to these two studies, Heylen and Pozzi (2007) argue that inflation crises induce human capital accumulation. This is highlighted in their model where temporary crisis will encourage young agents to delay working and invest more on education. The empirical evidence from 86 countries for the year 1970-2000 proves that inflation crisis increases the average years of education by 0.4 years. This is the only study that finds the positive link between crisis and education in a large panel of countries in a dynamic setting. Previous evidence focuses solely on one country, for example Dellas and Sakellaris (2003) and Shady (2004).

2.2.3 Empirical Evidence on Volatility and Growth

Ramey and Ramey (1995) have highlighted the harmful effect of volatility on growth. The study provides evidence that suggest average output growth rates is negatively affected by output volatility and investment is a trivial channel through which volatility affects growth. Recent empirical studies that agree with the negative relationship of volatility and growth include Fatas (2002); Hnatkovska and Loayza (2005); Aghion and Banerjee (2005); Norrbin and Yigit (2005); Furceri (2007) and Badinger (2010) among others. Aizenman and Marion (1999) conduct a similar study but disaggregated investment into public and private investment. In contrast to Ramey and Ramey (1995), in this study, private investment is the important channel through which volatility and growth is correlated. Chatterjee and Shukayev (2005) replicate Ramey and Ramey's analysis and find a different result. They claim that the

negative relationship between mean growth and output volatility is biased, not robust and depends on the definition of growth rate. They test the robustness of the study using alternative definitions of growth[7] and alternative data that covers a longer period in a broader sample of countries.

The above-mentioned studies, however, contradict the earlier studies by Kormendi and Meguire (1985) and Grier and Tullock (1989). These studies find that increases in output volatility are positively correlated with average growth rates. Bredin and Fountas (2005) study the effect of macroeconomic uncertainty (output growth and inflation) on the level of growth and inflation. Lee (2010) has shown that higher growth is correlated with higher volatility of the innovations for growth for a panel of G7 countries from 1965-2007.Although they present mixed evidence, their results signify that macroeconomic uncertainty does not always harmful for growth; in some cases, it enhances growth and improves macroeconomic performance.

As argued by Imbs (2002) omitted variables and reverse causality have been the main concern when studying volatility and growth, as they are other underlying factors that may cause growth or volatility. To overcome these issues, studies have identified and isolated the exogenous source of volatility. Judson and Orphanides (1999) examine the relationship between inflation volatility and growth in a panel data of 119 countries in 30 years. The negative relationship of inflation volatility on growth is robust even after controlling for the level of inflation.

[7] Ramey and Ramey (1995) use log difference of GDP per capita growth, while Chaterjee and Sukayev (2005) use standard definition of growth rates (percentage change).

Chauvet and Guillaumont (2009) take a different approach by studying aid volatility and the stabilizing/destabilizing effect of aid on growth. Their findings suggest that aid increases growth stability while its volatility decreases the impact. Chong and Gradstein (2009) provide empirical support for the adverse effect of volatility on growth using a detailed cross-country firm level dataset. Additionally, they identify institutional quality as the main channel through which this effect magnifies. This study complements Rodrik (1999), where both studies conclude that the detrimental effect of volatility is larger when institutions are weak.

From the literature, it is shown clearly that the empirical evidence does not support the theoretical expectations. Existing evidence on the positive relationship between volatility and education is scarce and inconclusive. Motivated by the reason, this chapter contributes to the literature by following the empirical growth specification and extends it by demonstrating that when interacted with education, volatility has a positive significant impact on growth. The usual growth accounting specification is expanded by including the interaction term between years of schooling and output volatility to compute the total effect of volatility on growth.

2.3 Data Description and Descriptive Statistics

2.3.1 Data and Variables

In this chapter, we gather a large panel dataset from 100 developing countries in Asia, Latin America and Africa over a 40-year period from 1970 to 2009. However, because of data constraints, the number of countries included in the analysis will differ relative to the independent variables used. Table A.1 of Appendix A lists the countries included in each

regression. It is important to note that the sample countries are chosen based on the availability of education data. In addition, the sample includes low-income countries in the African region and high volatility countries in the Latin America region. The period considered also include financial crises faced by some countries in the sample[8].

Because the data on education is measured in five-year intervals, we average the other variables over five-year intervals: 1970 corresponds to the average of 1970-1974; 1975 corresponds to 1975-1979 and so on. This gives us eight observations per country. This is also useful in order to eliminate the cyclical component. The number of observations varies across specifications depending on the control variables used. The major sources of our data are World Bank-World Development Indicators (2010) and Penn World Tables 6.3 (henceforth PWT 6.3).

The first concern that arises in measuring human capital is the suitable variable as a proxy for education. The literature on human capital uses different proxies to measure education. This is due to the unavailability of annual data for educational attainment in addition to reliable data for developing countries. One main approach is to use the latest average number of years of schooling of the adult population constructed by Barro and Lee (2010). Some studies use other measures like secondary enrollment, literacy rate or construct their own measure of human capital (de la Fuente and Domenech, 2006; Bassanini and Scarpetta, 2002).

The use of these different measures has both advantages and disadvantages. Literacy rate only measures the ability of an individual to read, write and understand a simple sentence for

[8] Asian financial crisis (1997) Argentina (1999-2002),Mexico(1994),Uruguay(2002).

everyday life, thus it can only represent a part of human capital. Enrollment ratios on the other hand, measures the number of students enrolled in a particular level relative to total corresponding age group and represents the flow of human capital. In addition, it shows the general level of participation in school and indicates the capacity of the education system to accommodate students at a certain age group (UIS, UNESCO, 2009).

The human capital stock is of interest, thus we utilize the updated education data from Barro and Lee (2010) and use the average years of total schooling as a proxy for education. This dataset provides educational attainment data for 146 countries in 5-year intervals from 1950 to 2010 for the population aged 15 years and above and 25 years and above. We also use disaggregated education data, which is the years of schooling at different levels namely primary, secondary and tertiary. This is important as we can assess which level of education has the most significant impact on growth. Based on insights from the theory and previous empirical work, we control for other variables, which includes initial real GDP per capita (*Initial GDP)*, investment in physical capital (*Investment*), the degree of openness (*Openness*) and population growth (*Population*).

Investment in physical capital is one of the most usual control variables in empirical growth. In addition, Levine and Renelt (1992) have found that the investment share of GDP is positively related to economic growth and the relationship is robust. According to the view of the recent theories of endogenous growth, investment is one of the most fundamental determinants of growth. This view attracts enormous empirical studies on the relationship between investment and economic growth (for example, Barro and Sala-i-Martin, 1995; Sala-i-Martin, 1997; Bond *et al*., 2001; Podrecca and Carmeci, 2002). Nonetheless, including

investment as one of the regressors may affect the significance of the schooling variables[9]. A positive relationship with growth is expected.

Population growth is included in the specification following Ramey and Ramey (1995) as well as Levine and Renelt (1992), whom identified it as another important control variable in growth regressions. Edwards and Yang (2009) however find no significant effect of population growth in their regression, which is supported by Norrbin and Yigit (2005). On the other hand, a study on the impact of population growth and economic performance by Klasen and Lawson (2007) claim that population growth has a negative and significant effect on growth. Hence, a negative relationship with growth is expected.

The inclusion of initial GDP is to study the convergence hypothesis. The initial GDP is measured at the beginning of each five-year average period. Openness is the ratio of the sum of exports and imports as a percentage of GDP. Openness to international trade is essential to economic growth. It helps to facilitate technology diffusion and promote competition and efficiency (Barro, 2001). Empirically, Sachs and Warner (1995) have shown that international openness is an important determinant of economic growth. We compute growth as the log difference of real GDP per capita from PWT 6.3. Volatility is then measured as the standard deviations of average growth from 1970-2009. Data for growth and the control variables are from PWT 6.3 and the World Bank-World Development Indicators (2010).

[9] See Krueger and Lindahl (2001) for detailed explanations.

2.3.2 Trends of core variables

This section presents and discusses the trends of core variables used in this chapter as discussed in previous section. Figure 2.1 displays the trends in average annual GDP growth measured by the log difference of real GDP per capita from 1970-2009 for 100 countries in the sample and two subsample- low and high-income developing countries[10]. On average, annual GDP growth in both subsample display similar trends, declines in mid and late 1970s. Then, it is followed by an expansion of annual GDP growth in the mid to late 1980s. There is also a sharp decline in the early 1990s and late 1990s due to the Asian financial crisis and economics crisis in the LAC region. Figure 2.2 is the trend of standard deviation of annual growth or growth volatility. Volatility display an increasing trend in the early 1970s and early 1980s but decline sharply in late 1980s. It increases again in early 1990s before declining constantly until early 2000.

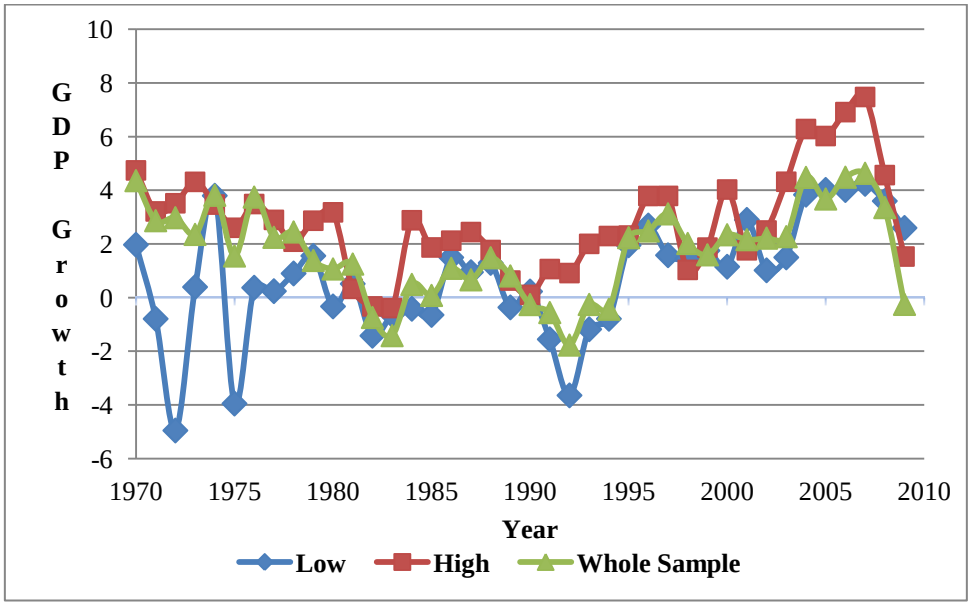


Figure 2.1: Average Annual GDP growth: 1970-2009

[10] The whole sample consists of developing countries only. Low are low-income countries and high are middle-income countries as classified by the World Bank.

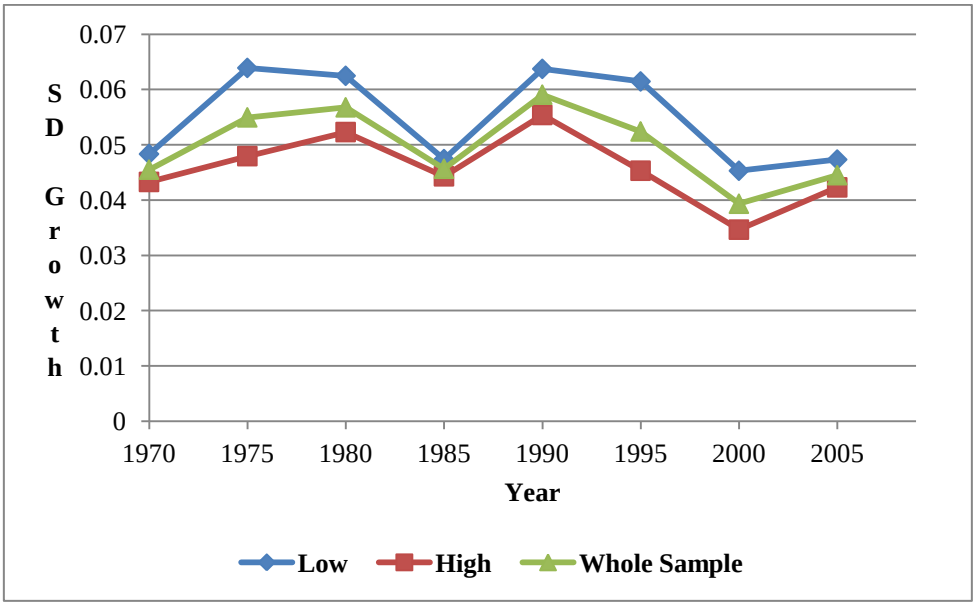


Figure 2.2: Standard Deviation of Annual Growth: 1970-2009

Our measure of human capital /education is the newest version of Barro and Lee (2010) on average years of schooling in the population aged 25 years and above. We present the trends for educational attainment in Figure 2.3. Briefly, looking at the upward trend, school attendance in all subsample has been increasing since 1970. The low-income countries have the lowest attainment rate while the middle-income countries have higher attainment compared to the whole sample. We also graph two different levels of education, primary (low) and tertiary (high) education for the whole sample. As shown in Figure 2.4, there is a significant difference in the attendance between the two levels although both levels display an upward trend. The attendance for tertiary education is very low in the developing countries compared to primary education. This is perhaps due to the implementation of universal primary education where all developing countries had successfully reached the 100% enrollment rate.

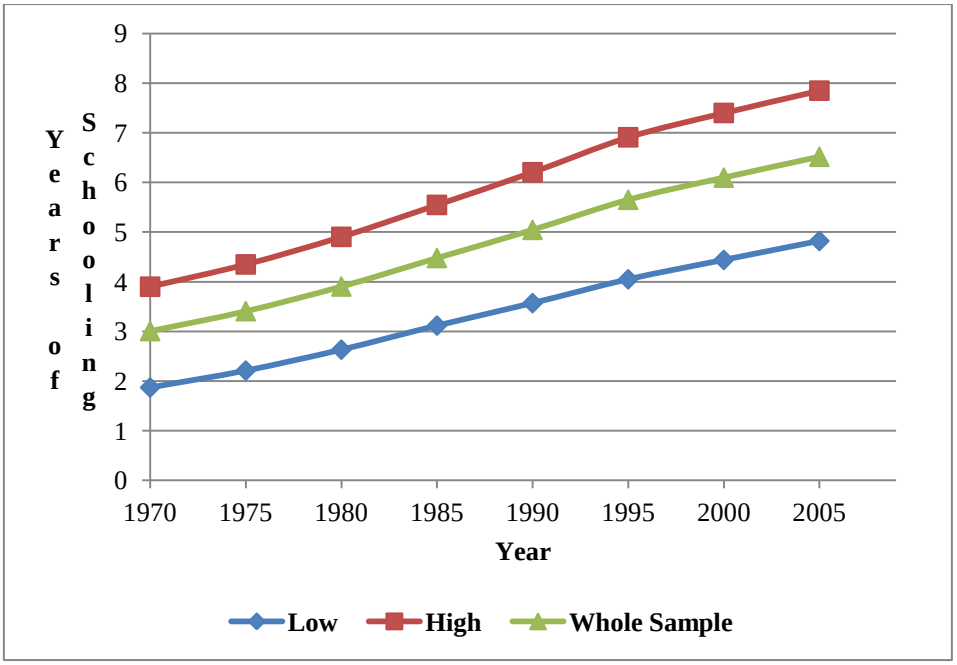


Figure 2.3: Average Years of Schooling for 25 years and above: 1970-2009

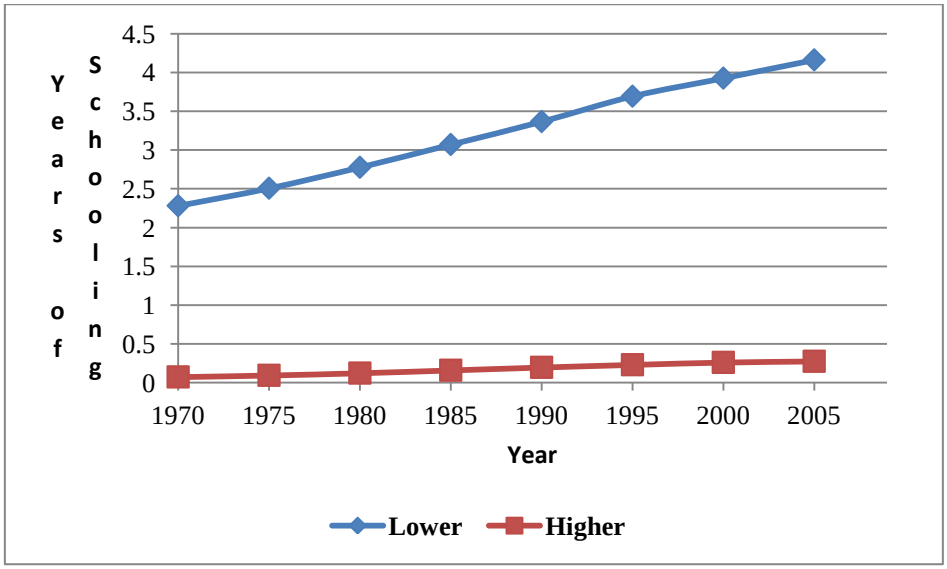


Figure 2.4: Average Years of Primary and Tertiary Schooling for 25 years and above: 1970-2009

Figure 2.5-2.7 are the trends for the control variables; investment in physical capital, degree of openness and population growth. To measure physical capital, we use the investment share of

GDP per capita at 2005 constant price from the Penn World Tables. On average, this measure displays an increasing trend despite a decline in the early 1980s to the late 1980s. It experiences a steady increase from the late 1980s before a sharp increase in early 2000. On the other hand, the degree of openness exhibits an increasing trend with a low decline in late 1980s and early 2000. Population growth shows a quite different trend between the low and high-income countries. It seems that the low-income countries illustrate a very similar trend to the whole sample with a decline in late 1990s and 2000s. Conversely, in high-income countries, the population growth displays a downward trend but with very low changes between the years.

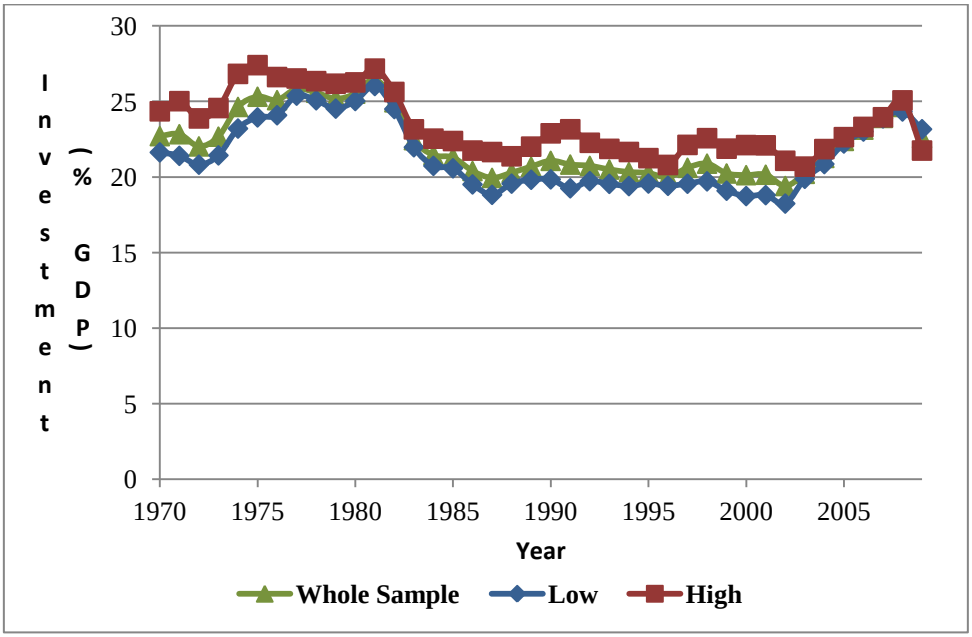


Figure 2.5: Investment share (% of GDP): 1970-2009

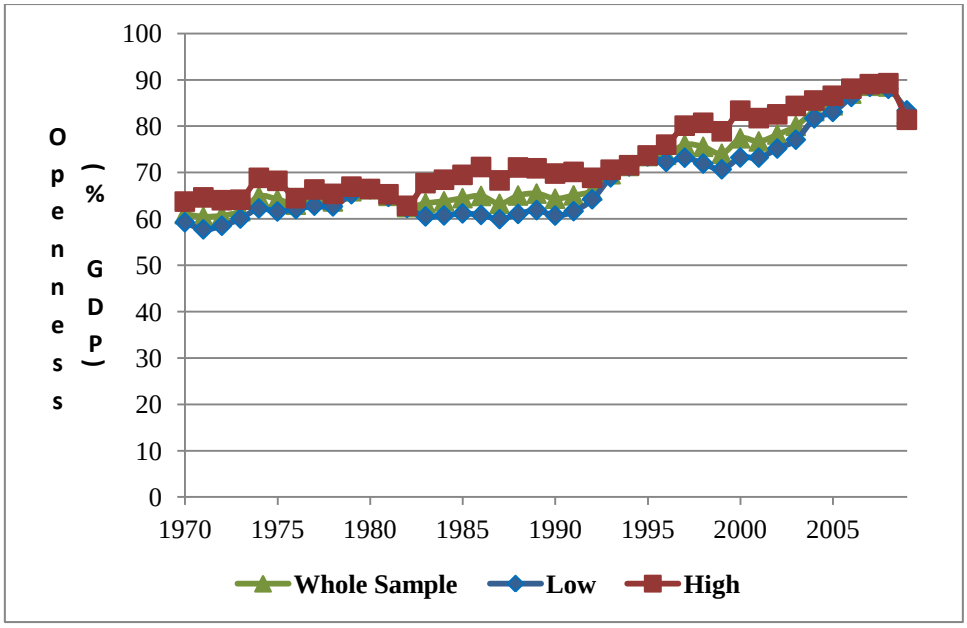


Figure 2.6: Openness (% of GDP): 1970-2009

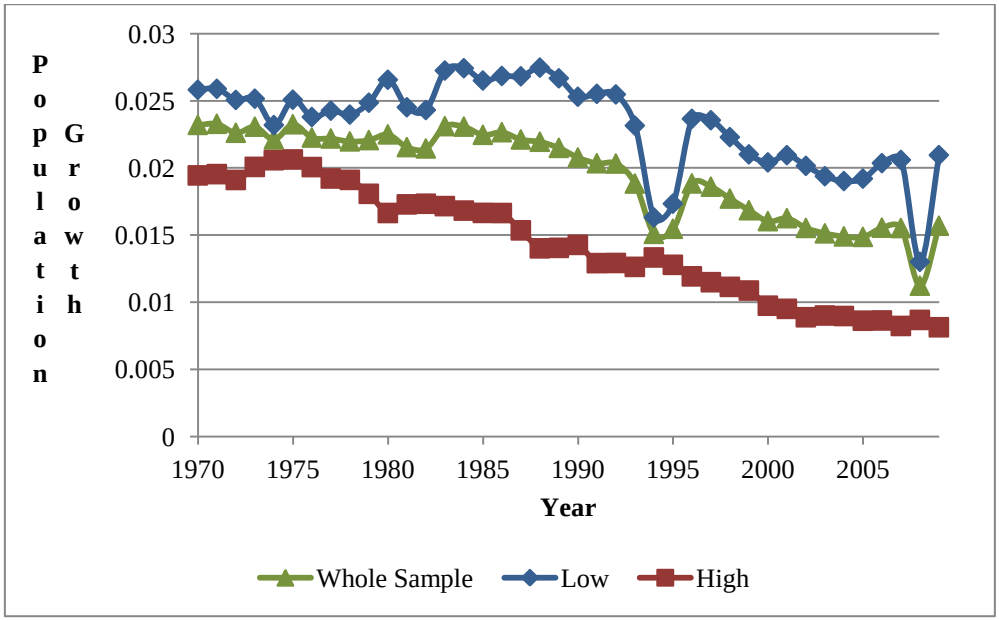


Figure 2.7: Population Growth: 1970-2009

2.3.3 Simple Correlation

Table A.2 in Appendix A presents descriptive statistics of the data while Table A.3 shows correlation coefficient between the variables and growth. There is a significant deviation in total years of schooling across the countries in the sample, ranging from the lowest in Mali to the highest in Russia. The average output volatility is 0.06, and the maximum is 0.25. The value is quite small because we consider the standard deviations of growth over the 40-year period. Inflation volatility displays the highest variability and the average level of inflation is very high in this sample. This is because; the sample includes high-inflated countries for example Bolivia, Brazil, Democratic Republic of Congo and Zimbabwe. The additional control variables display good variation in the sample hence favoring the use of dynamic panel estimation.

As for the correlations, years of schooling (total schooling and levels of schooling) is positively correlated to growth. Volatility is negatively related to growth. The alternative volatility measures are highly correlated; the correlation between the short-term volatility and standard definition of volatility is 0.81. This is expected because they are calculated from the same variable, which is the real GDP per capita. It is also important to note that, all the volatility measures negatively correlate with growth, which confirms our first expectation. Population growth is negative as indicated in the literature and the other variables have the correct signs. Volatility is positively correlated to openness. Greater openness to trade means greater exposure to some of the most volatile markets in the world (Bowdler and Malik, 2005). Aghion *et al.* (2009) also show that greater financial openness will raise exposure to the pro-cyclical capital flows, which in turn lead to higher volatility. Although the correlation matrix

does not precisely explain the relationship between the variables, it gives an initial view on the sign of the relationship.

Figures 2.8-2.13 provide scatter plots for bivariate prediction between growth in GDP per capita and the variables used in the analysis as discussed above. Figures 2.8, 2.9 and 2.13 show a negative relationship between growth in GDP per capita and volatility, initial income and population. However, the negative relationship between growth and population is not obvious. There is also a positive relationship between education, investment and openness with growth (Figures 2.10, 2.11 and 2.12). Although the graphs show the expected relationship, some variables may not have any impact on the growth of the economy. This needs to be explored in detail by econometric analysis.

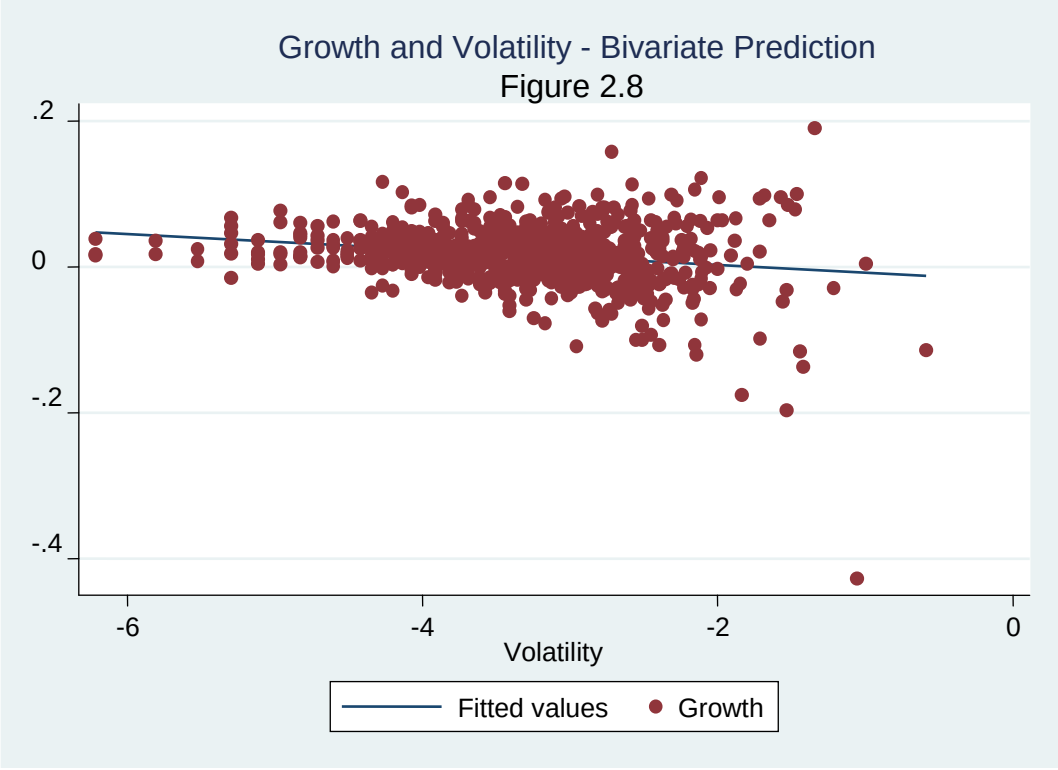


Figure 2.8

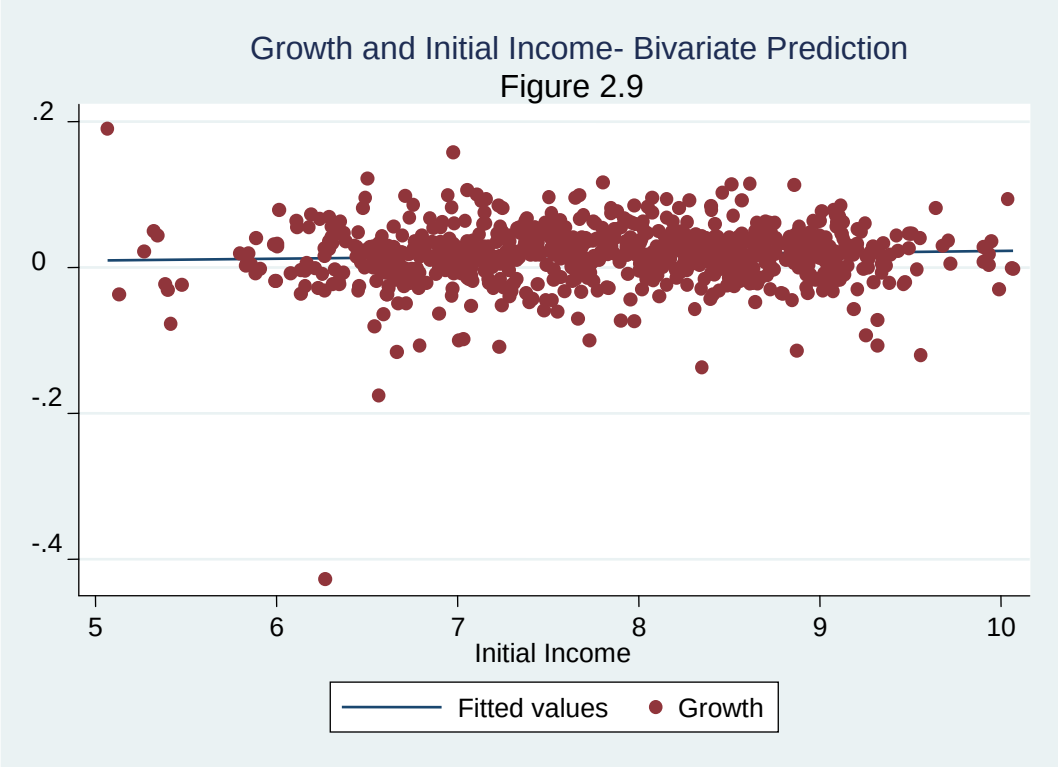


Figure 2.9

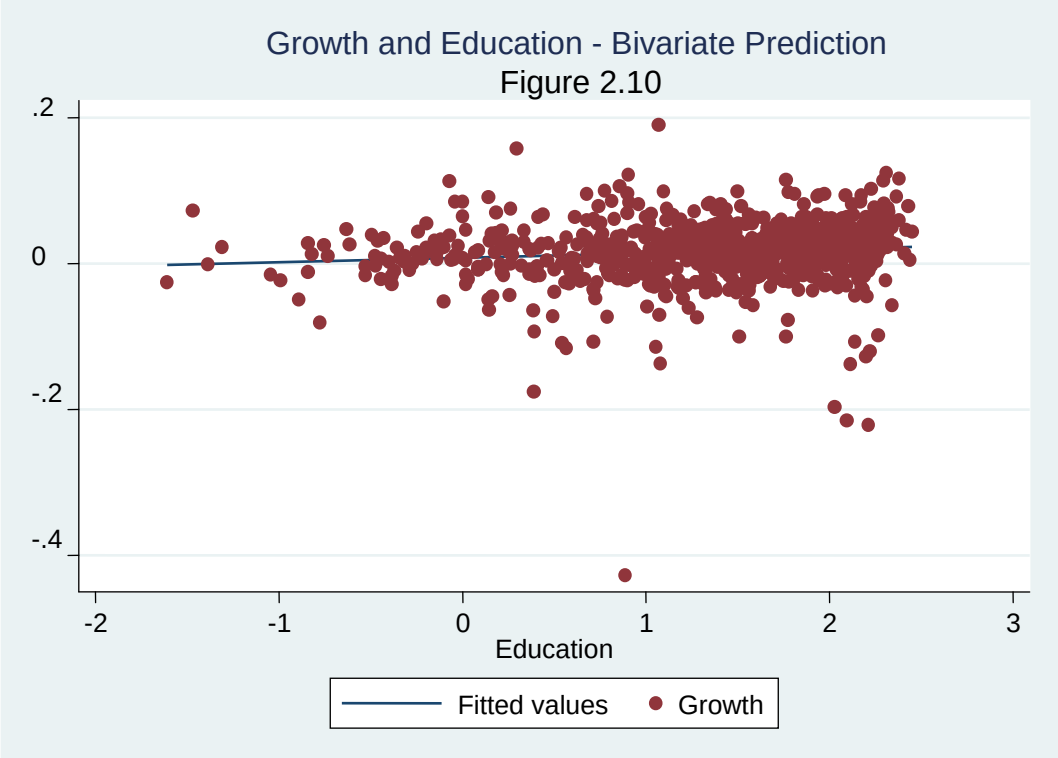
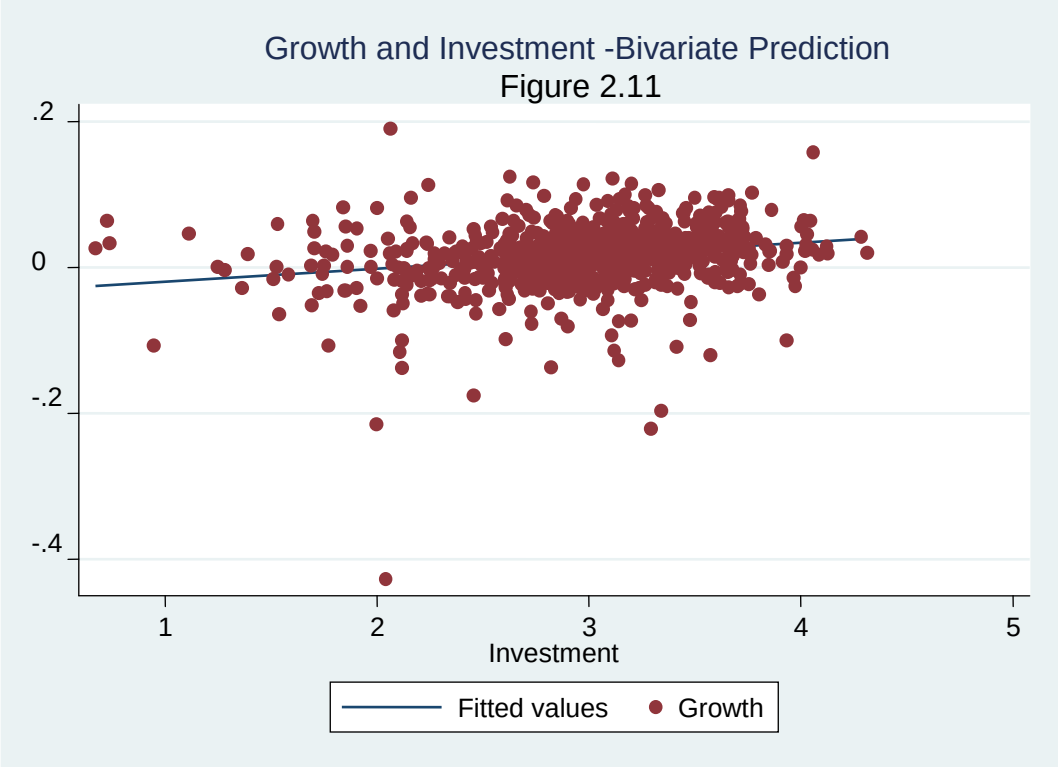
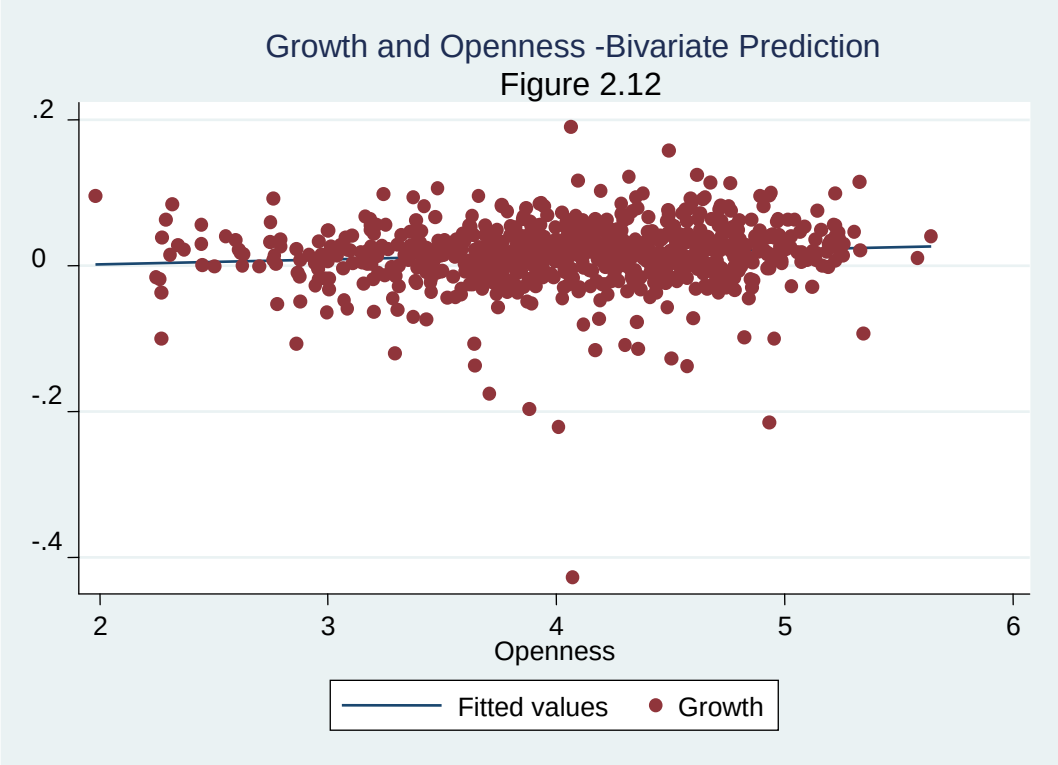
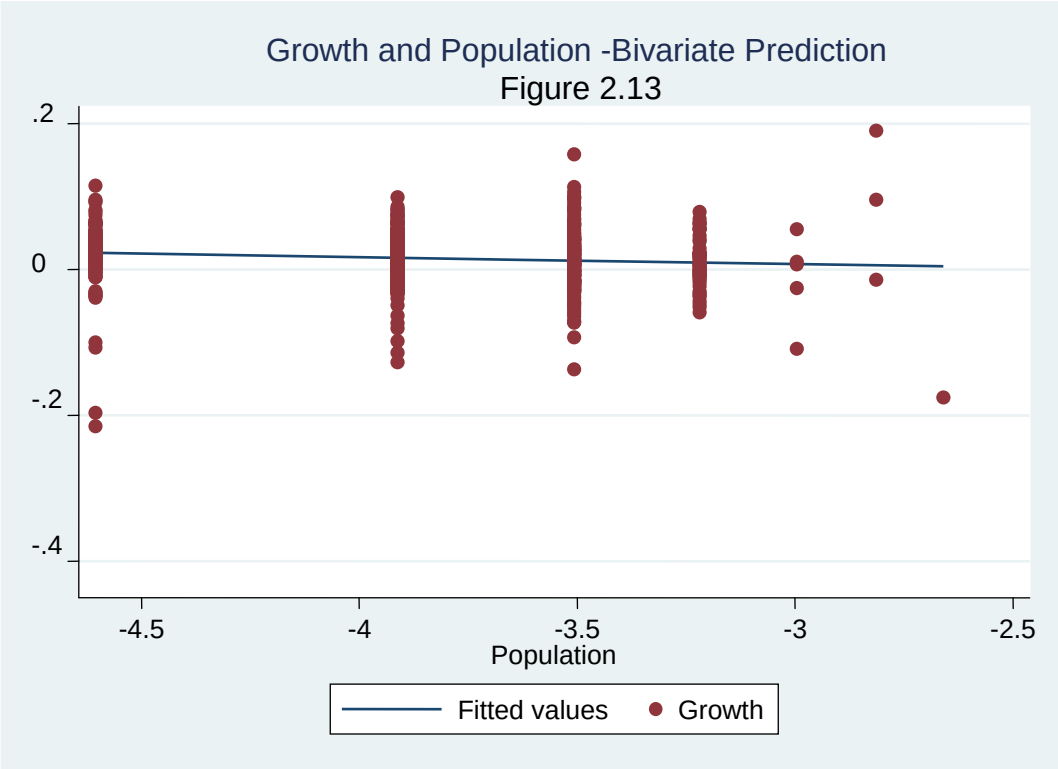


Figure 2.10


Growth and Investment -Bivariate Prediction
Figure 2.11
.2
0
-.2
-.4
1
2
3
4
5
Investment
Fitted values
Growth


Growth and Openness -Bivariate Prediction
Figure 2.12
.2
0
-.2
-.4
2
3
4
5
6
Openness
Fitted values
Growth



2.4 Econometric Methodology and Model Specification

2.4.1 Econometric Methodology

In this subsection, we describe the model specification and econometric methodology used to study the relationship between education, volatility and growth. The theoretical foundation for the link between human capital and growth relies on the growth models of Uzawa (1965) and Lucas (1988). The emergence of research that focuses on the endogenous growth models starts in the early 1990's. These models assume that innovations and human capital are important determinants of growth. Romer (1990) and King and Rebelo (1990) are among the first who utilize the model to study the long run effect of human capital on economic growth.

In this chapter, we employ the usual growth accounting exercise that follows the bulk of literature (Barro, 1990, 2001; Mankiw *et al*., 1992; Islam, 1995; Krueger and Lindahl, 2001 among others). For the purpose of our analysis, the equation adopts the usual growth regression approach where the per capita GDP growth is specified as a function of a set of independent variables. We further extend the empirical model by adding the interaction term between education and volatility; so the focus of this chapter is twofold. First, it analyzes the importance and significance of education while controlling for volatility and other variables, and second, it studies the joint effect of education and volatility on growth.

A variety of methods is used to assess growth empirically. Most of the earlier work on empirical growth accounting and volatility conduct their analysis using cross-sectional methods like Barro (1990), Benhabib and Spiegel (1994) and Ramey and Ramey (1995) among others. Mankiw *et al.* (1992) as quoted by Bond *et al*. (2001) however point out that these estimations could potentially raise some econometric issues. The independent variables are potentially endogenous to the dependent variables and measured with errors. There are also concerns on omitted variables bias. Since the empirical growth model is motivated by the convergence hypothesis, the initial level of efficiency (which is not observed) should be included in the regression. Thus, these imply that the ordinary least squares estimates are biased due to the omitted variable, which is correlated with the initial level of income (Bond *et al*., 2001).

One approach to overcome the omitted variable bias is to use panel data. Panel data approach eliminates the time-invariant heterogeneity across countries in the sample and the fixed effects panel can reduce the omitted variable bias. However, the time-varying country effects are not

controlled and the endogeneity problem may still exist in this specification. Caselli *et al.* (1996) has utilized the first-differenced generalized method of moment (GMM) estimator originally developed by Holtz-Eakin *et al.* (1988) and Arellano and Bond (1991). This method corrects for heterogeneity, omitted variables bias and endogeneity of the regressors resulting in consistent estimates of the variables even with the presence of measurement errors.

The instrumental variable technique is applied to tackle the endogeneity issue. For example, Barro (2001) employs three-stage least square (3SLS) method and use the lagged of the independent variables as instruments. On the other hand, study on volatility and growth for example Hnatkovska and Loayza (2005) have used inflation volatility, term of trade shocks, a measure for real exchange rate misalignment and the frequency of systematic banking crises as instruments for output volatility. Although using instrumental variable approach seems to mitigate the endogeneity problem, it is often difficult to find suitable external instruments that match the required assumptions. Badinger (2010) uses instruments that are based on exogenous volatility spillovers from abroad to account for the endogeneity in volatility and growth regression[11].

However, the newly introduced approach has some disadvantages. According to Bond *et al*. (2001), finite sample biases occur when instrumental variables are weak. The first-difference GMM estimator behaves poorly when time series observations are small and persistent. This is because; lagged values of the variables are weak instruments for the following first-differences. Thus, they propose on using system GMM estimator to estimate empirical growth

[11] This study however is a cross sectional study which covers the period 1960-2003 for both developed and developing countries.

regressions. The system GMM proposed by Arellano and Bover (1995) and later developed by Blundell and Bond (1998) uses additional moment condition compared to the first difference estimator. The level equation uses lagged differences as instruments and instruments for the difference equation is the lagged levels (Arellano and Bover, 1995 and Blundell and Bond, 1998).

There are two advantages in using this particular panel estimator. First, this estimator controls for the unobserved country specific effects. In a cross-sectional regression, the unobserved country specific effects are included in the error term. Thus, it can produce biased coefficient estimates if the error term is correlated with the explanatory variables. The inclusion of the lagged dependent variable gives rise to autocorrelation as the lagged value is correlated with the error term. However, this approach will give consistent and efficient estimates even when the country specific effects (which is part of the error term) is correlated with the lagged value.

Second, the dynamic panel estimator controls for the possible endogeneity of all the independent variables. Studies on human capital and growth often ignored the reverse causality that may arise between education and output. Causality may run from output to education or from education to output. It can be the fact that education affects growth and vice versa. Countries with better education will have higher productivity thus increasing output. On the other hand, higher growth will influence a country to allocate more on educational spending. Causality may also run from volatility to growth. Thus, the issues of causality and endogeneity are important to the analysis of this chapter. Endogeneity may cause loss of dynamic information in the panel data framework and may lead to simultaneity bias. In addition, this estimator is designed for small number of time series observations and large

cross sectional units as argued in Roodman (2009a). This is exactly the characteristic of this chapter, where we have small *T* (8 years) and large *N* (100 countries).

2.4.2 Model Specification

We model the growth of per capita GDP as a function of education, initial level of GDP per capita, investment, trade openness, population growth and volatility of output. Our dynamic econometric setup allows for the fact that not only growth but also other determinants such as education can be persistent because of slow adjustment to changes (see Baltagi *et al*., 2009; Bobba and Coviello, 2007). Hence, we are interested in estimating the following model:

$$GR_{it} = \alpha + \beta_1 \ln Y_{i,t-1} + \beta_2 \ln EDUC_{i,t-1} + \beta_3 VOL_{i,t-1} + \beta_4 X_{i,t-1} + \mu_{it} \qquad (2.1)$$

i and t represent country and 5-year interval time period respectively. GR_{it} is the log difference of the real GDP per capita over the years, which is the growth rate. $Y_{i,t-1}$ is the initial real GDP per capita which captures the convergence effects. The independent variables are: $EDUC_{i,t-1}$ which is the years of schooling, $VOL_{i,t-1}$ is the volatility of output and $X_{i,t-1}$ is a set of control variables. The control variables include the logarithm of investment as a percentage of GDP, the logarithm of openness to trade and the logarithm of population growth, which are explained in detail in section 2.3.1. The error term, μ consists of country and time-specific effects and is given by:

$$\mu_{it} = \eta_i + \gamma_t + \varepsilon_{it} \qquad (2.2)$$

η_i denotes the country specific effects that are time invariant for example geographical location or climate. γ_t is the time specific fixed effects and is capable of picking up the impact of any crises that affected any of the countries in the sample. ε_{it} is independent and identically distributed with mean 0 and variance $(0,\sigma^2)$ over time and across countries.

We expand the above equation to include an interaction term. The interaction term is estimated by adding $\beta_5\left(lnEDUC_{i,t-1} * VOL_{i,t-1}\right)$ to equation (2.1) as follows:

$$GR_{it} = \alpha + \beta_1 \ln Y_{i,t-1} + \beta_2 \ln EDUC_{i,t-1} + \beta_3 VOL_{i,t-1} + \beta_4 X_{i,t-1} + \beta_5\left(\ln EDUC_{i,t-1} * VOL_{i,t-1}\right) + \mu_{it} \quad (2.3)$$

The interaction term (the main variable of interest) examines whether the significance of volatility-growth relationship varies according to the average years of education. Lagging the explanatory variables by one period is useful to address the strong assumption of exogeneity, which entails zero covariance between the regressors and the error term. It also eliminates the potential bias in the estimates that comes from contemporaneous shocks to growth and any of our explanatory variables (Baltagi *et al.*, 2009).

Equation (2.3) hypothesizes that growth is determined by education and volatility, together with additional control variables as described earlier. The interaction term between education and volatility is expected to shed light on the theoretical expectations outlined by Canton (2002), Blackburn and Galindev (2003), Varvarigos (2007, 2008) and Blackburn and Varvarigos (2008). The marginal effect of education in the presence of volatility can be

examined by calculating the partial derivatives of education with respect to volatility. We can also calculate the marginal effect of volatility in the presence of education using similar exercise as follows[12]:

$$\frac{\delta GR_{it}}{\delta \ln(EDUC_{i,t-1})} = \beta_2 + \beta_5 VOL_{i,t-1} \quad (2.4)$$

$$\frac{\delta GR_{it}}{\delta(VOL_{i,t-1})} = \beta_3 + \beta_5 \ln EDUC_{i,t-1} \quad (2.5)$$

Due to its relative advantage in improving precision and reducing finite-sample bias, we adopt the two-step system GMM estimator as our preferred estimator (Baltagi, 2008; Blundell and Bond, 2000). This estimator is appropriate in the presence of time-invariant regressor (which is volatility in our case) that is wiped out by the difference GMM estimator. It is also more appropriate than one-step system GMM due to potential autocorrelation.

To illustrate the dynamic panel system GMM technique, consider the general form of the empirical model below:

$$y_{it} - y_{it-1} = (\alpha - 1)y_{it-1} + X_{it}^{'}\beta + \eta_i + \gamma_t + \varepsilon_{it} \quad (2.6)$$

Where y is the logarithm of real GDP per capita, X is the set of explanatory variables other than the lagged of GDP per capita, η is an unobserved country specific effects, γ

[12] The marginal effects analysis is reported in Table 2.8. We report the education (volatility) derivative evaluated at the mean, minimum and at the maximum of volatility level (education). The derivatives provide further robustness analysis on the interaction.

is time-specific effects, ε is the independent and identically distributed error term, and *i* and *t* represent the country and time period, respectively. Equation (2.6) can be rewritten as:

$$y_{it} = \alpha y_{it-1} + X_{it}^{'}\beta + \eta_i + \gamma_t + \varepsilon_{it} \quad (2.7)$$

To eliminate the country specific effects, we take the first difference of equation (2.7) which results in equation (2.8).

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \Delta X_{it}^{'}\beta + \Delta\gamma_i + \Delta\varepsilon_{it} \quad (2.8)$$

The system GMM overcomes the bias problems of the difference GMM estimator by taking both equations (2.6) and (2.8) together. The estimator assumes that the country specific effects are uncorrelated with the first difference of the dependent variable and the independent variables. Consequently, along with the usual assumptions of the difference GMM, system GMM has two extra moment conditions, which are the correlation between the dependent variable and the error term and the independent variables and the error term. The moment conditions are illustrated below:

$$E\left[\Delta \mathrm{y}_{\mathrm{i,t-s,}} \Delta \varepsilon_{\mathrm{i,t}}\right] = 0, For\ s \geq 2, t = 3, \ldots T$$

$$E\left[\Delta X_{i,t-s,} \Delta \varepsilon_{i,t}\right] = 0, For\ s \geq 2, t = 3, \ldots T \quad (2.9)$$

The efficiency and consistency of the GMM estimator depend on the absence of serial correlation and the validity of lagged values as instruments. To test for autocorrelation, we apply the Arellano-Bond test of autocorrelation. The test has the null hypothesis of no

autocorrelation and test whether the differenced error term is correlated. The test rejects the null hypothesis for AR (1) but should not reject the null for AR (2). To test the validity of the instruments, we conduct the Hansen J test of over-identifying restrictions. The null hypothesis of this test is the instruments are exogenous. This test has a Chi-square distribution with j-k degrees of freedom; j being the number of instruments and k is the number of regressors.

2.5 Empirical Results

2.5.1 Baseline Model

In this section, we present the estimation results of the effects of education and volatility on real GDP per capita growth. In all regressions, we use robust standard errors to ensure that the estimates are not biased and efficient. We first estimate the growth model using three different methods- pooled ordinary least square (OLS), random effects (RE) and fixed effects (FE) before conducting and presenting the instrumental variable (IV) method. These estimations are conducted to check the robustness of the result and to compare with existing literature.

We employ a three-stage regression strategy with the aim to identify the significance of education, volatility and their interaction term. Firstly, we begin the estimation of the baseline model by testing the significance of education controlling for standard determinants of growth (Model 1). Then, we add volatility into the regression to examine the significance of schooling in the presence of volatility and vice versa (Model 2). Finally, we analyze the significance further by adding the interaction term in the regression (Model 3). This strategy is expected to provide sufficient robust evidence on the significance of both schooling and volatility in

developing countries. Each table consists of three columns representing the results of the three-stage regression discussed above. In each regression, the dependent variable is the log difference of real GDP per capita.

Table 2.1: Panel Evidence for Education and Volatility: Baseline Model [Pooled OLS, Random Effects and Fixed Effects]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	OLS	OLS	OLS	RE	RE	RE	FE	FE	FE
Initial $GDP_{(t-1)}$	-0.007***	-0.007***	-0.008***	-0.008***	-0.008***	-0.008***	-0.056***	-0.056***	-0.056***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.007)	(0.007)
$Education_{(t-1)}$	0.008***	0.006**	0.016***	0.009***	0.008**	0.016	-0.015**	-0.016**	-0.019
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.012)	(0.006)	(0.006)	(0.013)
$Volatility_{(t-1)}$		-0.009***	-0.009***		-0.009***	-0.012*		-0.006**	-0.005
		(0.003)	(0.003)		(0.003)	(0.007)		(0.003)	(0.006)
$Educ_{(t-1)}$ *$Vol_{(t-1)}$			0.001			0.003			-0.001
			(0.001)			(0.004)			(0.004)
$Investment_{(t-1)}$	0.007*	0.006*	0.007*	0.006	0.005	0.005	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)
$Openness_{(t-1)}$	0.001	0.002	0.001	0.001	0.003	0.003	0.006	0.007	0.006
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)
$Population_{(t-1)}$	-0.034***	-0.035***	-0.033**	-0.035*	-0.036*	-0.036*	-0.032	-0.033	-0.033
	(0.012)	(0.013)	(0.014)	(0.019)	(0.019)	(0.019)	(0.032)	(0.032)	(0.033)
Constant	-0.050	-0.078**	-0.071*	-0.037	-0.069	-0.082	0.394***	0.368***	0.374***
	(0.033)	(0.036)	(0.039)	(0.050)	(0.056)	(0.067)	(0.125)	(0.132)	(0.141)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	655	655	655	655	655	655	655	655	655
R-squared	0.156	0.181	0.206	0.158	0.185	0.186	0.252	0.263	0.263

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. The number of countries included in the regression is 100 developing countries. Significant time dummies are included in every regression

Table 2.1 above presents the estimation results. The results in column 1 and 4 for OLS and RE show an expected positive and significant effect of years of schooling on growth over the period. However, schooling is negative and significant for the FE estimation. The coefficients on schooling for both the OLS and RE models are very close suggesting the robustness of the result. Controlling for other variables, increasing one year of education will increase growth by 0.008-0.009 percent. Volatility is then added into the same regression and as shown in column 2, 5 and 8 the coefficients of volatility are negative and significant.

The result of the OLS estimation goes in line with Ramey and Ramey (1995) among others; although the coefficient for volatility in this study is very small[13]. Volatility is also lower compared to Hnatkovska and Loayza (2005) whom controls for initial GDP, education and financial development[14]. As expected, education has a significant positive effect on growth, but volatility has the opposite effect under both models without the interaction term, hence confirming the findings of existing literature.

Some studies find a positive effect of volatility on growth but the transmission channels are explicitly spelt out (Caporale and McKiernan, 1996). We want to explore the possibility that the negative effect of volatility on growth may be conditional on the value of education. In other words, we want to show that education is a key route through which we may observe a less harmful effect of volatility on growth. Thus, we add an interaction term between education and volatility to the model. Contrary to the studies cited earlier, we do not find a

[13] The coefficient for volatility in this study is -0.211, controlling for similar set of control variables with different country coverage.
[14] In their regression, the coefficient on volatility is -0.2605, but they use secondary school enrollment as a proxy for education.

positive and significant effect between education and volatility on growth as seen in column 3 and 6. However, we will further analyze the effect of volatility on growth conditional on education by calculating the marginal effects of volatility on growth at the minimum, mean and maximum level of education in the next section to show that the detrimental effect of volatility and growth is mitigated through education or investment in human capital.

In models with the interaction term, volatility does not change sign and significance. Nevertheless, the coefficient of education becomes higher and significant for OLS, insignificant for RE or FE when the interaction term is included. Education appears to reinforce this mitigation effect, as the overall effect is statistically significant. The pooled OLS explains 21 percent of the cross-country variation in growth rates in the sample.

Confirming the convergence hypothesis, the coefficient on initial GDP per capita is significantly negative in specifications with or without the interaction term. Investment in physical capital is significant only in OLS. Openness to trade appears insignificant in all models. In addition, population growth is significant with the expected sign in all columns except the FE model.

As discussed in section 2.4.1, endogeneity is an important issue to consider in growth regressions.There is also issue of causality in this particular study. For example, causality may run from growth to volatility or growth to education and vice versa. To tackle those issues, we first employ two-stage least square (2SLS) and use external instruments for the endogenous variables. We treat education (years of schooling) and volatility as endogenous variables. Following Hnatkovska and Loayza (2005), we use inflation volatility and term of trade shocks

as instruments for output volatility. In addition, we also use lagged values of output volatility and education as additional instruments. Table 2.2 below reports the results.

In column 1, education has the expected sign and significance. When volatility is added into the regression, the coefficient on education becomes lower but still significant. Volatility has a quite strong effect on growth compared to the years of schooling. In column 3, we can see that the inclusion of the interaction term yields a positive and significant coefficient. Other variables have similar signs and significance with earlier methods. However, the statistics for the weak identification test shows that the regression suffers from weak instruments. Thus, we proceed to use a dynamic panel estimation technique, i.e. two-stage system GMM estimator similar to Aghion and Banarjee (2005).

All the regressions are estimated using the finite sample correlation standard errors for the variance matrix proposed by Windmeijer (2005). This is because the two-step system GMM presents standard errors that are downward biased. We aim to limit instrument proliferation by restricting the number of lags used as instruments in the regression to preserve the reliability and improve the performance of the over-identifying tests.

The results for the two-step system GMM are very close suggesting the robustness of the result. For example, controlling for other variables, increasing one year of education will contribute to the growth rate by 0.009 percent, which is within the range of the previous estimators. When volatility is added into the regression, education loses its significance. The interaction term is still insignificant, but other variables have similar signs with the other estimation methods. We note that in the two-step system GMM results all the diagnostics are

satisfactory. The Hansen test does not reject the null of valid instruments. As expected, the absence of first order serial correlations is rejected while the absence of second order serial correlation is not rejected. Thus, the system GMM is the preferred and more appropriate estimator when endogeneity and weak instruments bias are taken into account. As such, we will discuss the results from system GMM estimation for the rest of the chapter.

Table 2.2: Panel Evidence for Education and Volatility: Baseline Model [2SLS and System GMM]

VARIABLES	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) SYSTEM	(5) SYSTEM	(6) SYSTEM
Initial $GDP_{(t-1)}$	-0.008***	-0.007***	-0.007***	-0.011**	-0.013***	-0.016***
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)
$Education_{(t-1)}$	0.012***	0.009**	0.097*	0.009*	0.005	0.025**
	(0.004)	(0.004)	(0.050)	(0.005)	(0.005)	(0.010)
$Volatility_{(t-1)}$		-0.016***	-0.049**		-0.014***	-0.017***
		(0.006)	(0.023)		(0.004)	(0.003)
$Educ_{(t-1)}$*$Vol_{(t-1)}$			0.027*			0.003
			(0.016)			(0.002)
$Investment_{(t-1)}$	0.010*	0.006	0.003	0.017*	0.017*	0.013
	(0.005)	(0.004)	(0.004)	(0.009)	(0.009)	(0.014)
$Openness_{(t-1)}$	-0.002	-0.001	0.003	-0.004	-0.000	-0.000
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.006)
$Population_{(t-1)}$	-0.029*	-0.031***	-0.037***	-0.053**	-0.056**	-0.055*
	(0.015)	(0.012)	(0.013)	(0.026)	(0.027)	(0.031)
Constant	-0.026	-0.080**	-0.219**	-0.077	-0.132	-0.121
	(0.039)	(0.039)	(0.090)	(0.072)	(0.086)	(0.088)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	463	409	473	655	655	655
Weak ID	5226.06	12.44	2.32			
AR1 [*p*-value]				0.01	0.01	0.04
AR2 [*p*-value]				0.87	0.72	0.69
Hansen J [*p*-value]	0.47	0.26	0.40	0.27	0.33	0.75

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. The number of countries included in the regression is 100 developing countries. Significant time dummies are included in every regression.

2.5.2 Level of Education

We then examine the impact of different levels of education on growth. The result is reported in Table 2.3. In this specification, we categorize the levels of education into two categories, lower and higher education. Lower education is the total average years of schooling for primary education while higher education is the average years of tertiary schooling. We omit secondary education from the analysis because it appears to be highly correlated with both primary and tertiary. If all levels of education were included in one specification, it will raise multicollinearity issue[15].

The results presented are from system GMM estimations. From column 1, we can see that both primary and tertiary educations are positive and significant as expected. The coefficient on primary education is higher compared to tertiary education, which suggests the fact that basic education in the sample countries is more important than tertiary education. The result could also be driven by the fact that most countries in the sample have reached universal primary education and have a high number of enrollments at all levels. This result is consistent with the fact that, primary education prepares an individual with knowledge and skills needed for the job market. Basic education (primary schooling) will only teach the basic levels of learning which is insufficient to make an impact on growth or to be a guard against uncertainty. Tertiary education enables individuals to use and utilize the skills and knowledge acquired at the lower level for future innovations.

[15] Nevertheless, we try to include all three levels of education in one specification and different combinations i.e. primary and secondary, primary and tertiary and secondary and tertiary. It appears that, in most specifications, secondary education is insignificant.

Primary education is no longer significant when volatility is added in the equation in both models. The effect of volatility on growth is a bit higher compared to the baseline model holding other variables constant. Note that we now have two interaction terms (i.e. low education *volatility and higher education*volatility). We estimate two separate models with the two interaction terms as shown in column 3 and 4. This is because, the interaction terms are highly correlated and estimating it together will most likely to cause the variables to be insignificant and the whole analysis to be inconsistent and inefficient. When the interaction term between low education and volatility is added into the model, the coefficient on volatility increases but higher education loses its significance. The coefficient for low education increases slightly and it is now significant. The variable of interest (the interaction term) is positive as expected and significant.

We observe a similar result when we include the interaction term for higher education and volatility, although the interaction term is now insignificant. Because we rely on the more efficient estimates of system GMM, we can safely conclude that the intuition behind the significance of the interaction term for lower education is, at volatile times, people with only lower education, which is usually the low salaried and less skilled workers are the most affected by the situation. Thus, they will seek more knowledge to secure better jobs and earnings. Individuals with higher education and advanced skills are less affected and are more likely to have secured jobs during bad times. The Hansen Test reveals the validity of the instruments used and we do not find any evidence of autocorrelation of order two in all specifications.

Table 2.3: Panel Evidence for Education and Volatility: Level of Education [System GMM]

VARIABLES	(1)	(2)	(3)	(4)
Initial GDP $_{(t-1)}$	-0.024***	-0.022***	-0.011*	-0.022***
	(0.005)	(0.006)	(0.005)	(0.006)
Low $_{(t-1)}$	0.013*	0.008	0.043***	0.010*
	(0.007)	(0.007)	(0.015)	(0.005)
High $_{(t-1)}$	0.010**	0.011*	0.006	0.015
	(0.005)	(0.006)	(0.004)	(0.011)
Volatility$_{(t-1)}$		-0.018***	-0.023***	-0.014**
		(0.003)	(0.008)	(0.006)
Low*Vol $_{(t-1)}$			0.011*	
			(0.006)	
High*Vol$_{(t-1)}$				0.001
				(0.003)
Investment$_{(t-1)}$	0.014	0.009	0.000	0.004
	(0.012)	(0.011)	(0.010)	(0.011)
Openness$_{(t-1)}$	0.011	0.010	0.008	0.012**
	(0.008)	(0.006)	(0.006)	(0.005)
Population$_{(t-1)}$	-0.051*	-0.057*	-0.044	-0.052*
	(0.026)	(0.029)	(0.030)	(0.027)
Constant	-0.004	-0.075	-0.118	-0.044
	(0.083)	(0.116)	(0.120)	(0.101)
Time Effects	Yes	Yes	Yes	Yes
Observations	644	644	644	644
AR1 [*p*-value]	0.01	0.01	0.01	0.01
AR2 [*p*-value]	0.64	0.82	0.87	0.96
Hansen J[*p*-value]	0.56	0.45	0.47	0.83

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Low is average years of schooling for primary and High is average years of schooling for tertiary education. Low*Vol is the interaction term between primary education and volatility while High*Vol is the interaction term between tertiary education and volatility. The number of countries included in the regression is 100 developing countries. Significant time dummies are included in every regression.

2.5.3 Split Sample

2.5.3.1 Income Level

Although we consider only developing countries in this chapter, the countries differ distinctly in their income level. Developing countries consist of countries with three different levels of income; low, lower middle and upper middle economies according to the World Bank specification. To examine the robustness of our findings, we split the sample of countries into two categories because non-negligible changes in estimated coefficients might arise when the sample studied changes (Bergh and Henrekson, 2011)[16]. We take the mean values of real GDP per capita for all countries and compare it with the mean value for individual country. If a country's mean income is less than the average income, we categorize the country as low-income country and high income country if the mean income is higher than the average income. We get a fairly balanced sample of countries, where 59 countries in the sample are considered low and 41 countries are high income.

Table 2.4 below presents the regression coefficients and associated standard errors for system GMM regressions of the growth rate of GDP per capita on education, volatility and the interaction term. The two-step estimation reveals quite similar result on both sample countries. The results for Model 1 however indicate that there is no significant association between schooling and growth for both samples. The effect of volatility is negative and significant in both low and high-income countries. Volatility has a significant negative effect in low-income

[16] We do not differentiate the countries following World Bank's specification because most of the countries in the sample fall in the 'middle income' countries. If we differentiate between lower and upper middle income economies, the sample would be constrained and estimating a constrained sample of a small number of observations may cause sample selection bias.

countries suggesting the stronger and more damaging impact of volatility to their growth than to more resilient high-income economies. The effect of volatility on high-income countries is smaller than the effect of volatility on low-income countries. The joint effect of education and volatility on growth is insignificant as in the baseline model.

After allowing for the interaction of both variables, we find significant effect of schooling in low-income countries. The coefficient of volatility in high-income countries does not change when the interaction term is included. Briefly, other control variables behave differently. Based on the negative coefficients for the initial income, convergence hypothesis are strongly supported in both sub-samples. In particular, the coefficients are highly significant (1% significance level) in the high-income countries. Conversely, investment is rarely significant and has the wrong sign for the high-income subset. We only observe the positive effect of investment for the low-income subset in the model without the interaction term. Furthermore, in this subset, openness to trade and population growth have no effect on the growth of the economy. However, when we analyze the high-income countries, population growth significantly reduces it. We reject the null hypothesis for the first order serial correlation (AR (1)). In addition, we are unable to reject the null of no second order serial correlation for the AR (2) test. We reject the null for the over-identifying tests, but in this subset, it seems that the test is robust but weakened by many instruments[17].

[17] According to Roodman (2009a), the high *p*-value (1.00) for Hansen J test indicates the presence of too many instruments. High number of instrument would cause problems for sample with large *T*. To avoid such problems, we should limit the number of instruments to be smaller or equal to the number of groups (*N*). Although we limit the instrument lags, the predetermined and endogenous variables are present in each regression. Nevertheless, Baltagi *et al.* (2009) among others report p-value of 1.00 for Hansen test.

Table 2.4: Panel Evidence for Education and Volatility: Income Level [System GMM]

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Low Income			High Income		
Initial $GDP_{(t-1)}$	-0.012*	-0.017**	-0.024***	-0.034***	-0.029***	-0.019
	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)	(0.014)
$Education_{(t-1)}$	0.011	0.006	0.024**	0.010	-0.000	0.018
	(0.007)	(0.006)	(0.010)	(0.009)	(0.009)	(0.012)
$Volatility_{(t-1)}$		-0.013**	-0.012***		-0.011*	-0.011**
		(0.006)	(0.004)		(0.005)	(0.005)
$Educ*Vol_{(t-1)}$			0.003			0.001
			(0.002)			(0.002)
$Investment_{(t-1)}$	0.024**	0.024**	0.016	-0.011	0.006	0.003
	(0.010)	(0.012)	(0.012)	(0.012)	(0.013)	(0.017)
$Openness_{(t-1)}$	-0.008	-0.004	0.001	0.004	0.004	0.003
	(0.008)	(0.007)	(0.008)	(0.005)	(0.005)	(0.006)
$Population_{(t-1)}$	-0.052	-0.053	-0.058*	-0.038*	-0.063**	-0.041
	(0.037)	(0.035)	(0.032)	(0.019)	(0.024)	(0.045)
Constant	-0.077	-0.094	-0.062	0.219**	0.034	-0.006
	(0.102)	(0.112)	(0.096)	(0.095)	(0.100)	(0.116)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	392	392	337	263	263	226
AR1 [*p*-value]	0.03	0.02	0.08	0.02	0.01	0.02
AR2 [*p*-value]	0.99	0.81	0.84	0.43	0.62	0.99
Hansen J[*p*-value]	0.87	0.99	1.00	1.00	1.00	1.00

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. Low-income countries consist of 59 countries and high-income countries consist of 49 countries. Significant time dummies are included in every regression.

2.5.3.2 Volatility Level

Besides income level, the countries also differ in the level of volatility. Thus, we extend our analysis on the subset of countries according to the level of volatility. This is also done following Turnovsky and Chattopadhyay (2003) which show differences in behavior among the level of volatility within the sample considered. Similar to the income level, we take the mean of volatility in the sample and compare it to individual country. The mean value of volatility for the whole sample is 0.06; 61 of the countries are low volatility countries while 39 countries are relatively high volatility countries. Among the high volatility countries are the sub-Saharan African countries (Botswana, Burundi and Ghana) and Latin American countries like Guyana and Nicaragua. Interestingly, the transition economies in the Europe and Central Asia region are categorized as high-income countries with high volatility. Other countries with the same characteristics are Tonga and Trinidad and Tobago. With almost one-half of the country in one category, the result should be interpreted carefully taking into account the characteristic of the countries.

We report the coefficients result along with relevant tests and standard errors in Table 2.5. The coefficients on schooling are insignificant when we divide the sample. Note that, although insignificant in the low volatility sample, the effect of volatility is robust with the expected sign for both subsets. In the case of the low volatility countries (columns 1-3), the inclusion of the interaction term increases the coefficient of volatility, but the effect is now significant. Nonetheless, we do not find significant effect of the interaction term in the low volatility sample. In contrast, both volatility and the interaction term are insignificant in the high volatility subset.

For other variables, there are significant differences. Investment is consistently positive and significant in the low volatility countries, which concurs with Turnovsky and Chattopadhyay (2003), but for the high volatility sample, the effect is insignificant. This is also true for population growth; the effect is strongly negative and significant in the low volatility subset. In contrast, we only observe the significant effect of population for high volatility countries in Model 2. While there is weak evidence of convergence effect in the low volatility subset, openness to trade has no significant effect on growth for this subset, which is also true for the high volatility subset. The specifications also pass the autocorrelation tests, where we only detect autocorrelation of order 1. The over-identifying tests are satisfactory, but as previous sub-samples, the test is robust but weakened by many instruments.

Table 2.5: Panel Evidence for Education and Volatility: Volatility Level [System GMM]

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Low Volatility			High Volatility		
Initial $GDP_{(t-1)}$	-0.007*	-0.008	-0.004	-0.019	-0.025	-0.021
	(0.004)	(0.005)	(0.006)	(0.012)	(0.017)	(0.020)
$Education_{(t-1)}$	0.002	0.000	0.004	0.016	0.012	0.028
	(0.005)	(0.005)	(0.009)	(0.010)	(0.009)	(0.022)
$Volatility_{(t-1)}$		-0.004	-0.008**		-0.009	-0.009
		(0.004)	(0.004)		(0.010)	(0.011)
$Educ*Vol_{(t-1)}$			0.001			0.003
			(0.002)			(0.005)
$Investment_{(t-1)}$	0.012**	0.016**	0.016*	0.007	0.008	0.012
	(0.006)	(0.007)	(0.008)	(0.018)	(0.014)	(0.025)
$Openness_{(t-1)}$	-0.003	-0.004	-0.003	0.012	0.015	0.014
	(0.003)	(0.003)	(0.003)	(0.018)	(0.019)	(0.021)
$Population_{(t-1)}$	-0.051***	-0.056***	-0.041**	-0.043	-0.068**	-0.048
	(0.012)	(0.012)	(0.016)	(0.039)	(0.033)	(0.046)
Constant	-0.080*	-0.112**	-0.117**	-0.038	-0.097	-0.097
	(0.046)	(0.056)	(0.058)	(0.137)	(0.107)	(0.149)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	422	422	362	233	233	201
AR1 [*p*-value]	0.00	0.00	0.00	0.05	0.02	0.10
AR2 [*p*-value]	0.94	0.97	0.25	0.61	0.96	0.83
Hansen J[*p*-value]	0.91	0.99	1.00	1.00	1.00	1.00

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. Low-volatility countries consist of 61 countries and high-volatility countries consist of 39 countries. Significant time dummies are included in every regression.

2.6 Robustness Test

2.6.1 Additional Variables

We introduce additional control variables to the baseline model as a sensitivity test. Here, we include variables that have been identified as important determinants of growth in the empirical growth literature. Specifically, we follow Levine and Renelt (1992), and Barro (2000) among others in selecting the additional variables. Among the variables, we choose private credit (as a percentage of GDP) to proxy for financial development and life expectancy to control for overall health in the sample. We also include the number of telephone lines per 1000 people as a proxy for infrastructure and government consumption share of GDP to "measure a set of public outlays that do not directly enhance an economy's productivity" (Barro, 2000:12). To control for institutions variables, we include democracy, political rights and civil liberty indices. These variables are regressed separately, together with the control variables in the baseline model. The regression results are reported in Table 2.6[18].

In general, the inclusion of additional control variables does not change the significance of the interaction term except for column 2 and 4. We note that the interaction term is now statistically significant with a range between 0.002 and 0.003 percentage points when we add infrastructure and democracy into the regression. The coefficient on volatility is consistently negative and highly significant and its contribution is always smaller than education which is contrary to the baseline model. Education is always positive and highly significant indicating

[18] For this robustness test, we only report the results for Model 3 (the regression with the full set of variables) for brevity.

the positive effect of education on growth. The fixed control variables behave as the baseline model, where investment in physical capital and openness to trade are rarely significant compared to population growth. Initial income is only affected in the first regression (column 1), where the significance level is lower compared to other regression.

Only three from the seven standard determinants of growth meet our prior expectations. Private credit is positive as expected and in line with Beck *et al*. (2000) and Kharroubi (2007). Infrastructure appears to be insignificant, which concurs to Calderon and Serven (2004). Life expectancy is relatively high and significant and we find that democracy is significant, confirming the prediction from the institution literature (for example, Persson and Tabellini, 2006). Government share enters with the positive sign and the other two institutions variables (political rights and civil liberties) are insignificant. In general, the main variables of interest, education, volatility and the interaction term interaction are not affected if we control for additional determinants of growth.

Table 2.6: Panel Evidence for Education and Volatility: Additional Variable [System GMM]

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	(+) Finance	(+) Infrastructure	(+) Government	(+) Democracy	(+)Political Right	(+)Civil Liberty	(+) Life
Initial $GDP_{(t-1)}$	-0.011*	-0.024***	-0.016***	-0.013***	-0.016***	-0.017***	-0.025***
	(0.007)	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)
$Education_{(t-1)}$	0.019	0.019**	0.026**	0.027***	0.027***	0.026***	0.015
	(0.011)	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)	(0.011)
$Volatility_{(t-1)}$	-0.015***	-0.015***	-0.017***	-0.013***	-0.016***	-0.017***	-0.013***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
$Educ*Vol_{(t-1)}$	0.002	0.002*	0.003	0.003*	0.003	0.003	0.003***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
$Investment_{(t-1)}$	0.017	0.011	0.014	0.019	0.014	0.014	0.004
	(0.013)	(0.012)	(0.011)	(0.013)	(0.009)	(0.009)	(0.009)
$Openness_{(t-1)}$	-0.003	-0.001	-0.001	-0.004	-0.001	0.000	0.002
	(0.006)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)
$Population_{(t-1)}$	-0.076**	-0.057*	-0.054*	-0.035**	-0.053*	-0.054*	-0.059*
	(0.031)	(0.033)	(0.031)	(0.017)	(0.030)	(0.029)	(0.030)
$Finance_{(t-1)}$	0.003*						
	(0.003)						
$Telephone_{(t-1)}$		0.006					
		(0.006)					
$Government_{(t-1)}$			0.005				
			(0.004)				
$Democracy_{(t-1)}$				0.002*			
				(0.001)			
$Pol.Right_{(t-1)}$					-0.000		
					(0.001)		
$Civ.Lib_{(t-1)}$						-0.000	
						(0.002)	
$Life_{(t-1)}$							0.104**
							(0.040)
Constant	-0.210*	-0.045	-0.130	-0.078	-0.112	-0.114	-0.434**
	(0.117)	(0.145)	(0.094)	(0.060)	(0.085)	(0.086)	(0.182)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	436	552	563	521	557	557	563
AR1 [*p*-value]	0.06	0.05	0.04	0.00	0.04	0.04	0.03
AR2 [*p*-value]	0.75	0.81	0.70	0.27	0.76	0.75	0.83
Hansen[*p*-value]	0.95	0.64	0.69	0.78	0.78	0.64	0.76

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. Pol.Right is the political rights index and Civ.Lib is the Civil liberty index.The number of countries included in the regression is 100 developing countries. Significant time dummies are included in every regression.

2.6.2 Alternative Schooling Sample and Proxies for Volatility

It might be relevant to evaluate the sensitivity effect of education and volatility of growth by using alternative measures of volatility or alternative measures of education. Castello and Domenech (2002) argue that the labor force in developing countries consists of young persons. Therefore, we investigate the robustness of our results based on the sample of individuals aged 15 years and above. In this section, we only report the results for Model 2 and 3. Column 1 and 2 of Table 2.7 display the regression results of the above-mentioned sample. The average years of schooling for the population aged 15 years and above is positively associated with income growth, but the effect is insignificant with the inclusion of the interaction term. The interaction term is still insignificant. The results are similar to the baseline model suggesting the indifference between the samples of the individuals considered in the study.

We also test the baseline model using alternative measures of volatility, namely inflation volatility. Judson and Orphanides (1999) have studied the detrimental effect of inflation volatility. The results contradict an earlier study by Levine and Zervos (1993). While the latter study finds that both the level and volatility of inflation are not robustly correlated to growth, the former concludes that the relationships are robustly negative for high inflation countries. The coefficients are expected to be different; however, the sign and significance should be similar to the results of output volatility. As shown in columns 3 and 4 of Table 2.7, education and inflation volatility are both insignificant. The estimates on inflation volatility are very small and insignificant which contradicts the findings of Judson and Orphanides (1999). The interaction term enters positively insignificant with a minimal impact on growth. This shows

that, both inflation volatility and the interaction term do not have any significant effect on growth.

Vandewege and Heylen (2005) study the effect of volatility on human capital formation by extending Checci and Garcia-Penalosa (2004). Their study concludes that, when using time-varying volatility measure, the effect of volatility on human capital changes from negative to positive. In this analysis, we an alternative volatility measure following Ramey and Ramey (1995) which is calculated as standard deviations of the residuals and examine if the interaction term changes sign or significance. The results in columns 5 and 6 in Table 2.7 are the estimated coefficients and associated standard errors for the above analysis. We observe that the effect of volatility is negative and significant as predicted by Ramey and Ramey (1995), and the interaction term is still insignificant. This proves that either measure of volatility has the same effect on growth. Other variables enter as in the baseline model and the analysis passes the relevant autocorrelation and instruments test.

In addition to the above regressions, we conduct another set of regression using an alternative definition of growth to calculate volatility, which is the standard definition[19]. This exercise replicates Chaterjee and Syukayev (2005) who claims that the relationship between volatility and average growth is not robust and depends on the definition of growth. It appears however, our finding is in contrast with the study. Based on the results from column 7 and 8 in Table 2.7, we find similar results as the log difference of growth, for both volatility and the interaction term. This suggests that the relationships in our sample countries are robust to the

[19] Growth is calculated as : $\frac{y_t - y_{t-1}}{y_{t-1}}$ instead of Log($\frac{y_t}{y_{t-1}}$).

inclusion of a set of control variables and alternative definitions of growth. Overall, the sign of the interaction term holds when we change the education variable and the definition of volatility. Additionally, although insignificant, inflation volatility and the interaction term have the expected signs as the baseline model.

Table 2.7: Panel Evidence for Education and Volatility: Alternative Proxies [System GMM]

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	15 Years and Above		Inflation	Volatility	SD of Residuals		Standard Definition	
$Education_{(t-1)}$	0.007**	0.012	0.008	0.008	0.005	0.012**	0.009*	-0.008
	(0.003)	(0.008)	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)	(0.007)
$Volatility_{(t-1)}$	-0.011***	-0.011***	0.000	-0.000	-0.011***	-0.010**	-0.003**	-0.006***
	(0.004)	(0.003)	(0.000)	(0.000)	(0.004)	(0.004)	(0.002)	(0.002)
$Educ_{(t-1)}*Vol_{(t-1)}$		0.002		0.000		0.001		0.001***
		(0.002)		(0.000)		(0.002)		(0.000)
Initial $GDP_{(t-1)}$	-0.010**	-0.012***	-0.009*	-0.010**	-0.011*	-0.011***	-0.017***	-0.016***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.004)	(0.006)	(0.006)
$Investment_{(t-1)}$	0.016**	0.017***	0.011	0.011	0.012	0.006	0.017	0.018**
	(0.007)	(0.006)	(0.008)	(0.008)	(0.011)	(0.007)	(0.010)	(0.009)
$Openness_{(t-1)}$	-0.001	-0.001	-0.002	-0.002	0.000	0.001	-0.000	-0.002
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.004)	(0.004)
$Population_{(t-1)}$	-0.059**	-0.057*	-0.051***	-0.052***	-0.057	-0.050*	-0.047*	-0.038
	(0.029)	(0.030)	(0.016)	(0.016)	(0.037)	(0.029)	(0.027)	(0.031)
Constant	-0.138	-0.131	-0.076	-0.074	-0.076	-0.048	-0.010	0.026
	(0.088)	(0.081)	(0.055)	(0.053)	(0.085)	(0.077)	(0.077)	(0.094)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	655	655	579	579	655	563	655	655
AR1 [*p*-value]	0.01	0.01	0.00	0.00	0.01	0.05	0.01	0.01
AR2 [*p*-value]	0.68	0.72	0.64	0.74	-0.14	-0.13	0.64	0.56
Hansen[*p*-value]	0.36	0.83	0.27	0.28	0.89	0.89	0.44	0.46

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is the log difference of GDP per capita. Educ*Vol is the interaction term between education and volatility. The number of countries included in the regression is 100 developing countries. Significant time dummies are included in every regression.

2.7 Marginal Effects of Volatility Conditional on Education

To analyze the effect of volatility on economic growth conditional on education, the chapter calculates the marginal effects of volatility on growth at the minimum, mean and maximum level of education. This is done to show that the importance of education in mitigating the damaging effect of volatility on economic growth. The results for the derivatives of volatility are reported in Table 2.8. Panel A of Table 2.8 is the marginal effects of the different methods for the baseline model. We can see that for each method, the negative effect of volatility becomes smaller with higher years of education. For example, for the pooled OLS, at the minimum years of education (-1.609), volatility is expected to decrease growth by 0.012 percent but the effect is reduced to 0.007 at the mean years of education (1.313). However, the effect is insignificant at the maximum for all methods but system GMM. For system GMM, the negative effect of volatility is reduced from 0.021 to 0.011 from the minimum to maximum years of education for the sample countries.

The above result is considered an important contribution of this chapter. Volatility alone is harmful for growth and education is not always positive and significant, but education is proven to mitigate the harmful effect of volatility on growth. Theory provides the intuition behind our significant marginal effects. Volatility induces a precautionary investment in education. A corresponding interpretation is that during recessions, individuals invest more in human capital than in physical capital accumulation to improve their employment prospects. This is because, education is more effective guard in bad times; educated people are more likely to be hired during recessions compared to low and unskilled workers.

Panel B is the derivatives of volatility for the different levels of education, income and volatility as well as alternative proxies for education and volatility. In this table, we only focus on system GMM as discussed in earlier sections. For level of education, it seems that the mitigating effect is stronger for higher education. In other words, the longer years spent on higher education, the less negative effect of volatility on growth. We observe a similar result for different levels of income; i.e dividing the sample does not change the main result. On the other hand, when we compare the low and high volatility countries, the results differ significantly. With more education, the low volatility countries have the ability to reduce the damaging effect of volatility on growth. However, higher years of education do not significantly affect the level of volatility for the high volatility subset.

Turning to the alternative proxies results, we observe significant marginal effects when we change the population sample to 15 years and above and alternative definition of volatility (standard definition). Inflation volatility is insignificant throughout while the derivative of the standard deviations of the residual is negative and significant only at the minimum level. This implies that this measure of volatility effects growth negatively but the effect does not vary with years of schooling. To conclude this section, we find support for our hypothesis; although the interaction effect is insignificant, the overall effect (calculated from the derivatives) shows that education has a mitigating effect on volatility. The findings are true regardless of level of education and income, only significant in low volatility countries. A possible explanation is that as countries are more developed, they have the institutions quality necessary to make them resilient to the effects of volatility. The result is also consistent with the fact that if volatile countries are very low-income countries, more education will help to enhance economic growth.

Table 2.8: Marginal Effects of Volatility on Economic Growth Conditional on Education

Panel A: Baseline Model

	Evaluated at		
Specification	Minimum	Mean	Maximum
Pooled OLS	-0.012**	-0.007**	-0.006
	(0.004)	(0.003)	(0.004)
Random Effects	-0.014***	-0.006**	-0.004
	(0.004)	(0.003)	(0.003)
Fixed Effects	-0.012***	-0.001	0.003
	(0.004)	(0.004)	(0.005)
2SLS	-0.093*	-0.014**	-0.017
	(0.048)	(0.006)	(0.018)
System GMM	-0.021***	-0.013***	-0.011**
	(0.005)	(0.004)	(0.005)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Panel B: System GMM Estimations

		Evaluated at		
Specification		Minimum	Mean	Maximum
Level of Education				
i)	Low	-0.043**	-0.012***	-0.0002
		(0.018)	(0.003)	(-0.005)
ii)	High	-0.020**	-0.017***	-0.013*
		(0.010)	(0.004)	(0.008)
Level of Income				
i)	Low	-0.016**	-0.009*	-0.006
		(0.006)	(0.005)	(0.007)
ii)	High	-0.013**	-0.009*	-0.008
		(0.006)	(0.005)	(0.006)
Level of Volatility				
i)	Low	-0.009*	-0.007**	-0.007
		(0.005)	(0.004)	(0.005)
ii)	High	-0.013	-0.005	-0.002
		(0.014)	(0.013)	(0.017)
Alternative Proxies				
i)	15 Years and Above	-0.013***	-0.009***	-0.007
		(0.004)	(0.004)	(0.004)
ii)	Inflation	-7.55e-06	-3.58e-06	-2.04e-06
		(0.000012)	(6.51e-06)	(4.49e-06)
iii)	Residuals	-0.011***	-0.009	-0.008
		(0.004)	(0.006)	(0.008)
iv)	Standard Definition	-0.008***	-0.005***	-0.004***
		(0.002)	(0.001)	(0.001)

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2.8 Summary and Concluding Remarks

In this chapter, we contribute to the literature on volatility, education and growth in two ways. First, using a panel data of 100 developing countries over the period 1970-2009 and adopting a dynamic system GMM estimator, we support the existence of a positive effect of education and detrimental effect of volatility on growth from the existing literature. Secondly, this chapter empirically shows the role of one of the fundamentals (i.e. education) in understanding the growth-volatility link. We find education as a channel to alleviate the adverse effect of volatility on growth. This complements the predictions of the stochastic growth models that examine the impact of volatility on human capital and economic growth. In our case, education also serves to dilute and eradicate the negative impact of volatility.

When we analyze the impact of different levels of education, it appears that the overall effect is stronger with higher level of education than with lower level when interacted with volatility. This proves that, volatility is reduced when people focus more time on higher education. Robustness checks on our work reveal that the extenuating effect of education does not depend on a country's level of income, but is only significant for low volatility countries. Adding further control variables does not change our results. In addition, the results hold when we substitute volatility with alternative proxies.

Our work sheds an important empirical insight on the robustness of the volatility-growth and the mechanism through which volatility impacts on growth. The possible explanation of the positive interaction term is that education promotes productivity, innovation and facilitates entrepreneurship when in turn lead to growth. The result points to the fact that

the link between growth and volatility is attributed to public economics issues such as education. Our work provides evidence that growth rates of economies and incidence of growth volatility are inherently linked with endogenously determined structural variables such as human capital accumulation and further similar analysis needs to be encouraged for better understanding of one of the most important macroeconomics – the growth-volatility relationship.

From a policy perspective, our findings suggest the need for countries to invest in education today to diffuse the detrimental effect of volatility on growth in the future instead of engaging in austerity measures which often include public expenditure cuts across the board including funding for education . Therefore, policy makers should be careful to distinguish between 'productive' spending (e.g. education) and 'unproductive' spending during fluctuations in the business cycle. In a dynamic setting, theoretical work shows that if agents engage in human capital accumulation, there is high growth/welfare equilibrium and a possibility of reducing the incidence of volatility (Palivos and Varvarigos, 2013). Thus, our empirical findings indicate the payoff that may be associated with the promotion of individuals' educational investments and social policies (e.g. education expansion by policy makers) on the growth-volatility relationship.

Appendix A

Table A.1: Sample Countries

Africa and Middle East [20]	Asia and Europe [21]	Latin America
Algeria	Afghanistan	Argentina
Belize	Albania	Barbados
Benin	Armenia	Bolivia
Botswana	Bangladesh	Brazil
Burundi	Bulgaria	Chile
Cameroon	Cambodia	Colombia
Central African Republic	China	Costa Rica
Congo	Fiji	Cuba
Cote d'Ivoire	Hungary	Dominican Republic
Egypt	India	Ecuador
Gabon	Indonesia	El Salvador
Gambia	Kazakhstan	Guatemala
Ghana	Kyrgyzstan	Guyana
Iran	Lao PDR	Haiti
Iraq	Latvia	Honduras
Jordan	Lithuania	Jamaica
Kenya	Malaysia	Mali
Lesotho	Maldives	Mexico
Liberia	Malta	Nicaragua
Malawi	Moldova	Panama
Mauritania	Mongolia	Paraguay
Mauritius	Nepal	Peru
Morocco	Pakistan	Trinidad and Tobago
Mozambique	Papua New Guinea	Uruguay
Namibia	Philippines	Venezuela
Niger	Poland	
Nigeria	Romania	
Rwanda	Russia	
Senegal	Sri Lanka	
Sierra Leone	Tajikistan	
South Africa	Thailand	
Sudan	Tonga	
Swaziland	Turkey	
Syria	Ukraine	
Tanzania	Vietnam	
Togo		
Tunisia		
Uganda		
Zambia		
Zimbabwe		

[20] This column combines countries from sub-Saharan Africa and Middle East and North Africa regions.
[21] This column combines countries from East Asia and Pacific and Europe and Central Asia regions.

Table A.2: Descriptive Statistics[22]

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Growth	764	0.02	0.04	-0.43	0.19	Penn World Table,6.3
Initial Income	756	7.82	0.99	5.06	10.07	Penn World Table,6.3
Years of Schooling	800	1.34	0.76	-1.61	2.45	Barro and Lee(2010)
Years of Primary	800	0.97	0.71	-1.83	2.07	Barro and Lee(2010)
Years of Secondary	800	-0.12	1.05	-3.51	1.78	Barro and Lee(2010)
Years of Tertiary	789	-2.32	1.20	-4.96	0.40	Barro and Lee(2010)
Output Volatility	757	-3.31	0.80	-6.21	-0.59	Penn World Table,6.3
Investment (Share of GDP)	763	2.97	0.53	0.67	4.31	Penn World Table,6.3
Openness(% of GDP)	764	4.07	0.64	1.98	5.64	Penn World Table,6.3
Population Growth	800	0.02	0.01	-0.04	0.07	WDI,World Bank(2010)
Additional Variables						
Years of Schooling (15 years above)	800	1.50	0.65	-1.24	2.44	Barro and Lee(2010)
Residuals	757	4.77	4.14	0.15	40.91	Penn World Table,6.3
Volatility(Standard Definition)	800	6.48	3.37	2.04	21.96	Penn World Table,6.3
Inflation Volatility	714	53.83	360.84	0.30	774.80	WDI,World Bank(2010)
Private Credit(% of GDP)	688	3.01	0.80	0.06	5.01	Beck and Demiguc Kunt(2009)
Telephone Mainline(per 1000 people)	764	0.71	1.67	-3.50	4.02	WDI,World Bank(2010)
Government Share(% of GDP)	764	2.23	0.54	-0.18	3.69	WDI,World Bank(2010)
Life Expectancy	800	4.10	0.18	3.36	4.37	WDI,World Bank(2010)
Democracy Index	707	3.52	3.62	0	10	Polity-IV Project (2009)
Political Rights Index	757	4.32	1.93	1	7	Freedom House(2009)
Civil Liberties Index	757	4.26	1.59	1	7	Freedom House(2009)

[22] All variables are expressed in logarithm except for volatility measures and institutions variables.

Table A.3: Correlation Matrix

Panel A: Baseline Model

	Growth	Initial Income	Total Schooling	Primary	Tertiary	Volatility	Investment	Openness	Population
Growth	1.00								
Initial Income	0.07	1.00							
Total Schooling	0.15	0.55	1.00						
Primary	0.15	0.52	0.97	1.00					
Tertiary	0.11	0.58	0.72	0.62	1.00				
Volatility	-0.20	-0.14	-0.20	-0.21	-0.17	1.00			
Investment	0.23	0.24	0.17	0.18	0.12	-0.08	1.00		
Openness	0.12	0.21	0.21	0.17	0.13	0.05	0.39	1.00	
Population	0.02	-0.29	-0.42	-0.40	-0.33	0.06	0.03	-0.05	1.00

Panel B: Additional Variables

	Growth	Schooling	Residuals	Inflation	Standard	Finance	Telephone	Government	Life	Democ	Pol.Right	Civil
Growth	1.00											
Schooling*	0.19	1.00										
Residuals	-0.15	-0.14	1.00									
Inflation	-0.03	-0.09	0.01	1.00								
Standard	-0.10	-0.16	0.47	0.01	1.00							
Finance	0.07	0.30	-0.07	-0.04	-0.16	1.00						
Telephone	0.19	0.72	-0.16	-0.08	-0.22	0.38	1.00					
Government	-0.06	-0.29	0.08	0.07	0.22	-0.14	-0.19	1.00				
Life	0.22	0.69	-0.19	-0.10	-0.28	0.37	0.79	-0.17	1.00			
Democ	0.13	0.38	-0.17	0.00	-0.25	0.17	0.46	-0.15	0.33	1.00		
Pol.Right	-0.11	-0.29	0.18	-0.01	0.27	-0.13	-0.40	0.12	-0.30	-0.88	1.00	
Civil	-0.16	-0.32	0.17	0.01	0.26	-0.14	-0.41	0.11	-0.27	-0.81	0.91	1.00

Notes: Schooling* is the average years of schooling for the population 15 years and above; Inflation is inflation volatility; Standard is output volatility calculated from the standard definition of growth; Democ is the democracy index; Pol.Right is the political rights index and Civil is the civil liberties index.

Table A.4: Marginal Effects Plots for System GMM

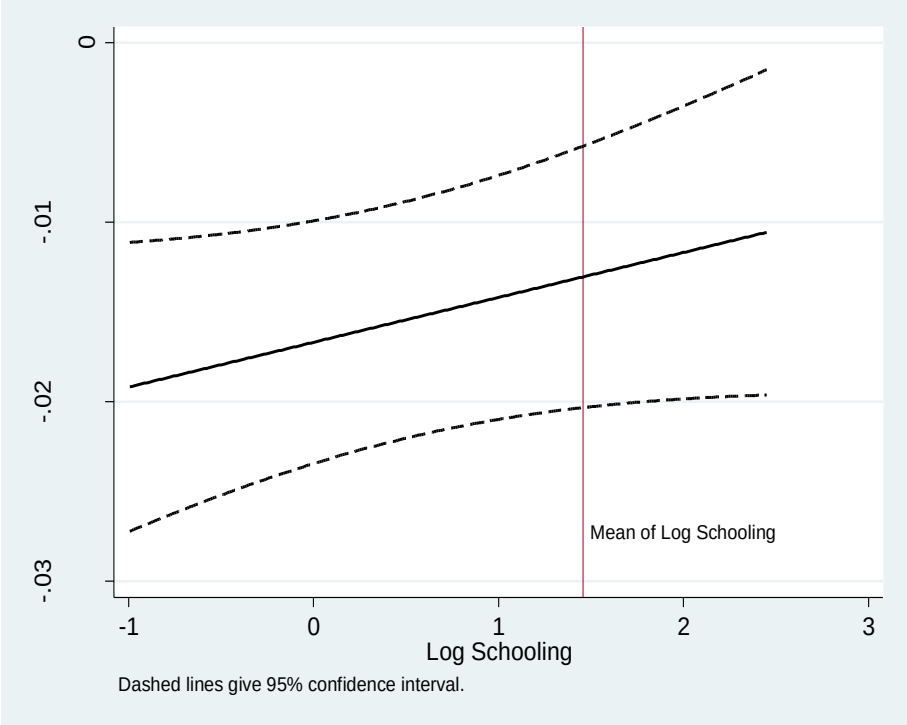


Figure 1: Baseline Model

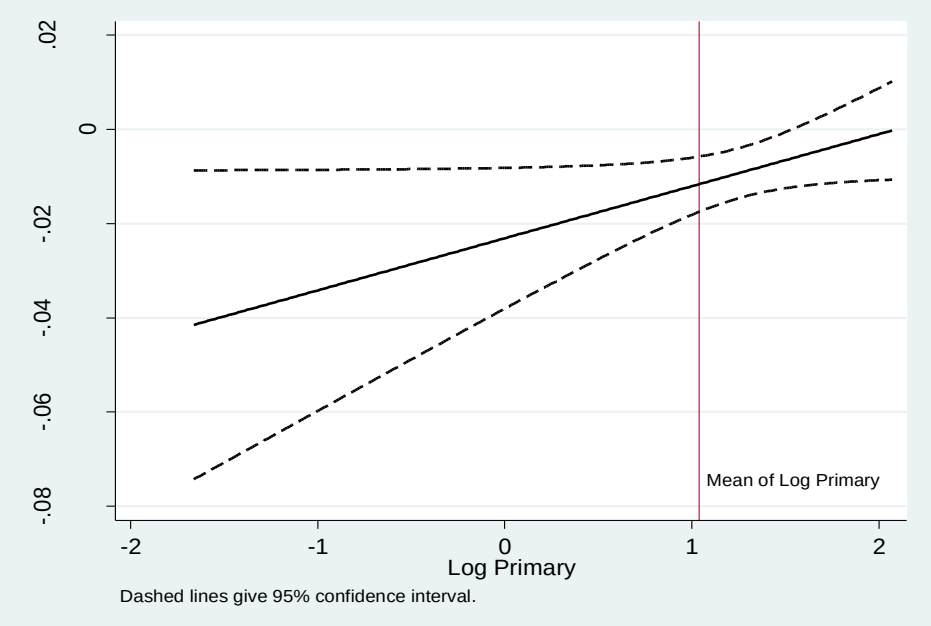


Figure 2: Level of Schooling (Primary)

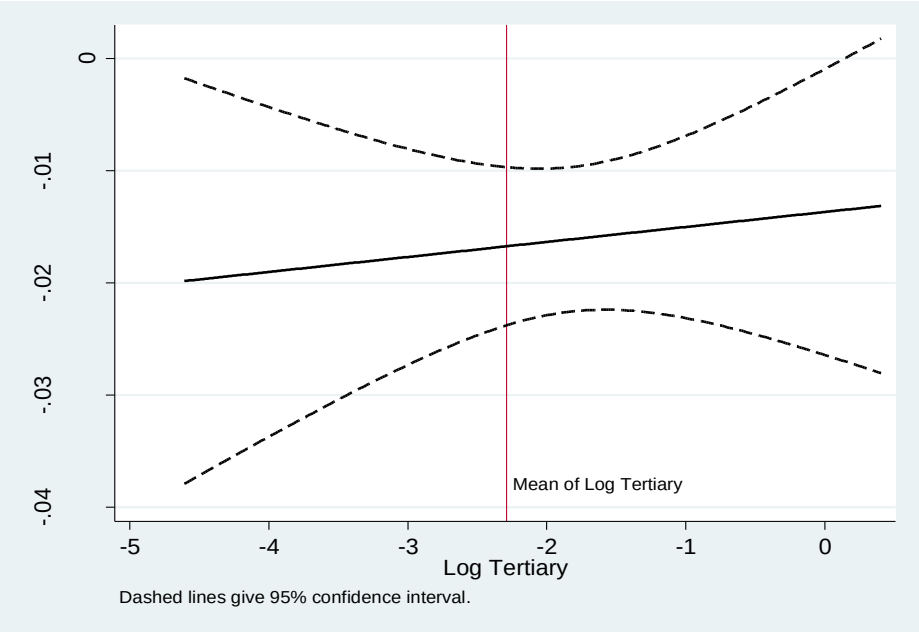


Figure 3: Level of Schooling (Tertiary)

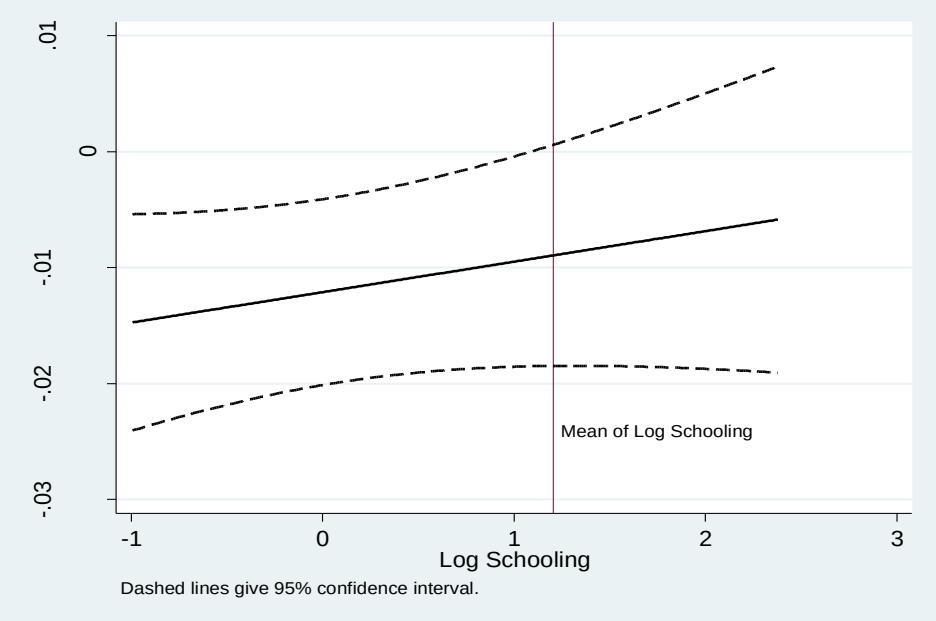


Figure 4: Level of Income (Low)

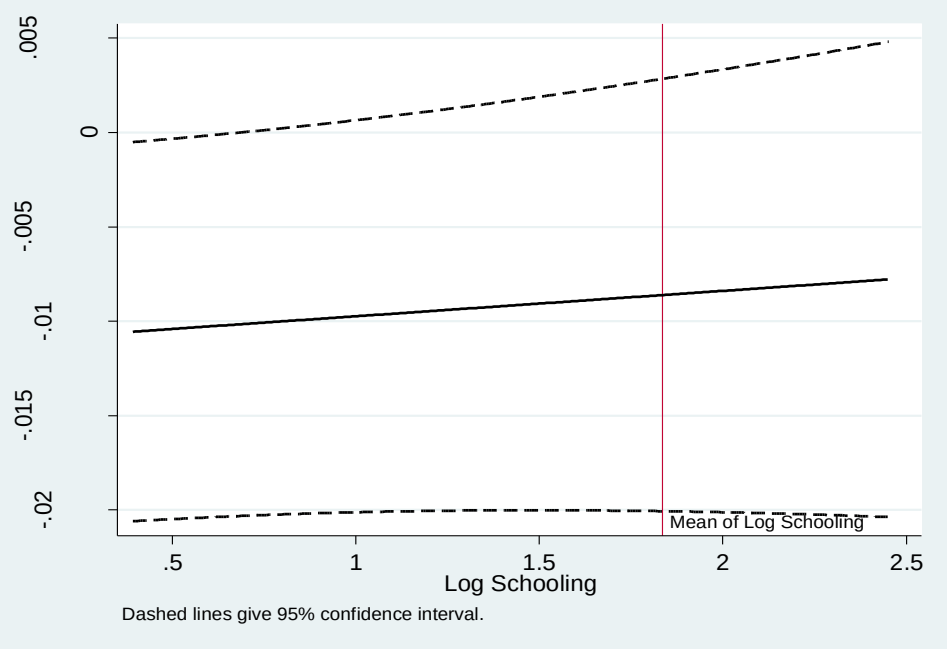


Figure 5: Level of Income (High)

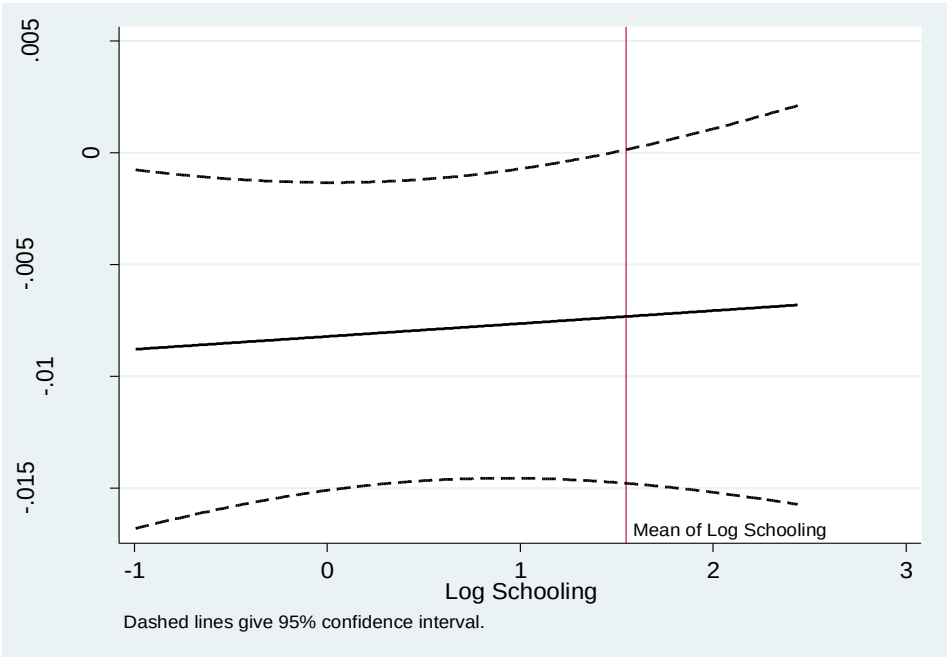


Figure 6: Level of Volatility (Low)

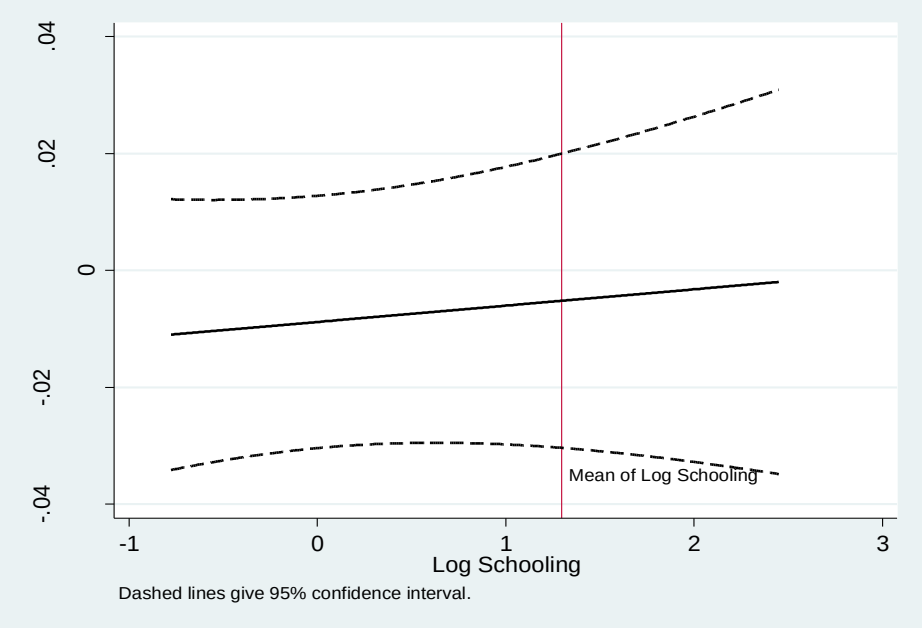


Figure 7: Level of Volatility (High)

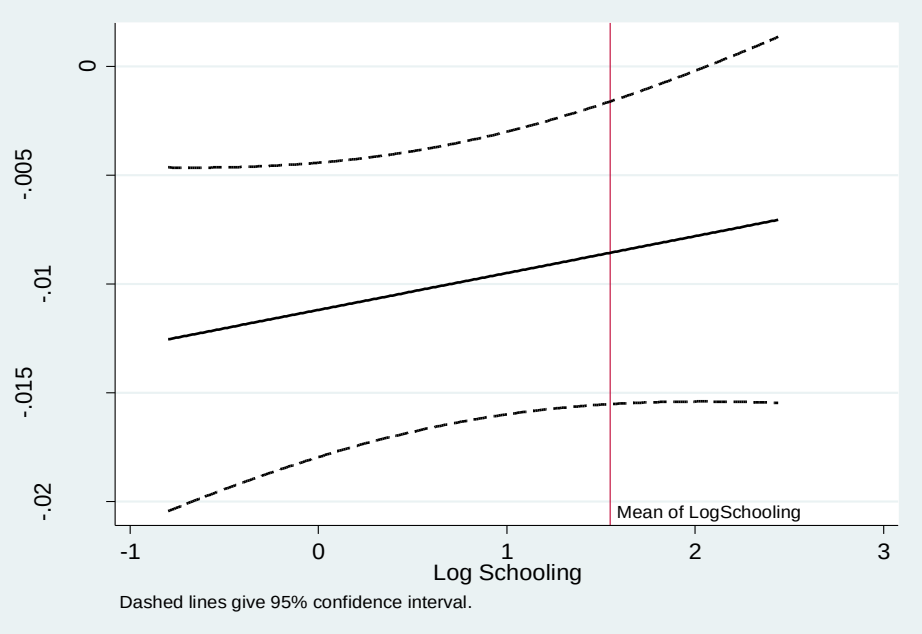


Figure 8: Population Aged 15 Years and Above

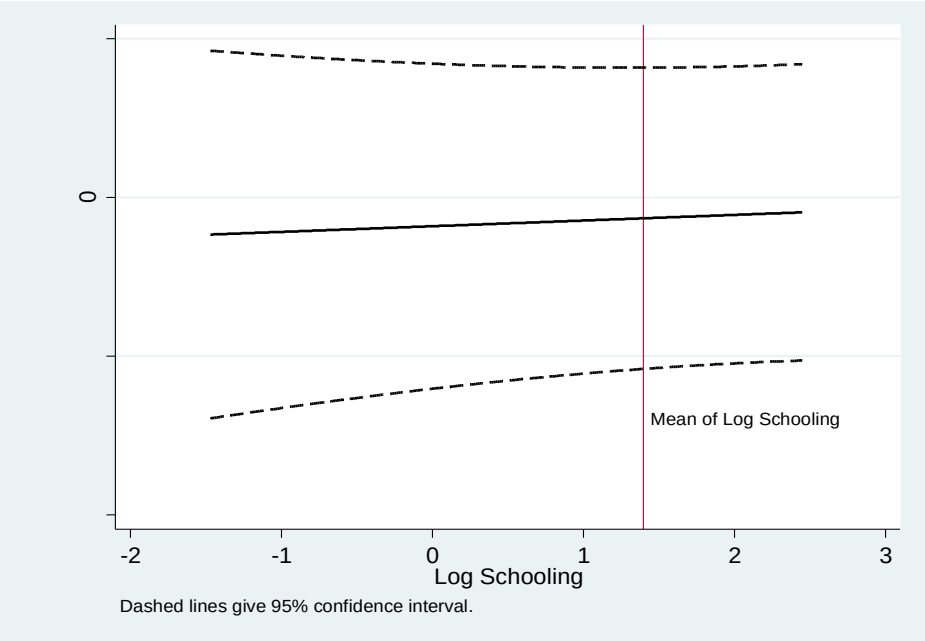


Figure 9: Inflation Volatility

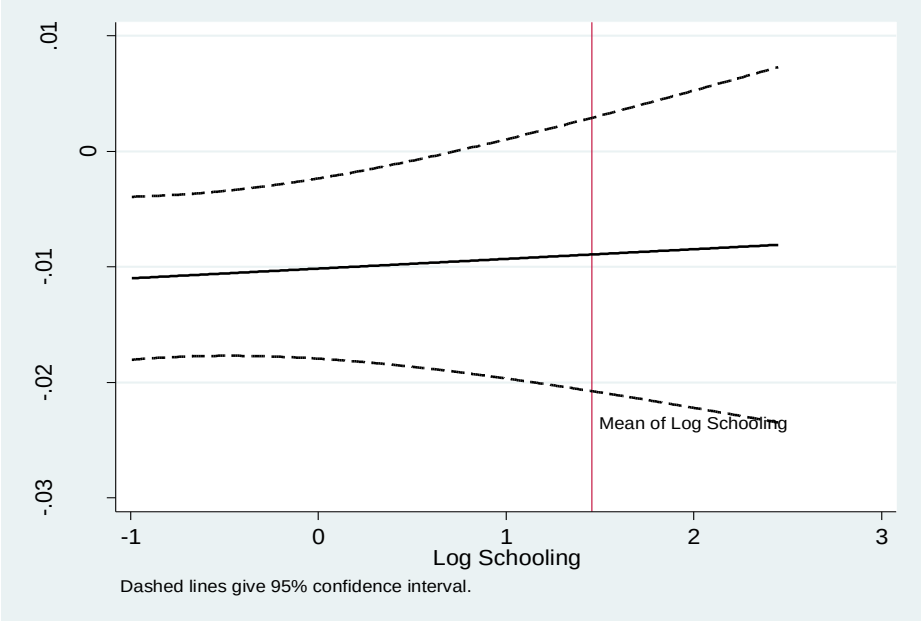


Figure 10: Residuals

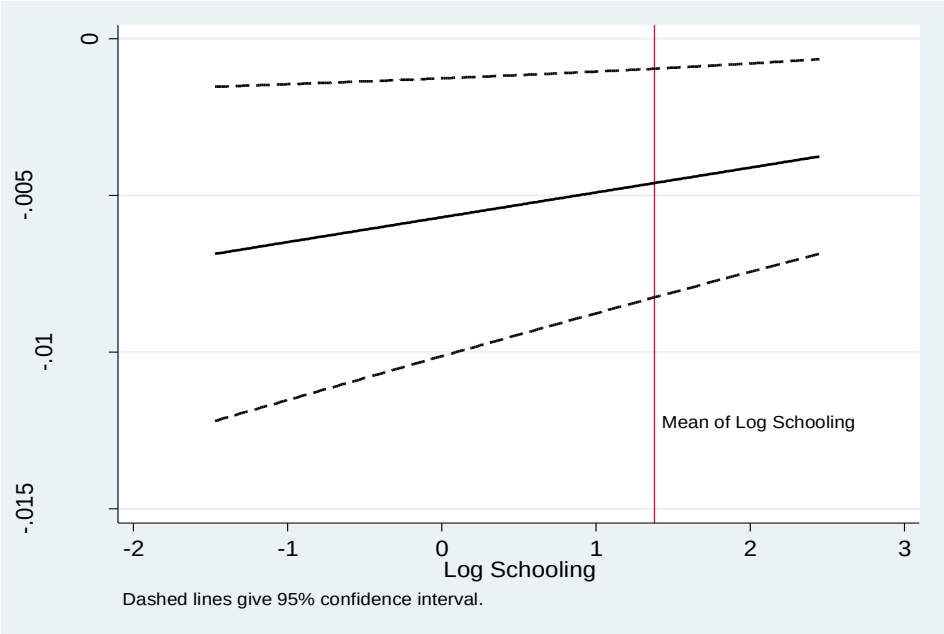


Figure 11: Standard Definition

CHAPTER 3

Does Education Reduce Poverty in Developing Countries?

3.1 Introduction

A huge amount of research studies has indicated the links between economic growth and poverty[23]. Generally, the studies have recognized growth as a dominant instrument in fighting poverty and concluded that growth is correlated with poverty reduction. However, as indicated by Green *et al* (2007), economic growth is insufficient to improve the living conditions of the poor or to be the dominant solution in achieving development. This has led to the search of new mechanisms and strategy to fight poverty. In light of this process, education has been pointed out as a preferred instrument to lift people out of poverty.

Poverty is often linked to low levels of educational achievement and gender gaps particularly in developing countries. Generally, the levels of enrollment correlate with Gross National Product (GNP) - low-income countries tend to have low enrollment rates. Combined with incomplete credit markets and wealth, it is difficult to finance education even when the benefits exceed the costs due to credit constraints (Brown and Park, 2002). Poorly educated parents may value education less and restrict their children's education.

[23] Ravallion and Chen (1997), Ravallion (2001), Dollar and Kraay (2002) and Besley and Burgess (2003) among others.

In addition, at the household level, evidence suggests that children from poor families receive less education since parents are unable to send their children to school as the costs of schooling can be unaffordable for the families with more than one child (Ahmed and Arends-Kuenning, 2006; Wedgewood, 2006). This may force the family to make the choice of removing children from school or to deny education to girls, as they think it is always better for girls to stay at home and help with house chores. Consequently, the lack of basic education would force the future household of the child (who is out from the school or do not attend school) to engage in low-productivity activities such as small-scale agriculture thus resulting in poverty.

The link between education and poverty is a subject that still attracts considerable attention from economists. This relationship has been the basis of the World Bank's political proposals since the late 1990s and has now been the focus of the development process (Tarabini, 2010). Nonetheless, relatively limited empirical research on the role of education on poverty has been carried out compared to the relationship between education and income/inequality distribution. Although related, poverty and income inequality/distribution are two different concepts. Poverty measure depends on the level of income or consumption and focuses on the standard of living for certain individuals and households. On the other hand, inequality concerns the total population and focuses more on distribution[24]. As stated by Edwards (2002):

*"Distribution is a question of how the pie is divided into portions, whereas poverty is a question of whether anybody is receiving a piece that is too small to provide the nourishment that they need" (*Edwards, 2002:17)

[24] See Atkinson (1987) for detailed explanation on the relationship.

Studies involving developed countries tend to focus more on inequality rather than poverty as discussed by Ferreira and Ravallion (2008)[25]. In our opinion, poverty is an important issue to consider especially in the developing countries because poverty measure exhibits greater variations in levels, more apparent changes (i.e. declining pattern) and has more prominent correlation with mean income (Ferreira and Ravallion, 2008). Because cross-sectional analyses or simple correlations may be misleading in the education-poverty context, we resolve to the appropriate econometric methods to minimize the potential endogeneity among the regressors. In this chapter, we employ dynamic panel methods that precisely deal with endogeneity problems (Arellano and Bover, 1995; Blundell and Bond, 1998). We believe that the use of dynamic method provides us with a thorough understanding of this relationship.

This chapter also relates to two other strands of empirical literature. One strand of literature focuses on the growth-poverty link and the other analyzes the education impact on inequality. The former studies the growth-reducing effect on poverty while the latter studies the role of education in the relation between growth and inequality. The core hypothesis of this chapter however is concerned more about the role of education in reducing poverty with the inclusion of both growth and inequality. Although the importance of education is clearly recognized, only a few research empirically examined this relationship. Hence, this chapter takes a distinct approach in assessing the direct effects of education on poverty.

[25] In this paper, they demonstrate the evidence that the poverty line ($1 a day) cannot be calculated for high-income countries. Plotting the poverty headcount index against GDP per capita, they show a clear pattern that poverty incidences decreases with mean income. This relationship, however vanishes when GDP per capita reaches approximately above $15,000 per annum. This may explain why studies on poverty have smaller sample countries that often include low and middle-income countries.

We do not propose to study the complex relationship between education and poverty, rather we aim to test a simple hypothesis that increases or improvement in educational levels would reduce poverty. In other words, our main research question is "How much poverty reduction may be expected from a 1% increase in enrollment." We first observe if education reduces poverty with the hypothesis that countries with higher enrollment will have lower poverty rates. Then, we analyze the impact of different levels of education on poverty reduction. We would like to test if the hypothesis that primary education plays an important role in bringing people out of poverty holds in our sample countries.

Further, we test the hypothesis that the poverty reducing impact of education is based on gender in which we examine the separate effects of education for men and women. The empirical strategy employed in this chapter relies on the estimation of reduced-form poverty equation augmented with education variable as an additional factor that affects poverty. We utilize a large country panel data set and employ generalized method of moments that controls for country specific effect and potential endogeneity[26] among the variables.

Our empirical study is based on a panel data of 72 developing countries in the years 1981-2008. We apply dynamics model to account for unobserved country specific effects and use the lagged values of explanatory variables to control for possible endogeneity. Our results suggest that education has a significant negative impact on poverty. This result is robust to different specifications namely: i) the use of different measures of poverty, ii) the use of different methods, iii) controlling for economic growth and inequality and iv) inclusion of a set of other control variables in the regression.

[26]The endogeneity of the variables is discussed in section 3.6.2.

The empirical analyses yield four important findings. First, we find that education has a consistent effect in reducing poverty even after controlling for economic growth. Secondly, different levels of education have different effects on poverty. Analyzing education by level, we find that higher education has consistent and significant effect in reducing poverty. Basic education, on the other hand, is weakly and positively correlated with poverty reduction and the effect is not robust to different measures of poverty. Third, we find that women's education is more important than men's education in lowering poverty. We also find similar results as above when analyzing the effect of the women's level of education. Lastly, we find that economic growth and inequality have a consistent significant effect on poverty in addition to the negative significant effect of good financial market on poverty.

The outline of the chapter is as follows. Section 3.2 discusses the conceptual issues relating poverty and education. Section 3.3 presents the poverty profile and trend in different regions. We briefly review the related literature on the education, poverty, growth and inequality in section 3.4. In section 3.5, we describe the data while the methodology is described in section 3.6. We present the empirical results in section 3.7 and finally, section 3.8 concludes.

3.2 Conceptual Issues on Poverty and Education

The study of poverty and education is complex because poverty is a multidimensional problem and many of the dimensions are affected by education. Generally, poverty is associated with lack of income. Additionally, we can define poverty as a deprivation in terms of quality of life, political rights or freedom of choice. Poverty is not only a cause for low education levels; it is also a consequence (Tilak, 2002; Knight *et al*., 2009). Poverty prevents access to education,

consequently, lack of education leads to the engagement of low-income activities and results in poverty.

Based on the Human Capital Theory (Schultz, 1963; Becker, 1964) and the human development approach, introduced by the United Nations Development Program (UNDP) and further expanded by Sen (1997), there is a strong relation between educational development and poverty reduction. The human capital approach recognizes education as a basic need as well as an instrument for development directly through the fulfillment of basic needs such as health and nutrition and indirectly through productivity and earnings functions (Tilak, 2002). On the other hand, the human development approach recognizes education as a development that relates to different dimensions of poverty. It also considers lack of education as poverty (Sen, 1997; Tilak, 2002).

In principal, the Human Capital Theory assumes that human capital investment will consequently impart skills and knowledge required to help poor children walk out of poverty. Morrisson (2002) clarifies this point further:

> *"Human capital theory assumes that any expenditure that provides five years of primary education is supposed to result in the acquisition of the same basic reading, write and arithmetic skills. It is also assumed that this stock of knowledge allows individuals to obtain employment at a given wage level, which, might, for instance, be twice that of the jobs available for an illiterate person. These two assumptions lead to a simple, stable relationship between an expenditure in favor of a child from a poor household and the future earning potential which will lift that child above the poverty line"* (Morrisson, 2002:6)

Morrison's explanation suggests how educational expansion policies are favored as an approach to fight poverty from the Human Capital Theory point of view (Bonal, 2007). Furthermore, he states that, greater investment in education will lead to a greater number of poor children escaping the poverty cycle.

3.2.1 The Impact of Education on Poverty

A substantial amount of empirical studies supports the foundation of the Human Capital Theory. Education can affect poverty through various channels; Zuluaga (2007) argues that education has both pecuniary and non-pecuniary benefits on poverty. The pecuniary benefits of education; or the direct effect of education on poverty works through the accumulation of income and wages (Zuluaga, 2007). Educated households are more productive, efficient and better skilled hence more opportunities in the job market. High-skilled jobs warrant a better pay that increases the income level of a household. With education, self-employed individuals are able to utilize the technology and market information for higher productivity and returns. Thus, education leads to higher wages and income level, which implies lower poverty.

Indirectly, education lowers poverty through the satisfaction of basic needs and quality of life (Tilak, 2002; Awan *et al.*, 2011) which is classified as the non-pecuniary benefits (Zuluaga,2007). The most important non-material benefit of education is better health and nutrition. Education significantly benefits personal health and has significant effects on women's fertility and contraceptive behavior (Bledsoe *et al.*, 1999). UNICEF recognized that women who are educated provide better nutrition for their families and ensure that their children are immunized; therefore, more children survive the early years resulting in a

decrease of infant mortality rates. World Bank (2001a) estimates that a year increase of education for 1000 women helps prevent two maternal deaths. Likewise, fertility rates decrease by 10 percent for one additional year of women's education (World Bank, 2001a). In addition to mortality and fertility rates, education can be a powerful tool to protect against HIV/AIDS infection. By giving young women the freedom to learn, they can gain information on how to prevent the disease or how to avoid contracting with it.

Democratic political institutions are more likely to exist in a country with educated individuals. In this aspect, education helps broaden the foundation of a good governance to tackle political and poverty alleviation issues within the society. It gives access to information through mass media and motivates the society to participate in community affair and make the democratic institutions function effectively. All these aspects consequently represent a higher standard and quality of life, which lead to poverty reduction.

3.3 Poverty Profile

Poverty and education are the two main subjects for the 2015 United Nation's Millennium Development Goals. Although the World Bank denotes that the goal of halving poverty by 2015 would be attained at global level, only some countries in East and Southeast Asia have successfully achieved poverty reduction. Although the success is remarkable, Southeast Asia's overall record in growth and poverty reduction has not been consistent. This can be seen through the experiences of countries like Indonesia, the Philippines and East Timor, as well as the transition economies (Cambodia, Lao PDR and Myanmar) where the poverty rate is still high. Countries outside that region, particularly in South Asia and sub-Saharan Africa are far

from reaching the goal because South Asia hosts two-thirds of the world's poor. The experiences of countries that have succeeded in reducing poverty significantly reveal that sustained growth plays an important role in attaining the goal. However, studies on poverty and growth conclude that high growth alone is not sufficient in achieving the goal of poverty reduction. In that regard, the importance of education as the key link between growth and poverty reduction is often pointed out.

Table 3.1 gives estimates for both the percentage and number of people living below the $1.25 a day (at 2005 PPP) for different regions in 1984, 1990, 1996 and 2005. The headcount index, which measure the proportion of people below the poverty line is 69.75% in 1984 corresponds to 2706.43 million people living in poverty. The bulk of the poor in that year is situated in East Asia and Pacific and South Asia and amounts to 80.05% of the total. In 1990, the headcount index for both regions decrease, but the number of poor people increases as the population grows. Sub-Saharan Africa on the other hand, experiences an increase in the percentage between the six-year gaps.

In 2005, East Asia and Pacific manages to reduce the percentage of the poor to half, but South Asia remains with 77.69% and sub-Saharan Africa has 75.33% people living in poverty. In South Asia, the greatest contributor to poverty is India, where 79.23% of the rural population is poor, while 65.52% of the urban population lives in poverty. These numbers reveal that more than half of the population in India lives in poverty. From these figures, it can be concluded that East Asia and Pacific has successfully reached the goal of halving poverty by 2015, but South Asia and sub-Saharan Africa are still far from the 'track' of halving poverty.

Besley and Burgess (2003) find that East Asia stands out in reducing more than half of the poverty rate. According to them, East Asia needs 2.7% of annual growth in halving poverty, but with historical annual growth of 3.3%, the region is the most advanced region in reducing poverty. South Asia needs an annual growth of 3.9% compared to 1.9% of historical growth and sub-Saharan Africa needs 5.6% of annual growth, which is 27 times its historical growth. These findings explain the failure of these two regions in reaching the 2015 Millennium Goal. Consequently, identification of other policy and strategy, which can directly reduce poverty especially in these regions, is important, as growth alone is insufficient. A commonly agreed view is that human capital is central to the growth process and it can contribute directly to poverty reduction or indirectly through the growth channel.

Table 3.1: Poverty Profile

	1984		1990		1996		2005	
Region	Poverty Headcount (%)	Number of poor (m)	Poverty Headcount (%)	Number of poor (m)	Poverty Headcount (%)	Number of poor (m)	Poverty Headcount (%)	Number of poor (m)
East Asia and Pacific	90.39	1307.22	82.36	1314.42	67.5	1166.84	42.25	796.17
Europe and Central Asia	8.02	34.87	8.16	38.01	13.57	64.06	9.94	47.08
Latin America and the Caribbean	30.18	117.69	23.71	103.87	23.95	116.19	18.76	103.26
Middle East and North Africa	26.38	50.15	22.88	51.61	23.68	61.09	20.02	61.11
South Asia	87.21	859.52	85.36	956.11	82.9	1047.35	77.69	1147.02
Sub-Saharan Africa	77.69	336.99	78.14	403.74	79.98	483.81	75.33	574.68
Total	**69.75**	**2706.43**	**65.74**	**2867.75**	**61.08**	**2939.33**	**50.05**	**2729.3**

Source: PovcalNet: the on-line tool for poverty measurement developed by the Development Research Group of the World Bank. http://iresearch.worldbank.org/PovcalNet/

3.4 Related Literature

3.4.1 Poverty and Education

Comparative cross-country studies on poverty and education over time are extremely scarce, and the dearth of empirical studies motivates this chapter. Existing studies have focused on specific countries, mainly South Asian and African countries due to the severity of poverty in these regions. For example, Edwards (2007) study the importance of education in disseminating poverty in Guatemala. This study urges the importance of secondary education in preventing the vicious cycle of poverty. Wedgwood (2006) agrees with the argument; his study reveals that primary education is insufficient to alleviate poverty in Tanzania and proposes increasing the public expenditure on post-basic education. Bigsten *et al*. (2003) conduct a study on growth and poverty in Ethiopia. In contrast to the above studies, this analysis claims that primary education is more important in improving the life of urban population.

A string of empirical literature studies the human capital development and economic growth that leads to the result that better education increase growth. Many existing literature examines the impact of education on either growth or income inequality. Available research on education and poverty dated back since early 1980s (Fields, 1980; Tilak 1989, 1994) clearly shows that education and poverty is negatively correlated. The higher the level of education, the lower proportion of the poor people as education is associated with higher productivity and earnings. In addition to the direct effects of education on poverty, the indirect effect includes the fulfillment of basic necessities, lower fertility and better health (Tilak, 2007).

Dollar and Kraay (2002) find that higher primary educational attainment of the workforce does not increase the income of the poor except for its effect on average income. As with education and economic growth, there is a two-way relationship between education and poverty. Family income has a strong positive association with educational attainment, while "low earnings of the poor result partly from lower human capital endowments and partly from labor market discrimination" (Quibria, 1994).

Erich *et al.* (2004) test the robustness of Dollar and Kraay's findings by using a broader measure of human capital that accounts for international differences in the quality of education. Their findings show that the quality-adjusted education increases the income of the poor and positively affects average income. The result suggests that education should be an essential component in determining policies for poverty reduction. Conversely, this study uses the average income of the poorest quintile as the proxy for poverty. Although quality of education is an important issue to consider in poverty alleviation, reliable data on educational quality is scarce among developing countries. The usual measures of quality that are based on school resources such as pupil-teacher ratio, repetition rates or educational spending are available annually after 1999 for many countries which do not suit our period of study. The data for pre-1999 is only available at five-year gap for some countries and including this variable in our analysis will reduce the number of observations inadequate for dynamic estimations.

A cross-country study by Gomanee *et al*. (2003) examine the effects of government expenditure on $1-a-day poverty line while holding GDP per capita constant over the period 1980 to 1998. Their result indicates that besides agriculture, housing and amenities,

expenditure on education have a positive and significant impact on poverty. The main objective of the study is to test the effect of aid-financed public spending on the welfare of the poor through direct and indirect channels, which includes education. For reasons stated earlier, we do not consider the inclusion of public spending or aid in our analysis; rather we include a measure of financial development to control for credit constraints in our regressions.

A study by Verner and Alda (2004) in searching the underlying causes, problems and risks faced by the poor shows that children from poor households achieve a lower level of education and often drop out of school. They develop a survey instrument that addresses poverty in a broad sense including low attainment of education. Additionally, they find out that parents with little education tend to raise uneducated children. They conclude that the relationship between education and income poverty can be broken by increasing the education of the poor. The lack of education disseminates poverty but poverty restricts access to education.

Brown and Park (2002) analyze the effects of poverty, intra-household decision-making, and school quality on educational investments in six Chinese provinces. In the study, they find that poverty significantly affects educational investments and the lack of available funding restricts enrollment. However, being poor does not affect children's performance in school. This study takes into account the quality aspect of education by making use of the school quality measure available from local primary and junior schools. Recent and similar studies by Knight *et al.* (2009, 2010) analyze the presence of poverty trap in the education-income relationship in rural China. They find evidence that poverty is detrimental for both quantity and quality of education. Low quality discourages quantity of education, which leads to the reduction of income. The results of these studies however are not comparable to the chapter since they are

based on a household survey although in general they conclude that education benefits the poor.

In this study, we take advantage of the newly comparable time series data on poverty and education to assess the direct effects of education on different measures of poverty. We take the commonly used framework in the poverty-inequality-growth literature as a benchmark for our empirical analysis. In the next sub-section, we review some of the related poverty-growth and education-inequality studies.

3.4.2 Poverty, Growth and Inequality

Traditionally, growth has been identified as the main instrument for poverty alleviation around the world. Ravallion and Chen (1997) analyze 67 developing and transition economies over the year 1981-1994. The study claims that growth in average income is negatively correlated with poverty; however, inequality (measured by changes in income distribution) is uncorrelated with poverty. The estimated growth-elasticity is around -3.0 for the $1-a-day poverty line. Ravallion (2001) accounts for some measurement errors in the survey and argues a lower value of growth-elasticity, which is around -2.1.

The influential Dollar and Kraay (2002) study provides evidence to support that growth in income is good for the poor. Their results prove that the incomes of the poor grow proportionately with average incomes, i.e. in their study, the growth-elasticity is equal to one (Dollar and Kraay, 2002). However, they find insignificant effects of other institutional and growth policy variables after controlling for average income. In another study, Kraay (2006)

analyzes the effect of the changes in average income and income inequality on poverty. The findings confirm that higher economic growth is significant in reducing poverty.

Adams (2004) extends Ravallion and Chen (1997) analysis with broader coverage. The findings concur with existing literature where higher growth is associated with lower poverty, but the rate of the reduction depends on the growth measures. It reveals that the effect of economic growth is significant when measured by changes in survey mean income and insignificant when measured by the changes in GDP per capita. The growth-elasticity, which is -2.79, is within the range of earlier estimates (Ravallion and Chen, 1997). In addition, the results also prove that, with more sensitive poverty measure (i.e. poverty gap and squared poverty gap) the poverty reduction rate is faster.

Besley and Burgess (2003) examine the growth-elasticity of poverty by region and reveal significant differences within the sample using an absolute measure of poverty (i.e. poverty headcount at $1-a-day). Confirming the role of growth in reducing poverty, they estimate that the growth-elasticity of the whole sample is -0.73, but register a higher estimate of -1.00 and -1.14 for East Asia and Pacific (EAP) and Eastern Europe and Central Asia (ECA), respectively. In addition, they also argue that higher income inequality is associated with higher poverty.

Other studies have pointed out the importance of income distribution in the growth-poverty relationship. Bourguignon (2003) estimates equations based on the lognormal distribution of income in which he assumes that the growth-poverty relationship depends on initial inequality.

Ravallion (2004) estimates higher growth-elasticity for low inequality countries[27]. Adams (2004) gives support to the study; he finds lower growth-elasticity of poverty in high inequality countries. Fosu (2009) examines how inequality affects the growth-poverty relationship in sub-Saharan Africa (SSA) countries and compares it with non-SSA countries. The results conclude that the impact of growth on poverty reduction exhibits a decreasing function of initial inequality and the poverty reducing effect is smaller in SSA.

3.4.3 Inequality and Education

Some studies analyze the role of education in the relation between growth and income inequality (see for example a survey by Psacharopoulos and Woodhall (1985) for earlier work on education and income inequality). Glomm and Ravikumar (1992) develop an overlapping generation (OLG) model with heterogeneous agents in which formal schooling is the possible transmission of higher growth. The model compares both public and private investment in education and yields three interesting results on educational investments and income inequality. First, public education reduces income inequality faster than private education. Second, if two public education economies differ in income inequality, per capita income in future period is higher in countries with the low level of inequality. Finally, public education yields high per capita income if the income inequality is high.

Sylwester (2000) explores one possible transmission that link the negative relationship between income inequality and growth. He finds that public spending of education as one

[27] Ravallion (2004) argues that one per cent increase in growth is associated with 4.3 per cent poverty reduction in low inequality countries. However, the growth reducing effect is only 0.6 per cent for high inequality countries.

possible transmission. Higher level of income inequality is associated with more spending on education; country with higher income inequality devoted more resources on education as a percentage of GDP. The impact of this phenomenon on future growth is positive because more educated population lead to higher productivity. In another study, Sylwester (2002) empirically examines the effect of educational resources on income inequality. He finds that public education expenditure is associated with the decrease in income inequality and the result is robust to the inclusion of various control variables. His findings are different with earlier research because he measures the association between the change in the level of income inequality and public spending on education.

De Gregorio and Lee (2003) analyze the relationship between education and income distribution. Their paper uses a panel data set, which comprises of internationally comparable human capital and income distribution, for a broad number of countries measured at five-year intervals from 1960 to 1990. The result indicates that higher education and equal distribution of education are important for income equality. In addition, they find that government social expenditure also plays a significant role in the distribution of income. Teulings and van Rens (2002) study education, inequality and growth from both theoretical and empirical perspectives. Income inequality data from a panel of countries is used to estimate the private return while GDP data is used to estimate the social return. The result shows that income inequality falls by 2 percentage points with an increase of one year of education. However, dynamic panel estimation reveals no evidence of the relationship.

Despite the empirical evidence, earlier theoretical studies imply that the relation between education and income inequality is not always clear. For instance, the human capital model of

Schultz (1963), Becker (1964) and Mincer (1974) implies that the level and distribution of schooling across the population determine the distribution of income. The model predicts a positive association between educational inequality and income inequality, even though the effect of increased average schooling on income distribution may be either positive or negative, depending on the evolution of rates of return to education (De Gregorio and Lee, 2003).

3.5 Data Description and Descriptive Statistics

3.5.1 Data and Variables

In this chapter, we are interested in analyzing the effect of human capital flow on poverty. Thus, we use the combined gross enrollment ratio as our main proxy for education. We then analyze the respective impact of basic (primary) and higher education on poverty. In order to examine this, we calculate the combined gross enrollment ratio for both secondary and tertiary education. Data for the educational measures is from Ed-Stats of the World Bank-World Development Indicators (World Bank, 2010). We choose enrollment ratio as our education measure because it is available annually and enable us to calculate the tri-annual averages for running a sensible panel-data regression. In addition, it is closely related to the current policies on schooling and human capital investment as compared to human capital stock (measured by educational attainment of the adult population) (Lopez, 2004).

To assess the impact of education on poverty, we use three different measures of poverty; the headcount index, poverty gap and squared poverty gap which are the poverty indicators of the

generic class of additive indices proposed by Foster *et al.* (1984a, 1984b)[28]. The headcount index or FGT (0) measures the percentage of people living under the poverty line[29]. While it is simple and widely used, the index does not change if people below the line become poorer. The second index, the poverty gap index or FGT (1) captures the depth of poverty and measures the gaps between the poor's living standard from the poverty line. This index provides a better indication of the depth of poverty; however, it does not take into account distribution among the poor. To consider distribution, we use the third index, which is the squared poverty gap or FGT (2). Squared poverty gap measures the severity of poverty and is the average of the square relative poverty gap of the poor. It is a weighted sum of poverty gaps, and the weights are proportionate poverty gaps.

We obtain the poverty and inequality data (Gini coefficient) from the World Bank-World Development Indicators. In addition to this, we replicate the poverty data using PovcalNet [30]. In this data set, Chen and Ravallion (2007) compiled data on measures of poverty and inequality from 675 national representatives' living standard household surveys. The new and updated surveys cover 116 developing countries spanning the period 1981-2008. In each household survey, average income or consumption per capita is converted to the 2005 Purchasing Power Parity (PPP).

[28] The measure of poverty has the form: $P_x = \frac{1}{N}\sum_{i-1}^{q}\left[\frac{(z-y_i)}{z}\right]^x$: z is the chosen poverty line, y_i is the income measure and x is the sensitivity parameter which are equivalent to 0,1 and 2 in our chapter.

[29] The poverty line is set to be $1.25 per day, equivalent to $38 per month.

[30] PovcalNet is an interactive computational tool that allows researchers to replicate the calculations made by World Bank. In addition, we are able to calculate poverty measures using different assumptions (i.e. specific poverty line) by choosing our own set of countries and years.

We acknowledge that the poverty measure is far from perfect, and using another measure such as the income share of the lowest quintile as in Dollar and Kraay (2002) or the newly constructed multidimensional poverty index may be more suitable[31]. However, the availability of the data for the countries and time period chosen impedes our choice of variable; the income share of the lowest quintile presents gaps that made it unsuitable for dynamic method. Introduced recently, the multidimensional index only covers a small group of countries over a limited time span. In addition, the index uses indicators of the most basic dimensions of deprivation, which include the lack of basic education. Thus, using this index will be inappropriate, as it will be highly correlated with the education measure. In this regard, the Povcal data signifies the best available source of information on the proportions of people living below a certain standard of living.

Poverty data is not available in many countries in the sample, so in order to get a balanced panel we compile and include countries with at least one observation. We are able to record the data for 98 countries where there is at least one observation of poverty. However, in order to study the dynamic nature of poverty, we can only include countries with at least four observations for the poverty measure, thus eliminating countries with fewer observations. The number of observations available for the estimations reduces when we merge the education and poverty data.

[31] The Multidimensional index (MPI) replaced the Human Poverty Index (HPI) and complements the money-based measures of poverty by considering multiple deprivations. These deprivations include living standards, health and education, which are the same three dimensions as the Human Development Index (HDI). For more and detailed explanations, see: Alkire and Santos (2010).

As the poverty data is measured approximately every three years, the number of countries that can be included in this chapter is limited to only 72 countries[32]. The study considers only developing countries spanning the years 1981-2008 where both education and poverty data are available. All the variables are expressed in three yearly averages, for example, the value for enrollment ratio that corresponds to the year 1980 is an average of enrollment over 1980-1982 where poverty data corresponds to the year 1981. In addition to the lagged poverty measures and the Gini coefficient, other variables included are; real GDP per capita growth, private credit, telephone lines per 1000 population, corruption and output volatility. Real GDP per capita growth is from Penn World Tables 6.3 (PWT 6.3) and measures the growth rate of income. Gini coefficient is a proxy for income inequality and it measures the degree to which the distribution of income or consumption among individuals or households in a country deviate from a perfectly equal distribution. We expect a negative correlation of growth and poverty. Conversely, we expect a positive relationship between inequality and poverty.

Secured financial system promotes long-term growth, which in turn reduce poverty. Not only that, the availability of credit is crucial in financing education. Relatively poor individuals are credit constrained, thus without the existence of good financial market, they either do not invest or restrict the investment in human capital (Mejia and St-Pierrre, 2008). Dollar and Kraay (2002) find that financial development has a negative impact on inequality. In addition, Honohan (2004) shows that financial development is negatively correlated with poverty headcount and the relationship holds even after controlling for mean income and inequality. In

[32] Among the countries, 9 countries are from East Asia and Pacific (EAP), 11 from Europe and Central Asia (ECA), 18 from Latin America and Caribbean (LAC), 5 from Middle East and North Africa (MENA), 4 from South Asia and finally, 25 from sub-Saharan Africa (SSA).

line with Honohan (2004), we use the ratio of private credit by deposit money bank to GDP to proxy for the financial system and availability of credit. A negative relationship is expected.

We also include a proxy for infrastructure to measure the infrastructure quality of a country. The importance of infrastructure as a key determinant for growth and development has long been discussed in the literature (Kessidess, 2004; Parker *et al*., 2008) but whether infrastructure directly benefits the poor is still a heated issue. Lack of basic infrastructure restricts access to education and can harm future investments and growth. Jalilian and Weiss (2004) find that infrastructure has negative impact on poverty indirectly through growth. Although infrastructure on its own does not have a significant impact on poverty reduction, it interacts with human capital to lower poverty. In this chapter, we choose telecommunications capacity which is the telephone lines (per 1000 people) to capture the availability of basic infrastructure because of the scarcity of the reliable data and evidence on the effectiveness of other physical infrastructure (e.g. access to road, clean water and sanitation).

Additionally, we include the corruption index based on the Political Risk Rating from International Country Risk Guide (ICRG) provided by the PRS Group (2009) to measure institutional and governance quality. The measure ranges from 0 to 6, where 0 represents the lowest level of corruption. Good governance and institutions are expected to have a negative impact on poverty, but a highly corrupted government will contribute more to the poverty level. Gupta *et al.* (2002) have shown that a one standard deviation of rising corruption increases inequality and poverty by 11 points and 5 percentage points respectively.

Macroeconomic instability is considered as one of the factors that lowers growth and most likely to hurt the poor. Behrman *et al*. (2003) find that high inflation and macroeconomic instability decrease the incomes of the poor. On the other hand, Guillamount and Korachais (2008) test a model of poverty change on a panel of data and conclude that income instability lowers poverty reduction for a given growth. In this chapter, we approximate the macroeconomic conditions of a country using the volatility of GDP growth. Volatility is the standard deviations of output growth and may accurately capture the shock that hit the poor in the sample countries. We expect a positive relationship between instability and poverty because, macroeconomic stability is essential to maximize the returns to education (Aoky *et al*., 2002).

All of the aforementioned variables but corruption index and private credit are from World Bank-World Development Indicators. Corruption index is from the International Country Risk Guide (ICRG) and private credit data is from Beck and Demirgüç-Kunt (2009). Details of every variable and data sources are available in Table B.9 in the Appendix. The list of countries in the sample is in Table B.10.

3.5.2 Descriptive Statistics and Trends of Core Variable

Table B.1 and B.2 in the Appendix report the descriptive statistics and correlation matrix between poverty and other explanatory variables used in this study. The summary statistics show a significant variation in the poverty level across countries in the sample. For instance, looking at the poverty headcount, we can see that more than 90% of the population in Guinea

lives with less than one dollar (in PPP, year 1992) whereas only 2% of the population in Kazakhstan lives under the poverty line in 1983. It also shows a large heterogeneity in both poverty gap and squared poverty gap. The minimum of both variables is zeros while the maximum are 63.34 and 48.51 respectively. Regarding inequality, the Gini coefficients range from a low of 14.59 (China, 2004-2006) to a high of 67.4 (South Africa in 2001-2004).

Enrollment on all levels also shows considerable variation with very low levels of higher enrollment (0.30) in Burkina Faso to the highest primary enrollment (220.49)[33] in Brazil. In all regions, enrollment ratios for higher education are increasing over time. This scenario shows that people nowadays realized the importance of higher education and the benefits that come with it. Primary enrollment in EAP, ECA and LAC on the other hand, show a decreasing pattern although the changes are quite small. This could probably due to the declining rates of young populations in the regions.

The correlation matrix shows a quite strong relationship between the explanatory variables and poverty measures. Poverty is negatively correlated with all measures of education and GDP growth. The correlation between poverty and higher education is fairly high compared to basic education. The negative associations between credit and infrastructure with poverty suggest that countries with more developed financial system and improved infrastructure along with highly educated population experience a reduction in poverty. Inequality is positively correlated with poverty as expected, but volatility has the incorrect sign. The negative correlation between corruption and poverty is misleading since it suggests that higher

[33] Gross enrollment ratio can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition (World Bank, 2010).

corruption tend to reduce poverty. While a simple correlation might be misleading, this can be a general overview of the relationship between poverty and education.

Figure 3.1 illustrates the trend of poverty headcount in all six regions (EAP, ECA, LAC, MENA, SA and SSA) between the years 1980-2008. In all regions, we can see that poverty headcount has been decreasing. However, the poverty rate in Sub-Saharan Africa (SSA) and Europe& Central Asia (ECA) has been increasing by the year 1995-1999. The rate has been declining although the changes are small. East Asia &Pacific (EAP) on the other hand, has very rapid decline during the 30-year period. In the 1980-1984, the poverty headcount was 92.52 per cent and it is only 38 per cent during the year 2005-2008. Compared to other regions, the poverty headcount in SSA is higher although it is also declining over time. Figure 3.2 is the trend for poverty gap in those six regions. In general, the trend for poverty gap is similar to poverty headcount for all regions.

Figure 3.1: Poverty Headcount: 1980-2008

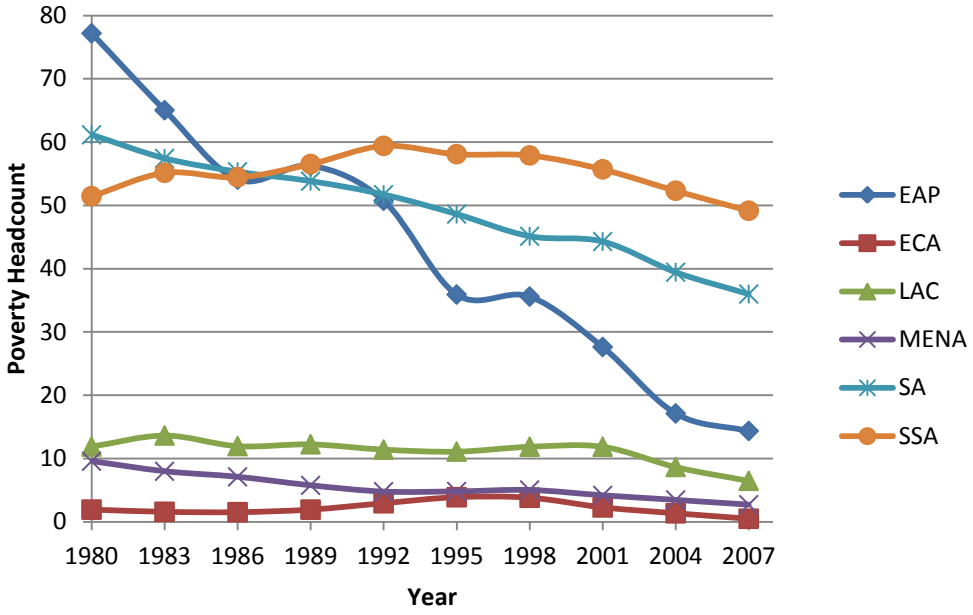


Figure 3.2: Poverty Gap: 1980-2008

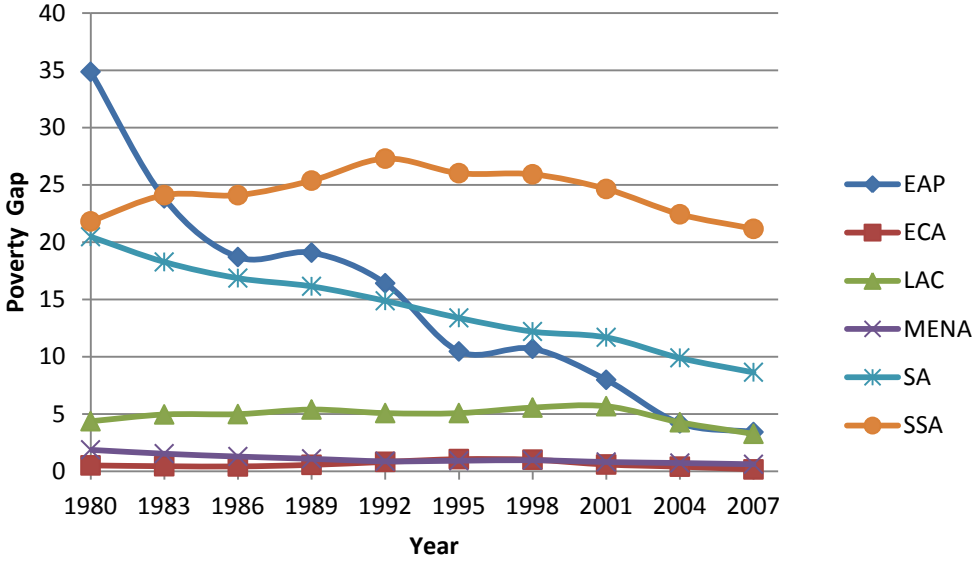
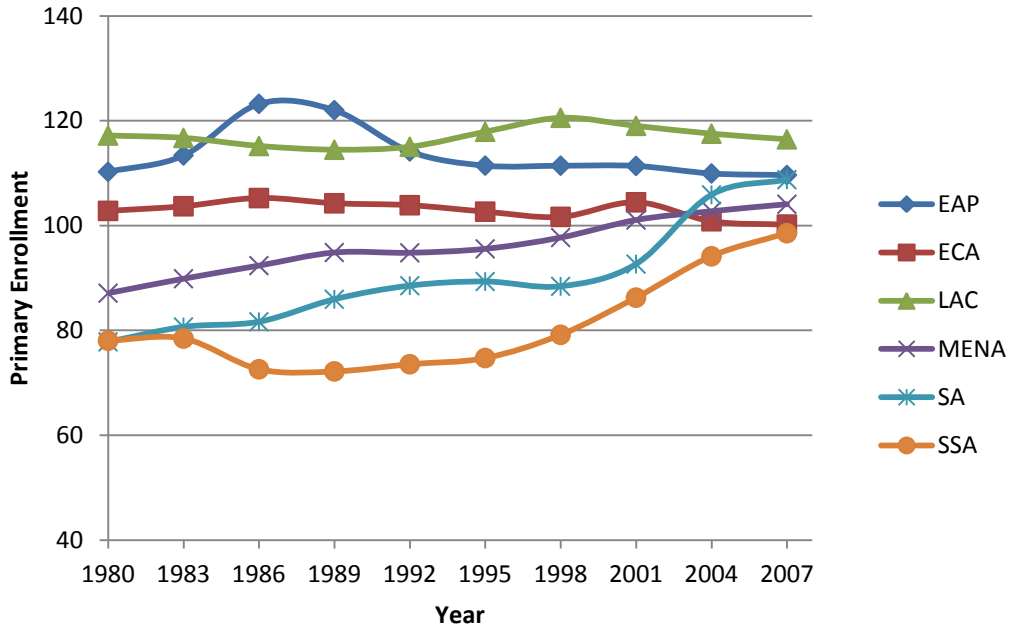


Figure 3.3 is the trend for primary enrollment in these regions. On average, all regions exhibit an increasing pattern and SA and SSA have the highest increase within the years 1980-2008.

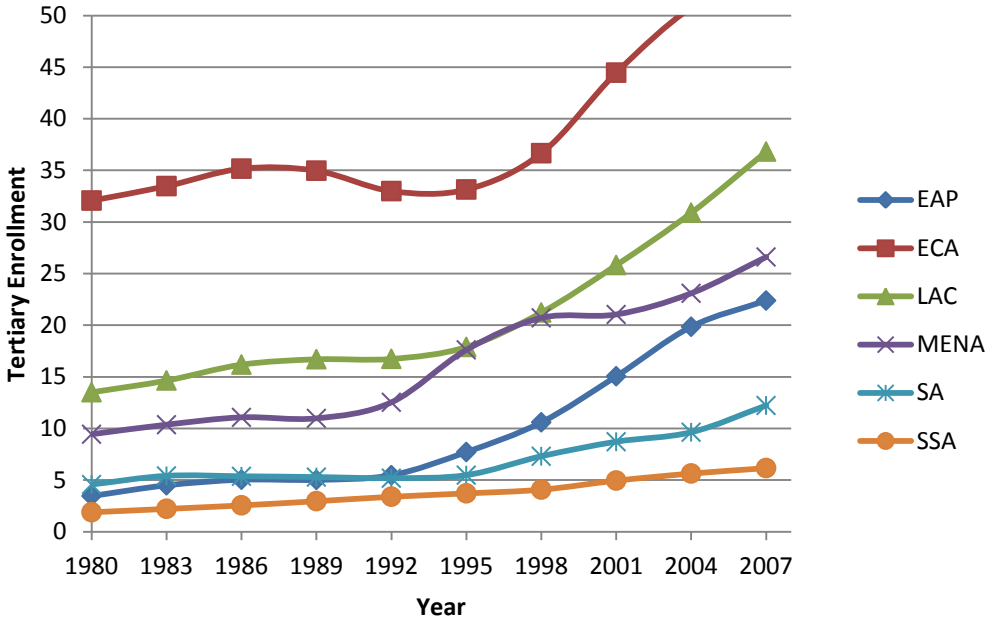
All regions have reached the Universal Primary Education (UPE) goal, which corresponds to 100% gross enrollment rate. However, there are problems such as repeaters and late entrance that makes the percentage of enrollment exceeds 100%.

Figure 3.3:Primary (Basic) Enrollment: 1980-2008



On the other hand, compared to primary enrollment, the percentage of tertiary enrollment is low in all regions. For example, according to Figure 3.4, the highest percentage of tertiary enrollment is only 45% for ECA during the years 2001-2004. Both SA and SSA have low percentage compared to other regions. Although increasing, tertiary enrollment in EAP is only 3% in early 1980s compared to MENA and LAC with 10% and 13% enrollment respectively.

Figure 3.4: Tertiary Enrollment:1980-2008



Figures 3.5-3.7 presents the graphs for the additional three main variables in the regression – GDP growth, private credit (finance) and Gini Coefficient. The pattern for GDP growth (Figure 3.5) in all regions is quite different. EAP has the highest growth rate in early 1980s and 1990s but then it declines sharply in late 1990s due to the financial crisis. ECA has negative growth in late 1980s but the growth rate increases at a steady rate until the middle of 2000s. SSA has quite unstable growth rate during the period with 3% as the highest growth rate.

Private credit measures the claims on private sector by banks and other financial institutions and is a proxy for financial development in this chapter. On average, except for MENA and LAC, all regions have increase the percentage of credit during the years observed. Both ECA and SSA experience a drop in percentage in late 1980s but increasing steadily after that period.

From the graph in Figure 3.7, we can see that LAC has the highest Gini in early 1980s while ECA has the lowest Gini for that year. Other regions have increasing trends from 1980s to late 1990s but SA start increasing slowly only after the middle of 1980s.

Figure 3.5: GDP Growth: 1980-2008

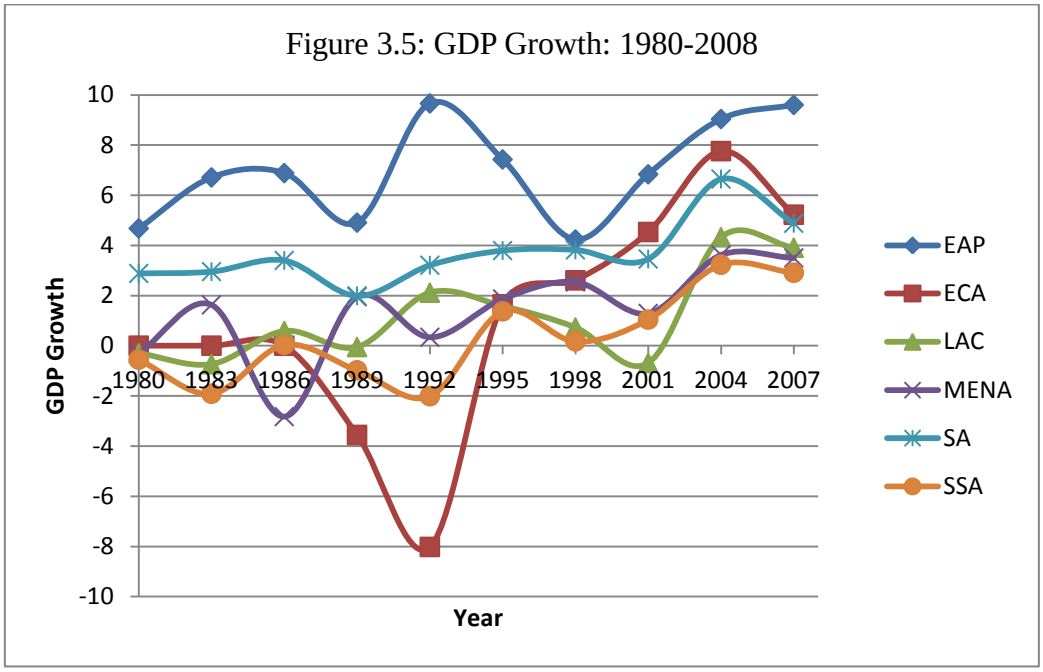


Figure 3.6:Private Credit :1980-2008

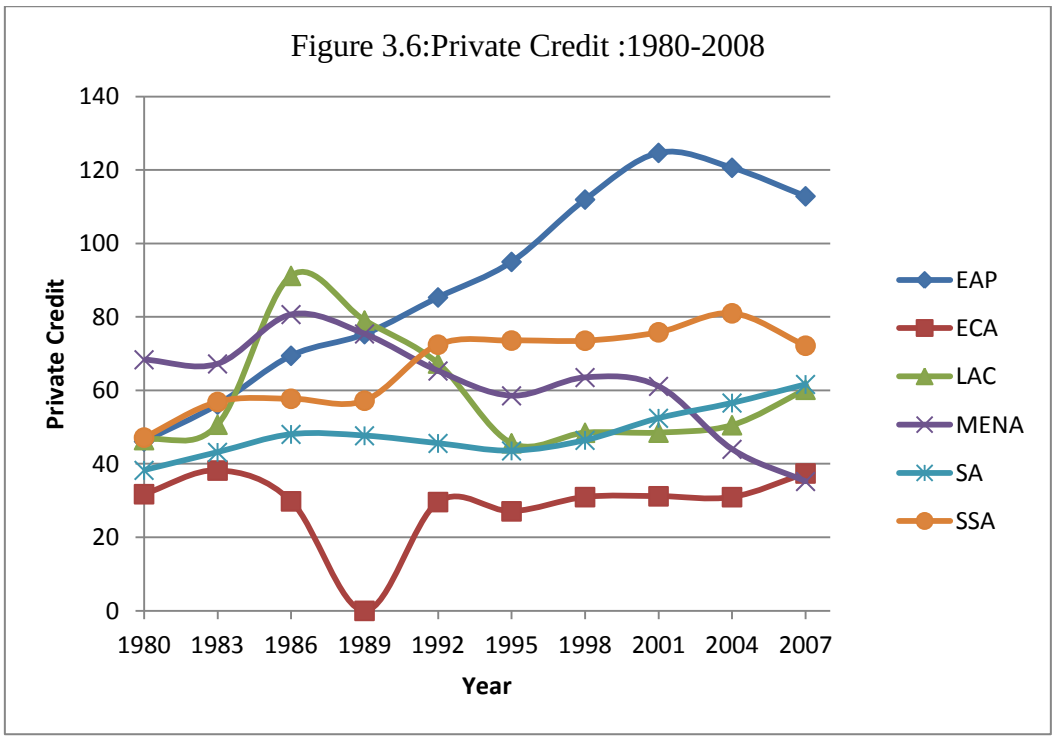
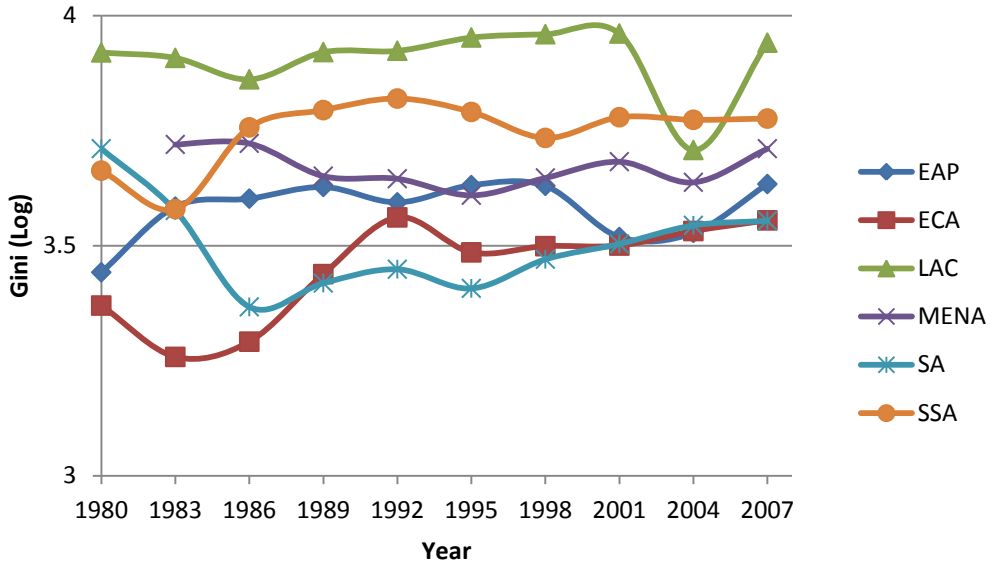
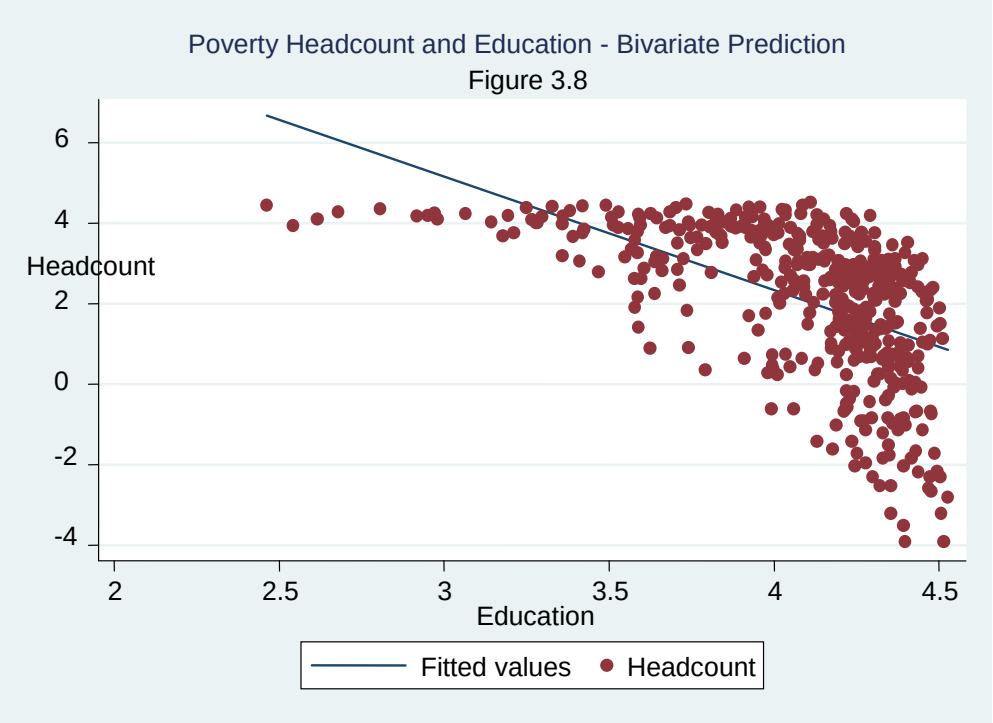
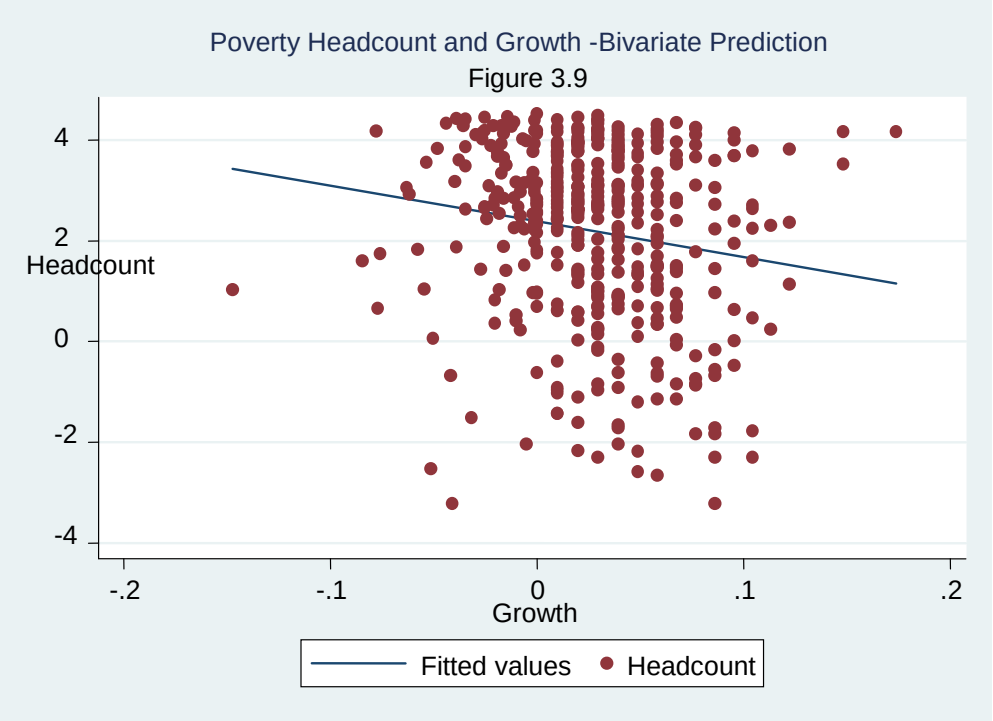


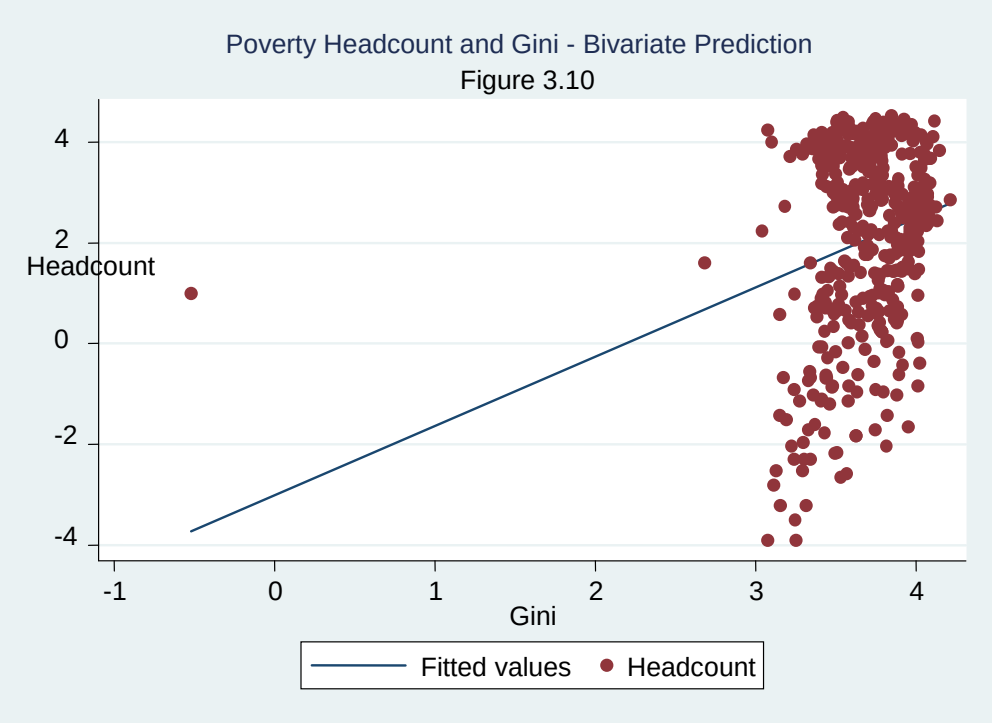
Figure 3.7 : Gini Coefficient: 1980-2008

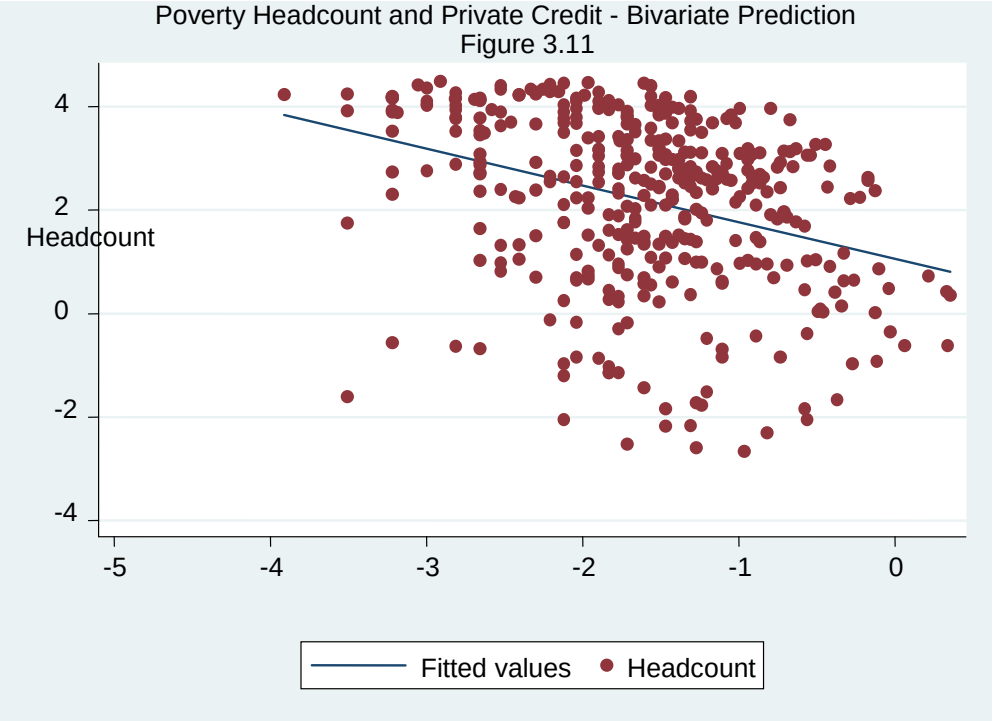


We demonstrate the relationship between headcount poverty and the core variables for the analysis in Figure 3.8-3.11. Figures 3.8, 3.9 and 3.11 show a negative relationship between poverty headcount and education, GDP growth and private credit. On the other hand, there is also a positive relationship between poverty and Gini coefficient (Figure 3.10). Although the graphs show the expected relationship, the variables may not have any impact on poverty headcount if explored in detail by econometric analysis.


Poverty Headcount and Education - Bivariate Prediction
Figure 3.8
Headcount
6
4
2
0
-2
-4
2
2.5
3
3.5
4
4.5
Education
Fitted values
Headcount


Poverty Headcount and Growth -Bivariate Prediction
Figure 3.9
Headcount
4
2
0
-2
-4
-.2
-.1
0
.1
.2
Growth
Fitted values
Headcount


Poverty Headcount and Gini - Bivariate Prediction
Figure 3.10
Headcount
4
2
0
-2
-4
-1
0
1
2
3
4
Gini
Fitted values
Headcount


Poverty Headcount and Private Credit - Bivariate Prediction
Figure 3.11
Headcount
4
2
0
-2
-4
-5
-4
-3
-2
-1
0
Fitted values
Headcount

3.6 Model Specification and Econometric Methodology

3.6.1 Model Specification

In order to estimate the effect of education on poverty, we follow the specification of the growth-poverty relationship by Ravallion and Chen (1997), Besley and Burgess (2003) and Adams Jr (2004) among others to assess the role of growth and income distribution in determining poverty reduction. In addition, this specification is similar to Alvi and Senbeta (2012)[34]. Thus, the following specification is estimated:

$$Log\ P_{it} = \alpha_0 + \beta_1 logG_{it} + \beta_2 logINEQ_{it} + v_i + \varepsilon_{it} \quad (3.1)$$

P_{it} is the measure of poverty for country i at time t, while G_{it} and $INEQ_{it}$ are real GDP per capita growth and Gini coefficient respectively. β_1 measures the growth-elasticity of poverty, v_i is the unobserved country specific effects and ε_{it} is an independent and identically distributed error term.

We then include the educational variable, $EDUC_{it}$ as an additional factor that may affect poverty rate. We also include the lagged of poverty ($P_{i,t-1}$) into the equation as an additional variable because past level of poverty may affect present and future poverty level. Earlier studies, for example, Huff (1999) and Hoynes *et al*. (2006) have pointed out the persistent nature of poverty. Thus, it is important to include it as one of the determinants of current level of poverty. The resulting equation is:

[34] Although similar, this study analyse the effectiveness of foreign aid in reducing poverty.

$$LogP_{it} = \alpha logP_{i,t-1} + \beta_1 logG_{it} + \beta_2 logINEQ_{it} + \beta_3 logEDUC_{it} + v_i + \varepsilon_{it} \quad (3.2)$$

In equation (3.2), we will also include a vector of variables X_{it}. There is a lack of clear theoretical guidance on the choice of determinants of poverty, leading to a wide set of possible specifications and uncertainty. In this chapter, we include a set of variables that may affect poverty and the macroeconomic conditions and policy of a country. X_{it} includes financial development, infrastructure, corruption and output volatility as described in detail in section 3.4.1. Equation (3.2) now becomes:

$$LogP_{it} = \alpha logP_{i,t-1} + \beta_1 logG_{it} + \beta_2 logINEQ_{it} + \beta_3 logEDUC_{it} + X_{it}'\theta + v_i + \varepsilon_{it} \quad (3.3)$$

β_3 is the parameter of interest that measure the impact of education on poverty after controlling for growth and income distribution. The total impact of education on poverty also depends on the control variables included in X_{it}. β_3 is expected to have negative significant value. On the other hand, β_2 determines the relationship between inequality and poverty and θ estimates the effect of the variables in X_{it} on poverty. A positive value of β_1 suggests that a growth in income increases poverty, and growth is good for poverty reduction if β_1 is negative.

3.6.2 Econometric Methodology

We discuss the econometric technique used to estimate the described specification in this section. Estimating equations (3.2) and (3.3) by Ordinary Least Square (OLS) raise several econometric problems. First, education and poverty are endogenous, and causality may run in

both directions. That is, on one hand the probability of being poor increases with the least amount of education gained and on the other hand, access to education is determined by the poverty status of the household. Therefore, these regressors may be correlated with the error term. Second, the presence of the lagged dependent variable gives rise to autocorrelation as $log\ P_{i,\ t-1}$ is correlated with the transformed error terms (Baltagi, 2008). This will make the estimator upward biased and inconsistent. Third, time invariant country specific effects may be correlated with the explanatory variables. This is because if the country specific effects affect any variable in one period, it will affect the variable in the previous period as well.

For that reason, instrumental variable (IV) method is required. The importance of using IV in this model is that it will correct for the omitted variables to the degree to which the instrumental variables are uncorrelated with the omitted variables (Moser and Ichida, 2001). With a panel data, a natural instrument will be the lags of the right hand side variables (Cook, 2002). In addition, IV estimation is required to adhere to the issue of reverse causality. To deal with persistence problem and endogeneity, we will apply the dynamic panel specification. The use of this method however, leads to problems of serial correlation in the error. It is important to detect possible serial correlation because we need to test the validity of the instruments and consistencies of the estimates.

Taking into account all the possible problems described above, we apply the most suitable method, which is the generalized methods of moment (GMM) estimator introduced by Arellano and Bover (1995) and later developed by Blundell and Bond (1998). This method allows us to estimate a regression equation in differences and in levels simultaneously, where each equation used its own set of internal instruments. The system GMM estimator uses two

sets of equations as instruments, that is the level equation is instrumented by lagged differences and difference equation is instrumented by the lagged levels. We demonstrate the illustration of the dynamic panel of system GMM method as below:

Consider a general form of the empirical model based on equation (3.3):

$$y_{it} = \alpha y_{i,t-1} + \beta x_{it}^{'} + \upsilon_i + \varepsilon_{it}$$

$$i= 1,.....,N \quad t= 1,.....T \tag{3.4}$$

To eliminate the country specific effect, Arellano and Bond (1991) proposed to take the first difference of equation (3.4).

$$y_{it} - y_{it-1} = \alpha\left(y_{i,t-1} - y_{i,t-2}\right) + \beta(x_{it}^{'} - x_{it-1}^{'}) + (\varepsilon_{it} - \varepsilon_{it-1}) \tag{3.5}$$

The difference equation however, introduces a bias problem because the error term is now correlated with the lagged dependent variable. To overcome this problem, Arellano and Bond (1991) take equation (3.4) and (3.5) together. The estimator assumes that the country specific effects are uncorrelated with the first difference of the dependent variable and the independent variables. Thus, the estimator has two extra moment conditions, which are:

$$E[y_{it}(\varepsilon_{it} - \varepsilon_{it-1})] = 0 \; for \; t \geq 2 \tag{3.6}$$

and

$$E[x_{it}(\varepsilon_{it} - \varepsilon_{it-1})] = 0 \; for \; t \geq 2 \tag{3.7}$$

if x is predetermined but not strictly exogenous. We assume the error terms to be independent and homoscedastic across countries and time in the first step. The assumptions are relaxed in the second step because we can construct a consistent estimate of the covariance matrix from the residuals obtained in the first step.

The consistency of the GMM estimator depends on the validity of the lagged dependent variables as instruments. We address the issue by considering two specification tests, which are the Hansen-J test of over-identifying restrictions and serial correlation tests. Hansen-J tests the overall validity of the instruments by analyzing the moment conditions used in the estimation process. A rejection of the null hypothesis gives a doubt to the validity of the estimates.

The serial correlation test examines the correlations of the error terms. We should reject the null hypothesis for the first-order serial correlation and accept the null for the second-order serial correlation. This is because; the presence of first-order serial correlation is expected when the original error term is uncorrelated. The acceptances of the null for the second order serial correlation indicates that the original error term is serially correlated and follows a moving average process of order one.

3.7 Empirical Results

3.7.1 Robustness Test for Panel Data

Before discussing the results in detail, we present the results for the robustness data test. We test the robustness of the panel by examining the baseline regression model via several methods, which are Pooled OLS, panel fixed effects, panel IV, difference GMM and system GMM. The focus of this exercise is to analyze the robustness of the panel estimations methods. Since the coefficients from Pooled OLS and panel Fixed Effects may suffer from endogeneity bias or autocorrelation because of the presence of the lagged dependent variable, we present panel IV as well as dynamic GMM (difference and system GMM). Panel IV estimator uses external exogenous variables as instruments. In this chapter, we utilize the lagged values of the endogenous variable as instrument because of the difficulties to find suitable external instrument.

As discussed in the previous chapter, the dynamic GMM estimation method is capable to handle unobserved country heterogeneity, omitted variable bias, measurement error, and potential endogeneity issues that may be present in the estimation (Caselli *et al.,* 1996). Additionally, we would like to determine the most robust and efficient dynamic panel GMM method for the poverty model outlined in this chapter. Blundell and Bond (1998) suggest that the difference GMM estimator may not be suitable in the presence of highly persistent series because of weak instrument bias. System GMM estimator is then invented to tackle the weak instrument problem.

Table 3.2 below presents the estimation results for five different methods. In general, the estimations meet our prior expectations, showing the expected results on all variables. The coefficients on the lagged poverty headcount are significant with the expected positive signs. The coefficients of our variable of interests, education, are negative and highly significant for

all five methods. Growth and inequality are also highly significant with the expected signs. Higher growth is expected to reduce poverty headcount while on the other hand, higher inequality increases it. The IV-GMM result however is very close and biased towards pooled OLS. Although the value for the Wald test is large, it shows that the instruments are not weak and valid. Both dynamic GMM estimators yield the expected results.

The Arellano and Bond (1991) tests of autocorrelation (AR (1) and AR (2)) show expected results. We reject the null for the first-order serial correlation and accept the null for the second-order serial correlation. The Hansen over-identification test shows the validity of the instruments used in the estimations although the value is close to 1.00, which is an indication of high instruments. The results also reveal one important finding; it is in line with Nickell (1981), Bond *et al.* (2001) and Hoeffler (2002). Nickell (1981) shows that the fixed effects estimation underestimate the effect of the lagged dependent variable under the presence of country specific effects. On the other hand, according to Bond *et al.* (2001) and Hoeffler (2002), OLS overestimates the effect and system GMM estimator should be between the two estimators.

Furthermore, Hauk and Wacziarg (2009), show in a Monte Carlo study that fixed effects and difference GMM can overestimate the coefficient of the lagged dependent variable and bias the coefficient of other variables towards zero if measurement error is present. Although our findings do not conform to Hauk and Wacziarg (2009), it is clearly shown that our coefficients for the lagged dependent variables are in accordance with the aforementioned studies; system GMM lies between the fixed effects (lower bound) and the OLS estimator (upper bound); i.e. $0.427<0.692<0.866$. The difference GMM estimator is smaller than the corresponding fixed

effects estimate, which is the lower bound in our panel. Thus, in our opinion, the estimator is downward biased and may cause unexpected sign or significance for education conforming Bobba and Coviello's (2007) findings.

Therefore, we determine two main conclusions from this robustness test; first, the country specific fixed effects is present in this panel as suggested by Nickell (1981), Bond *et al.* (2001) and Hoeffler (2002). Second, because the difference GMM coefficient is lower than the fixed effects one, it is a sign that the estimate is biased downward, thus the use of System GMM is recommended. Bond *et al.* (2001) and Bobba and Coviello (2007) among others have shown evidence that system GMM produces a more efficient and robust result, therefore our analysis of the remaining chapters will be drawn from the system GMM estimates. Nevertheless, we present the IV-GMM and difference GMM for comparison and robustness. As discussed, IV – GMM is biased toward OLS and difference GMM behaved poorly when the time series observations are small and persistent; Bond *et al*. (2001) pointed out that finite sample biases occur when instrumental variables are weak; as the lagged values of the variables are weak instruments for the following first-differences. The results are in the Appendix.

Table 3.2: Robustness Test for Poverty Model

	(1)	(2)	(3)	(4)	(5)
Estimation Method	Pooled OLS	Fixed Effects	IV-GMM	DIFF-GMM	SYS- GMM
$Poverty_{(t-1)}$	0.866***	0.427***	0.862***	0.323**	0.692***
	(0.046)	(0.089)	(0.046)	(0.123)	(0.070)
Education	-0.384***	-1.476***	-0.407***	-2.286***	-0.831**
	(0.106)	(0.423)	(0.113)	(0.665)	(0.376)
Growth	-4.275***	-4.333***	-4.275***	-3.547***	-3.855***
	(1.396)	(1.624)	(1.414)	(1.213)	(1.411)
Inequality	0.208**	0.355***	0.212***	0.269***	0.344***
	(0.084)	(0.107)	(0.082)	(0.069)	(0.108)
Constant	1.077*	5.991***	1.163*	-	2.779*
	(0.599)	(1.826)	(0.617)	-	(1.590)
Countries	72	72	72	57	72
Observations	319	319	313	243	319
Adj R-squared	0.821	0.261	0.823		
AR1 *p*-value	-	-	-	0.08	0.01
AR2 *p*-value	-	-	-	0.91	0.74
Hansen *p*-value	-	-	0.75	0.98	0.99
Weak ID	-	-	1545.80	-	-

Notes: The dependent variable is the log of poverty headcount. Robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

3.7.2 Pooled OLS and Fixed Effects Estimations

We present the results of estimating equations (3.2) and (3.3). We first conduct the OLS regression before analyzing again using fixed effects. As far as the results are concerned, the pooled OLS and fixed effects results are meant for robustness check and comparison with earlier studies. We focus on the coefficients of the main variables of interests, which are the education variables, the Gini coefficient and growth. If the signs are similar and close in magnitudes, then it will suggest that the results are robust across different methods.

Equations (3.2) and (3.3) are estimated using three alternative measures of poverty: i) poverty headcount, ii) poverty gap and iii) squared poverty gap. Table 3.3 presents the results obtained when regressing total enrollment on different poverty measures. The results in Table 3.3 are based on a pooled OLS estimator, while Table 3.4 is the result from fixed effects respectively. Each table consists of three columns representing the results of three different dependent variables. In addition, we regress the baseline model (equation 3.2) before adding control variables (equation 3.3) in each regression. In all the specifications, education variable is treated as endogenous.

In general, the lagged dependent variables for all three measures of poverty show the expected positive sign and significance. This indicates the persistent nature of poverty. The parameter of interest, education, shows similar results on both pooled OLS and fixed effects estimations. In particular, when we add other control variables to the poverty headcount regression, the coefficient of education decreases, i.e. from -0.384 to -0.278 (pooled OLS) and from -1.476 to -0.155 (fixed effects). Education has a consistent negative effect on all three poverty measures, with higher coefficients on the more sensitive measures.

As far as the additional variables are concerned, both pooled OLS and fixed effects estimations yield mixed results. Income growth and inequality are significant with the right signs in both estimations. However, growth is only significant when regressed without the additional control variables in the fixed effects estimation. As for inequality, the effect is positive and it displays higher significance in the fixed effects estimation. Access to credit or finance is the only variable that has consistent effects in both estimations. It shows that it is important to have a financial market in order to lift people out of poverty. Corruption, on the

other hand, is positively correlated with poverty only in the fixed effects estimations. On the other hand, macroeconomic stability does not have any effect on poverty regardless of estimation methods.

For the reasons and arguments mentioned in the previous section, (section 3.7.1), it is important to note that the results above should be taken as indicative in nature. Because of the reliability of the system GMM as confirmed by the robustness test, we will mainly discuss the findings from this estimator for more conclusive findings on the relationship between education and poverty.

Table 3.3: Education and Poverty: Pooled OLS

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.866***	0.857***				
	(0.046)	(0.050)				
Gap			0.849***	0.834***		
			(0.044)	(0.050)		
Squared Gap					0.818***	0.781***
					(0.046)	(0.052)
Education	-0.384***	-0.278**	-0.460***	-0.321*	-0.513***	-0.393*
	(0.106)	(0.110)	(0.154)	(0.168)	(0.196)	(0.221)
Growth	-4.275***	-3.145***	-3.944***	-3.805***	-2.621	-4.350**
	(1.396)	(1.148)	(1.458)	(1.388)	(1.610)	(1.752)
Gini	0.208**	0.272***	0.156	0.207*	0.414**	0.630***
	(0.084)	(0.079)	(0.100)	(0.108)	(0.176)	(0.110)
Credit		-0.206***		-0.236***		-0.288***
		(0.056)		(0.073)		(0.091)
Infrastructure		0.007		0.010		0.023
		(0.026)		(0.035)		(0.039)
Corruption		0.022		-0.012		-0.082
		(0.054)		(0.063)		(0.065)
Volatility		0.047		0.058		0.016
		(0.046)		(0.059)		(0.075)
Constant	1.077*	-0.025	1.378*	0.241	0.485	-1.064
	(0.599)	(0.594)	(0.713)	(0.806)	(0.937)	(1.001)
Observations	319	241	319	241	307	229
Adj R-squared	0.821	0.826	0.786	0.797	0.741	0.775

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 3.4: Education and Poverty: Fixed Effects

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.427***	0.389***				
	(0.089)	(0.104)				
Gap			0.409***	0.351***		
			(0.097)	(0.108)		
Squared Gap					0.433***	0.381***
					(0.076)	(0.078)
Education	-1.476***	-0.155	-1.683***	-0.092	-1.542**	-0.349
	(0.423)	(0.460)	(0.523)	(0.594)	(0.678)	(0.809)
Growth	-4.333***	-1.445	-3.881**	-1.372	-3.279*	-1.785
	(1.624)	(1.277)	(1.614)	(1.427)	(1.731)	(1.780)
Gini	0.355***	0.326***	0.268**	0.212**	0.686***	0.721***
	(0.107)	(0.085)	(0.115)	(0.091)	(0.089)	(0.083)
Credit		-0.424***		-0.377*		-0.267
		(0.148)		(0.193)		(0.243)
Infrastructure		-0.092		-0.149		-0.184
		(0.101)		(0.147)		(0.200)
Corruption		0.160*		0.193		0.180**
		(0.093)		(0.116)		(0.089)
Volatility		0.042		0.034		0.024
		(0.032)		(0.042)		(0.056)
Constant	5.991***	-0.345	6.405***	-0.922	3.823	-1.984
	(1.826)	(1.915)	(2.295)	(2.482)	(2.804)	(3.261)
Observations	319	241	319	241	307	229
Adj R-squared	0.261	0.290	0.224	0.238	0.242	0.275

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

3.7.3 Dynamic Panel Estimations

In this section, we present and discuss the estimation results for system GMM estimator. As aforementioned, Bond *et al*. (2001) and Bobba and Coviello (2007) have shown that system GMM uses additional moment conditions to produce consistent and efficient estimates. This estimator combines the equation in first differences and in levels and use both lagged levels and differences as internal instruments. More efficient from the one-step estimator, the two-step system GMM takes the residuals from the one-step estimate and uses a consistent estimate of the weighting matrix (Davidson and Mackinnon, 2006). However, the two-step GMM presents standard errors that tend to be downward biased; but this problem is solved by applying the finite sample corrections proposed by Windmeijer (2005) to gain estimates that are more efficient. Table 3.5 below presents the estimation results.

The variable of interest – education, is negative and significant in all six specifications. Results from these tables suggest similar results on education although the size of the magnitudes is different. For example, the poverty-reducing effect of total education for panel IV estimator is about 0.28 to 0.52 whereas the system-GMM estimator suggests a higher estimate of 0.73 to 1.20. The estimates for difference-GMM suggest even higher estimates from the system-GMM estimator, which is around 2.8 to 3.3. However, when additional control variables are added into the difference-GMM regressions, total education is insignificant. This is the evidence that is in accordance with Bobba and Coviello (2007); this estimator is likely to be downward biased and leads to the insignificance of the main variable of interest.

The results indicate that education plays a significant role in reducing poverty. The result is robust even after controlling for growth, inequality and other determinants of poverty. The poverty-reducing effect of education decreases in magnitude when the control variables are added into the regression. This result confirms the policy findings by the World Bank (World Bank 2001, and Aoky *et al.* 2002); World Bank published a great amount of reports and documents highlighting the priority and importance of education in alleviating poverty[35]. When poverty gap and squared gap are used, the coefficients on education increase suggesting that education has a bigger impact on severe poverty. The coefficient estimates of education suggest that a one per cent increase in enrollment will reduce poverty by around 0.728 per cent to 1.20 per cent.

The Gini coefficient has the expected sign and significance, and the elasticity increases relative to the sensitivity of the poverty measure. The estimates on inequality confirm the fact that inequality is positively correlated with poverty. The estimates of income per capita growth are negative and significant and consistent with earlier findings by Ravallion and Chen (1997) and Besley and Burgess (2003). Ravallion and Chen (2003) estimate that the growth-elasticity in developing countries is around -3.0 on average for the $1-a-day poverty line. Conversely, the growth-elasticity from our estimations is higher than the studies when poverty headcount is used. It is probably because of the different method of estimations used in the study.

Besley and Burgess (2003) use fixed effects method which does not take into account the endogeneity of poverty and other variables. This estimate is also consistent with Bhalla's

[35] The World Bank first publication on poverty is the World Development Report (1990) and then follows by the World Development Report 2000/2001: Attacking Poverty. More publications and details reports are available on the webpage: http://www.worldbank.org under 'Research' and 'Publication'.

(2002) suggestion that growth-elasticity should be around -3.4 or -5.0 (for $1.08 poverty line) for developing countries. The elasticity decreases when we use poverty gap and squared poverty gap as dependent variables. Interestingly, the growth-elasticity for the headcount ratio (column 2) is close to Adams (2004), where he records a value of -2.267 for a sample of developing countries using GDP per capita as a measure of growth[36].

Another interesting finding is the effect of the availability of finance or credit on poverty. Credit is consistently negative and significant in every specification. This suggests that countries with developed credit system are more likely to have less poor people. The finding is in line with Honohan (2004) and Beck *et al.* (2007). Honohan (2004) argues that financial depth is negatively correlated with poverty headcount, with elasticity ranges from 1.3 per cent to 3.5 per cent. Beck *et al*. (2007) on the other hand, argue that financial development raises income of the poor more than proportionately.

The effect of volatility is not robust to the use of different estimation methods. From the Tables, we can see that when poverty headcount is used as the dependent variable, it has a positive and significant effect in system GMM methods, but it is insignificant when analyzed by panel-IV and difference GMM. Output instability is expected to increase poverty rates, mainly because the poor are more vulnerable to shock compared to the rich. They are the first to suffer during a crisis because they have little access to credit, undereducated, unskilled and depend more on public and social services.

[36] Although similar, the study excludes Europe and Central Asia region. The growth-elasticity, however, is insignificant in the study.

In all specifications, the lagged dependent variables enter positively and significantly suggesting the persistence nature of poverty. Infrastructure and corruption do not enter significantly indicating lack of direct effects of infrastructure and institution on poverty once we control for growth and inequality. The insignificant effect of the institutions variable (i.e. corruption) confirms the findings of Dollar and Kraay (2002). On the other hand, the lack of direct significant impact of infrastructure is in line with Jalilian and Weiss (2004). The validity of instruments is checked by performing the Hansen J test of over-identifying restrictions and Arellano-Bond tests for first and second order serial correlation of the difference residuals. We do not reject the null that all the instruments are valid and no second order autocorrelation is detected in the specifications. Specifically, a *p*-value above 0.05 for the second order serial correlation and Hansen J test suggests the model is correctly specified with valid instruments (Cameron and Trivedi, 2006).

In general, across the three estimation methods above, our main variables of interest have all the expected sign. Countries with higher enrollment, faster growth, low inequality and developed financial market have low percentage of poor people. These are expected results and they confirm previous findings.

Table 3.5: Education and Poverty: System GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.632***	0.639***				
	(0.082)	(0.002)				
Gap			0.559***	0.588***		
			(0.085)	(0.077)		
Squared Gap					0.659***	0.565***
					(0.127)	(0.128)
Education	-0.916**	-0.728***	-1.203**	-0.937**	-0.853*	-0.942*
	(0.371)	(0.018)	(0.483)	(0.466)	(0.511)	(0.499)
Growth	-3.796***	-2.550***	-3.417*	-3.229*	-2.187	-3.845*
	(1.433)	(0.095)	(1.741)	(1.769)	(1.933)	(2.092)
Gini	0.398***	0.376***	0.314*	0.306	0.645***	0.847***
	(0.139)	(0.003)	(0.178)	(0.221)	(0.171)	(0.081)
Credit		-0.264***		-0.342**		-0.372**
		(0.006)		(0.144)		(0.159)
Infrastructure		-0.006		-0.014		-0.002
		(0.005)		(0.064)		(0.067)
Corruption		-0.002		-0.039		-0.091
		(0.007)		(0.092)		(0.069)
Volatility		0.097***		0.069		0.007
		(0.002)		(0.088)		(0.064)
Constant	3.061*	1.844***	4.106**	2.535	1.050	0.332
	(1.721)	(0.083)	(1.889)	(2.116)	(2.158)	(1.959)
Observations	319[72]	241[57]	319[72]	241[57]	307[72]	229[57]
AR1 *p*-value	0.01	0.02	0.02	0.03	0.00	0.02
AR2 *p*-value	0.77	0.50	0.39	0.24	0.65	0.35
Hansen J *p*-value	0.52	0.91	0.47	0.91	0.49	0.71

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

3.7.4 Different Levels of Education and Poverty

Over the last two decades, primary or basic education has been the focus among governments and international agencies mainly because of its role in reducing poverty. Psacharopoulos and Patrinos (2004) for example, have proven that primary education improves labor market productivity and agriculture**.** Primary schooling is an important starting point in a child's life and it is free in most developing countries. The Millennium Development Goals (MDGs) concerns more on achieving primary education to free people from poverty. This is also emphasized by the World Bank's sourcebooks for poverty written by Aoky *et al*. (2002: 233–234) which is outlined in Tarabini (2010):

''Failure to provide basic education seriously compromises a country's efforts to reduce poverty. A large body of research points to the catalytic role of basic education for those individuals in society who are most likely to be poor. Basic education or literacy training, of adequate quality, is crucial to equipping disadvantaged individuals with the means to contribute to and benefit from economic growth'' (quoted in Tarabini, 2010).

We examine if such result holds in our study. Table 3.6 is the results of estimating education by level, basic and higher education. We will only discuss the results from system GMM estimations and the alternative results are presented in the Appendix (Table B.5 and B.6). We use the same specifications as before but with levels instead of total education. Basic education is the enrollment ratio in primary school, while higher education is the combined gross enrollment ratios for secondary and tertiary education. We do not include all three different levels of education in one specification mainly to avoid the collinearity problem. This

is because secondary enrollment ratio appears to be highly correlated with tertiary enrollment ratio[37].

The results signify that higher education reduces poverty while basic education does not have any effect on poverty in this sample. The coefficients on higher education are fairly high and significant. One possible reason behind the findings would be the quality of the basic education delivered in these countries. Although children are enrolled in primary school, repetition rates are high in some countries where children always drop out of school. In most countries, primary education is compulsory and publicly funded by the government, so it has less opportunity cost. With only primary education, it is insufficient to ensure an individual to get involved in medium to high-income jobs. The ability to learn simple sentences or calculation is important, but still it is inadequate to compete in the developing world nowadays. In addition, it is also possible with educational expansion (rapid progress of Universal Primary Education (UPE) and increases in higher enrollment) only higher education is significant in the analysis. It can be argued that, although it is necessary to have at least primary education, it is still insufficient to reduce poverty.

This finding seems surprising in light of the known Millennium Development Goals (MDG's) which suggests that primary education should be effective in decreasing the percentage of poor people around the world. It implies that policies that aim to lower poverty through the expansion of education are likely to be more effective focusing on higher education instead of primary education. Nonetheless, it corroborates Wedgwood (2006), Holsinger and Jacobs

[37] The correlation between secondary enrollment and tertiary enrollment is 0.86. Nonetheless, we try to estimate the three levels together in one specification. It appears that in all specifications, secondary enrollment is insignificant which is not within our expectations.

(2009) and King *et al.* (2007) among others. Wedgwood (2006), for example, argues that primary education is insufficient to bring economic development and poverty reduction in Tanzania. Holsinger and Jacobs (2009) claim that in many cases, primary and secondary education certificates are inadequate to secure an employment in the era of globalization. In support to the above literature, Van der Venn and Preece (2006) point out the importance of adult education, which includes vocational education, community development and training for active citizenship (Van der Venn and Preece, 2006).

Higher education is costly and not affordable for most poor people. Only a few individuals from poor families are able to attain or complete higher education. Despite the cost, its effect on poverty is proven in this study. The significance of only higher education in this chapter could be explained by the severity of poverty for the countries in the sample. Most of the countries in the sample are African countries where the poverty headcount is very high, so by having only primary is insufficient to lower the high rate of poverty.

Briefly, other variables behave differently in the regression. Growth is consistently negative and significant, while on the other hand, inequality is associated with increases in poverty except in the poverty gap regression. The importance of financial development in reducing poverty is proven as credit is negative and highly significant in all three models. Nevertheless, infrastructure enters with the expected sign but is insignificant throughout. Volatility and corruption are both insignificant with negative signs. We do not reject the over-identifying restrictions for the results reported and the specifications pass the autocorrelation tests.

Table 3.6: Different Levels of Education and Poverty: System GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.728***	0.669***				
	(0.097)	(0.102)				
Gap			0.649***	0.562***		
			(0.107)	(0.109)		
Squared Gap					0.673***	0.540***
					(0.106)	(0.120)
Basic	-0.069	0.530	0.427	0.553	0.211	0.829
	(0.449)	(0.536)	(0.775)	(0.934)	(0.817)	(0.814)
Higher	-0.418*	-0.595**	-0.575*	-0.782*	-0.320	-0.633*
	(0.215)	(0.249)	(0.301)	(0.399)	(0.310)	(0.330)
Growth	-2.144**	-2.422**	-2.233**	-3.007*	-1.811	-4.818**
	(0.928)	(1.196)	(1.071)	(1.629)	(1.652)	(2.144)
Gini	0.322***	0.280***	0.192	0.222	0.544**	0.620***
	(0.106)	(0.097)	(0.126)	(0.152)	(0.211)	(0.095)
Credit		-0.216**		-0.239*		-0.366**
		(0.087)		(0.130)		(0.153)
Infrastructure		-0.001		-0.008		-0.010
		(0.032)		(0.045)		(0.055)
Corruption		-0.009		-0.059		-0.142
		(0.059)		(0.093)		(0.093)
Volatility		0.026		0.012		-0.056
		(0.047)		(0.061)		(0.076)
Observations	306[71]	234[58]	306[71]	234[58]	295[71]	223[58]
AR1 *p*-value	0.02	0.06	0.02	0.04	0.00	0.02
AR2 *p*-value	0.89	0.68	0.61	0.34	0.92	0.49
Hansen J *p*-value	0.95	1.00	0.69	0.99	0.97	1.00

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Constant not reported to save space.

3.7.5 Education by Gender and Poverty

In this section, we examine the effects of education associated with gender on poverty. The main hypothesis to test in this analysis is that poverty reducing impacts may differ between men and women. Birdsall *et al*. (2005) have acknowledged that education, particularly of girls as a central means of breaking the poverty cycle. Women's education has been shown to be an important factor in improving health and reducing fertility rates (Hannum and Buchmann, 2005). In light with this evidence, we also examine the effects of women educational level on poverty reduction. Although not reported, we observe similar evidence with our earlier findings where women's basic education does not have significant effect on poverty reduction.

Table 3.7 presents the results from analyzing the effect of education on poverty by gender. As previous analyses, the alternative methods' results are presented in the Appendix (Table B.7 and B.8). In all specifications, we find rather weak evidence on the impact of women's education on poverty reduction. This is because when additional control variables are added into the regressions for poverty gap and squared gap, women's education becomes insignificant. Surprisingly, men's education is insignificant in all regressions although it enters with the expected sign.

The results provide support for the importance of women's education as a development strategy particularly in developing countries. The World Bank (2008) has verified that women's education is crucial for economic growth and poverty reduction. Moreover, the returns to women's education are the largest in secondary education compared to primary, which support our findings. As women are the primary caretaker of a household, investing in

women's education not only raises productivity and income of a particular country, but it is the main channel to break the vicious cycle of poverty in addition to other economic and social benefits (World Bank, 2008). Educated women tend to have fewer children and more awareness of children's health and nutrition, which will lead to lower dependency ratios, and improved infant mortality and survival rates.

Despite the importance of women's education, women receive less education in developing countries compared to developed countries. Higher education is particularly important for women, but the lack of access to this level of education prevents women to gain the necessary benefits. Patrinos and Sakellariou (2011) suggest by improving the quality of education delivered as well as using incentives for financial supports like scholarship. Private credit is negative and highly significant in this regression, suggesting the importance of a developed financial market in lowering poverty. Furthermore, the sign of the coefficient on volatility is now positive and significant, supporting the view that economic uncertainty is associated with higher poverty. The autocorrelation tests are satisfactory and we reject the null for the over-identifying tests, but in this regression, the test is robust but weakened by many instruments[38].

[38] The detailed explanation of this problem is in page 51.

Table 3.7: Education by Gender and Poverty: System GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.784***	0.734***				
	(0.101)	(0.077)				
Gap			0.727***	0.724***		
			(0.087)	(0.059)		
Squared Gap					0.730***	0.594***
					(0.098)	(0.110)
Women	-0.691**	-0.546**	-0.604*	-0.525	-0.090	-0.080
	(0.302)	(0.258)	(0.329)	(0.381)	(0.353)	(0.306)
Men	-0.056	-0.058	-0.242	-0.019	-0.416	-0.145
	(0.443)	(0.479)	(0.405)	(0.380)	(0.443)	(0.380)
Growth	-1.381	-2.096	-1.760	-2.997	-1.440	-4.202*
	(1.108)	(1.744)	(1.404)	(2.197)	(1.685)	(2.186)
Gini	0.376***	0.372***	0.264**	0.247**	0.572**	0.747***
	(0.097)	(0.107)	(0.108)	(0.113)	(0.250)	(0.133)
Credit		-0.235***		-0.307**		-0.443***
		(0.079)		(0.129)		(0.151)
Infrastructure		0.015		0.009		-0.037
		(0.042)		(0.050)		(0.063)
Corruption		0.036		0.045		-0.090
		(0.077)		(0.094)		(0.071)
Volatility		0.049		0.043		-0.025
		(0.059)		(0.063)		(0.073)
Observations	301[73]	227[58]	301[73]	227[58]	291[73]	217[58]
AR1 *p*-value	0.03	0.10	0.00	0.01	0.00	0.02
AR2 *p*-value	0.61	0.84	0.45	0.76	0.97	0.38
Hansen test *p*-value	0.57	0.89	1.00	1.00	0.99	1.00

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Constant not reported to save space.

3.8 Summary and Concluding Remarks

The effectiveness of poverty reduction strategies in developing world has been debated for decades. The experiences of countries that have succeeded in reducing poverty significantly indicate that sustained growth plays an important role in attaining the goal. However, although necessary, growth alone is insufficient in achieving the goal of poverty reduction. Poverty is a multi-dimensional problem, thus policies that target every aspect of poverty are beneficial. In that regard, the importance of education as the key link between growth and poverty reduction is often pointed out. On that note, the effects of education on poverty have attracted limited interest in the empirical literature. In contrast, ample studies devoted the empirical work to closely related issues as education impact on inequality or poverty reducing effect on growth.

This chapter is probably the first that studies the empirical assessment of the direct impact of education on poverty. The strategy employed in this chapter involves the estimation of a growth-poverty equation augmented by education variable. We further add a set of control variables to the basic framework to assess the strength of an independent link between education and the poverty measures. The empirical specifications are estimated on a large panel dataset using dynamic panel data method. The method, namely the system GMM takes into account the potential endogeneity of the regressors and country specific effects.

In general, the results reveal a consistent negative significant impact of education on poverty. The results are robust to different specifications namely: i) the use of different measures of poverty, ii) the use of different methods, iii) controlling for economic growth and income inequality and iv) inclusion of a set of control variables in the regression. We find that

different levels of education have different impact on poverty; higher education is important in reducing poverty, but no robust significant effects of basic education. This chapter has also attempted to analyze the relationship between education and poverty according to gender. The resulting evidence suggests that women's education matter more for poverty reduction in developing countries. However, only women's higher education is robust; though necessary, women's primary education is insufficient for poverty reduction. In addition, growth is good for the poor and unequal distribution of income increases poverty. Our growth-elasticity is comparable and within the range suggested by earlier studies.

The findings imply that the direct effect of education on poverty could be the most important transmission through which education correlates with poverty. The policy implication is to strengthen education sector, by encouraging enrollment and devoting more resources as well as providing more quality education rather than pursuing the goal of increasing growth alone. The policy to focus on only primary education should be revised, although it is proven that achieving a universal primary education is important to reduce poverty and promote growth. Thus, it suggests that the United Nations Millennium Development Goals (UNMDG) on universal primary education is insufficient although important. It is also important that primary education is complemented with junior secondary education completion in order to enable children to gain the full benefits from education. In the UNMDG 2012 report, it is stated that further poverty reduction in developing countries is possible if countries maintain positive growth and handle the lack of education issue which hinders employment effectively (United Nations, 2012).

In more industrialized countries, tertiary education is important. On the contrary, broad based secondary education is more likely to alleviate poverty in low-income countries. While we verify that higher education is more important in reducing poverty, poor households have limited access to secondary and tertiary education due to limited mobility and high costs. Hence, economic policies should be directed to ease the access to education for poor households especially women. These include financial support as well as quality education in the early years of children. Parents are more motivated to enroll their children in higher education if children have high achievement in primary education. Educational policies however, should target both boys and girls from poor households. Both the quantity and quality of education should be the priority for international policy makers because education is proven to empower the people, which in turn lead to improvements in governance and institutional matters for example corruption.

Appendix B

Table B.1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variable					
Headcount	462	2.08	1.82	-3.91	4.53
Gap	461	0.82	1.99	-4.61	4.15
Squared Gap	450	0.11	1.98	-4.61	3.88
Education					
Total Enrollment	747	4.02	0.41	2.12	4.53
Basic Enrollment	706	4.53	0.32	2.89	5.40
Higher Enrollment	715	3.31	0.84	-1.20	4.51
Control Variables					
Growth	696	0.02	0.04	-0.20	0.20
Inequality	466	3.70	0.32	-0.52	4.21
Credit	583	-1.67	0.82	-4.61	0.35
Infrastructure	748	0.92	1.73	-4.35	3.67
Corruption	546	2.66	0.95	0	6
Volatility	653	0.88	0.96	-2.94	3.45

*Note: **(1)** Headcount: Poverty Headcount **(2)** Gap: Poverty Gap **(3)** Squared Gap: Squared Poverty Gap **(4)** Growth: Real per capita GDP growth **(5)** Inequality: Gini Coefficient **(6)** Total Enrollment: Combined gross enrollment ratios at all levels **(7)** Basic enrollment : Primary enrollment ratios **(8)** Higher enrollment: Combined secondary and tertiary enrollment ratios **(9)** Credit: Private credit as % of GDP**(10)**Infrastructure: Telephone Mainline per 1000 people **(11)** Corruption: Corruption Index from ICRG **(12)** Volatility: Standard deviations of Real GDP per capita growth.*

Table B.2: Correlation Matrix

	Headcount	Gap	Squared Gap	Total	Basic	High	Growth	Gini	Credit	Infra	Corrupt	Volatility
Headcount	1.00											
Gap	0.97	1.00										
Squared Gap	0.90	0.97	1.00									
Total	-0.53	-0.51	-0.48	1.00								
Basic	-0.31	-0.31	-0.30	0.80	1.00							
High	-0.66	-0.65	-0.62	0.78	0.64	1.00						
Growth	-0.23	-0.26	-0.26	0.14	0.10	0.23	1.00					
Gini	0.18	0.17	0.20	0.01	0.08	-0.08	-0.15	1.00				
Credit	-0.29	-0.32	-0.34	0.22	0.29	0.37	0.08	0.12	1.00			
Infra	-0.20	-0.20	-0.20	0.23	0.12	0.28	0.00	-0.13	-0.06	1.00		
Corrupt	-0.24	-0.22	-0.20	0.10	0.11	0.07	-0.13	0.06	0.09	0.02	1.00	
Volatility	0.01	0.00	0.00	-0.08	-0.16	-0.10	-0.23	-0.02	-0.20	0.05	-0.03	1.00

*Note: **(1)** Headcount: Poverty Headcount **(2)** Gap: Poverty Gap **(3)** Squared Gap: Squared Poverty Gap **(4)** Growth: Real per capita GDP growth **(5)** Inequality: Gini Coefficient **(6)** Total: Combined gross enrollment ratios at all levels **(7)** Basic : Primary enrollment ratios **(8)** High: Combined secondary and tertiary enrollment ratios **(9)** Credit: Private credit as % of GDP**(10)**Infrastructure: Telephone Mainline per 1000 people **(11)** Corruption: Corruption Index from ICRG **(12)** Volatility: Standard deviations of Real GDP per capita growth*

Table B.3: Education and Poverty: Panel IV-GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.862***	0.857***				
	(0.046)	(0.049)				
Gap			0.846***	0.835***		
			(0.044)	(0.050)		
Squared Gap					0.819***	0.786***
					(0.047)	(0.052)
Education	-0.407***	-0.281**	-0.490***	-0.328**	-0.516***	-0.368*
	(0.113)	(0.114)	(0.157)	(0.164)	(0.194)	(0.212)
Growth	-4.275***	-3.118***	-3.864***	-3.731***	-2.539	-4.280**
	(1.414)	(1.140)	(1.477)	(1.375)	(1.634)	(1.740)
Gini	0.212***	0.268***	0.150	0.199*	0.403**	0.620***
	(0.082)	(0.078)	(0.098)	(0.104)	(0.180)	(0.110)
Credit		-0.214***		-0.247***		-0.303***
		(0.055)		(0.072)		(0.089)
Infrastructure		0.010		0.016		0.030
		(0.026)		(0.033)		(0.037)
Corruption		0.024		-0.007		-0.079
		(0.055)		(0.064)		(0.065)
Volatility		0.041		0.048		0.003
		(0.046)		(0.058)		(0.073)
Constant	1.163*	-0.018	1.519**	0.260	0.527	-1.171
	(0.617)	(0.602)	(0.720)	(0.787)	(0.927)	(0.966)
Observations	313[72]	237[57]	313[72]	237[57]	301[72]	225[57]
R-squared	0.823	0.833	0.789	0.807	0.748	0.791
Wald Test	1545.80	1025.69	1628.63	1094.77	1647.76	1098.69
Hansen J *p*-value	0.75	0.80	0.92	0.83	0.89	0.98

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B.4: Education and Poverty: Difference GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.247*	0.218				
	(0.130)	(0.136)				
Gap			0.269*	0.259**		
			(0.135)	(0.109)		
Squared Gap					0.416***	0.349***
					(0.140)	(0.113)
Education	-2.880***	-0.322	-3.353***	-0.276	-2.049	0.279
	(0.810)	(0.989)	(0.880)	(1.319)	(1.290)	(1.467)
Growth	-3.001**	-0.854	-2.590	-0.977	-2.212	-1.613
	(1.436)	(1.782)	(1.626)	(1.888)	(1.824)	(2.090)
Gini	0.289***	0.285***	0.175**	0.142***	0.755***	0.751***
	(0.104)	(0.071)	(0.077)	(0.043)	(0.099)	(0.062)
Credit		-0.411**		-0.354**		-0.138
		(0.189)		(0.165)		(0.242)
Infrastructure		-0.106		-0.098		-0.293
		(0.130)		(0.178)		(0.242)
Corruption		0.159		0.209		0.177
		(0.113)		(0.125)		(0.111)
Volatility		0.040		0.043		0.025
		(0.035)		(0.041)		(0.065)
Observations	243[57]	180[47]	243[57]	180[47]	231[57]	168[47]
AR1 *p*-value	0.16	0.11	0.13	0.07	0.03	0.04
AR2 *p*-value	0.84	0.89	0.72	0.50	0.78	0.38
Hansen J *p*-value	0.35	0.74	0.51	0.72	0.45	0.70

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B.5: Different Levels of Education and Poverty: Panel-IV

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.849***	0.796***				
	(0.054)	(0.062)				
Gap			0.818***	0.781***		
			(0.056)	(0.063)		
Squared Gap					0.809***	0.769***
					(0.057)	(0.063)
Basic	0.171	0.259	0.181	0.236	0.017	-0.071
	(0.178)	(0.196)	(0.253)	(0.268)	(0.309)	(0.292)
High	-0.349***	-0.321**	-0.431***	-0.358**	-0.384**	-0.282
	(0.112)	(0.127)	(0.148)	(0.166)	(0.163)	(0.194)
Growth	-1.915*	-2.692**	-1.883	-3.363***	-0.961	-3.847**
	(1.087)	(1.120)	(1.295)	(1.291)	(1.618)	(1.719)
Gini	0.219***	0.249***	0.140	0.194*	0.368*	0.590***
	(0.070)	(0.073)	(0.087)	(0.104)	(0.191)	(0.103)
Credit		-0.207***		-0.256***		-0.283***
		(0.059)		(0.077)		(0.104)
Infrastructure		0.012		0.018		0.035
		(0.027)		(0.031)		(0.040)
Corruption		0.008		-0.026		-0.077
		(0.058)		(0.066)		(0.069)
Volatility		0.006		0.005		-0.009
		(0.042)		(0.052)		(0.075)
Observations	285[57]	219[48]	285[57]	219[48]	277[57]	211[48]
R-squared	0.837	0.831	0.802	0.814	0.752	0.791
Wald Test	74.31	25.96	79.92	31.03	87.98	35.41
Hansen J *p*-value	0.35	0.50	0.34	0.49	0.44	0.47

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Constant not reported to save space.

Table B.6: Different Levels of Education and Poverty: Difference GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.430***	0.326*				
	(0.152)	(0.180)				
Gap			0.377**	0.259**		
			(0.152)	(0.113)		
Squared Gap					0.459***	0.296**
					(0.137)	(0.126)
Basic	0.723	0.317	-0.453	-0.932	0.284	-0.308
	(1.006)	(0.561)	(0.952)	(0.997)	(1.445)	(0.574)
High	-0.635**	-0.265	-0.652**	-0.245	-0.380	-0.368
	(0.243)	(0.282)	(0.306)	(0.421)	(0.354)	(0.559)
Growth	-3.076**	-1.510	-2.664*	-1.478	-1.760	-2.782
	(1.257)	(1.300)	(1.556)	(1.520)	(1.714)	(3.093)
Gini	0.315***	0.228***	0.185**	0.146***	0.728***	0.775***
	(0.088)	(0.058)	(0.078)	(0.051)	(0.072)	(0.108)
Credit		-0.393**		-0.339		-0.233
		(0.192)		(0.216)		(0.218)
Infrastructure		-0.053		0.043		-0.155
		(0.195)		(0.344)		(0.259)
Corruption		0.166**		0.221*		0.098
		(0.070)		(0.123)		(0.120)
Volatility		0.043		0.036		-0.019
		(0.046)		(0.046)		(0.061)
Observations	229[57]	171[47]	229[57]	171[47]	220[56]	162[46]
AR1 *p*-value	0.07	0.11	0.07	0.07	0.02	0.08
AR2 *p*-value	0.67	0.82	0.77	0.40	0.99	0.47
Hansen J *p*-value	0.85	0.99	0.92	0.97	0.89	0.99

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table B.7: Education by Gender and Poverty: Panel IV-GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.908***	0.858***				
	(0.043)	(0.049)				
Gap			0.864***	0.828***		
			(0.041)	(0.048)		
Squared Gap					0.826***	0.790***
					(0.042)	(0.046)
Women	-0.002	-0.121	0.054	0.042	-0.147	0.337
	(0.296)	(0.315)	(0.377)	(0.424)	(0.555)	(0.527)
Men	-0.360	-0.097	-0.585	-0.348	-0.546	-0.858
	(0.382)	(0.392)	(0.489)	(0.532)	(0.690)	(0.683)
Growth	-1.978**	-2.463**	-1.892	-3.289**	0.263	-2.505
	(0.972)	(1.167)	(1.293)	(1.428)	(1.688)	(1.656)
Gini	0.228***	0.293***	0.168*	0.244**	0.443**	0.679***
	(0.070)	(0.076)	(0.090)	(0.108)	(0.183)	(0.099)
Credit		-0.225***		-0.266***		-0.288***
		(0.066)		(0.079)		(0.093)
Infrastructure		0.019		0.027		0.043
		(0.028)		(0.035)		(0.039)
Corruption		0.049		0.022		-0.020
		(0.057)		(0.061)		(0.064)
Volatility		0.032		0.045		0.014
		(0.047)		(0.054)		(0.075)
Observations	266	200	266	200	259	193
R-squared	0.853	0.843	0.818	0.828	0.777	0.818
Wald Test	9.87	5.08	9.85	5.04	9.73	5.06
Hansen J *p*-value	0.72	0.78	0.87	0.89	0.86	0.97

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Constant not reported to save space.

Table B.8: Education by Gender and Poverty: Difference GMM

VARIABLES	(1) Headcount	(2) Headcount	(3) Gap	(4) Gap	(5) Squared Gap	(6) Squared Gap
Headcount	0.379**	0.122				
	(0.186)	(0.122)				
Gap			0.363**	0.181		
			(0.152)	(0.112)		
Squared Gap					0.312**	0.216**
					(0.153)	(0.105)
Women	-0.352*	-0.221	-0.288	-0.074	0.557	-0.553
	(0.208)	(0.241)	(0.357)	(0.433)	(0.809)	(0.668)
Men	-0.360	-0.088	-0.583	-0.398	-1.438	0.372
	(0.385)	(0.405)	(0.519)	(0.595)	(0.949)	(0.639)
Growth	-2.906*	-1.955	-2.924**	-2.139	-2.233	-3.256
	(1.453)	(1.349)	(1.368)	(1.772)	(1.705)	(2.023)
Gini	0.346***	0.338**	0.257***	0.189***	0.812***	0.666***
	(0.062)	(0.144)	(0.060)	(0.060)	(0.081)	(0.071)
Credit		-0.547**		-0.480***		-0.420*
		(0.214)		(0.137)		(0.243)
Infrastructure		-0.096		-0.066		-0.331
		(0.207)		(0.217)		(0.259)
Corruption		0.152**		0.157*		0.133
		(0.063)		(0.087)		(0.090)
Volatility		0.034		-0.009		-0.011
		(0.063)		(0.041)		(0.072)
Observations	218[57]	160[47]	218[57]	160[47]	209[55]	151[45]
AR1 *p*-value	0.14	0.20	0.06	0.16	0.08	0.08
AR2 *p*-value	0.41	0.28	0.34	0.40	0.92	0.53
Hansen J *p*-value	1.00	1.00	1.00	1.00	0.92	0.99

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table B.9: Variables Definition and Sources

Variable	Variable Definition	Sources
Growth	Log of Real GDP per capita growth	Penn World Table 6.3
Inequality	Log of Gini coefficient	UNU-WIDER and Povcal.net, World Bank
Total Enrollment	Log of School Enrollment at all levels (% gross)	Edstat,World Development Indicators, World Bank
Headcount Index	Log of proportion of people living under a poverty line	Povcal.net, World Bank and World Development Indicators, World Bank
Poverty Gap	Log of the average income shortfall as share of poverty line	Povcal.net, World Bank and World Development Indicators, World Bank
Squared Poverty Gap	Log of the squared of average income shortfall as share of poverty line	Povcal.net, World Bank and World Development Indicators, World Bank
Credit	Log of Private Credit (% of GDP)	Beck and Demirgüç-Kunt (2009)
Infrastructure	Log of Telephone Mainline (per 1000 people)	World Development Indicators, World Bank
Corruption Index	Corruption Index (ranges from 0-6)	International Country Risk Guide (ICRG)
Volatility	Standard deviation of Real GDP per capita growth	Penn World Table 6.3

Table B.10: Sample Countries

East Asia Pacific	Europe and Central Asia	Latin America Caribbean	Middle East North Africa	South Asia	Sub-Saharan Africa
Cambodia	Albania	Argentina	Egypt	Bangladesh	Burkina Faso
China	Bulgaria	Belarus	Iran	India	Burundi
Indonesia	Georgia	Bolivia	Jordan	Pakistan	Cameroon
Lao PDR	Kazakhstan	Brazil	Morocco	Sri Lanka	Central African Republic
Malaysia	Latvia	Chile	Tunisia		Cote d' lvoire
Mongolia	Moldova	Colombia			Ethiopia
Philippines	Poland	Costa Rica			Ghana
Thailand	Romania	Dominican Republic			Guatemala
Vietnam	Tajikistan	Ecuador			Guinea
	Turkey	El Salvador			Kenya
	Ukraine	Honduras			Lesotho
		Jamaica			Lithuania
		Mexico			Madagascar
		Panama			Mali
		Paraguay			Mauritania
		Peru			Mozambique
		Uruguay			Nicaragua
		Venezuela			Niger
					Nigeria
					Rwanda
					Senegal
					South Africa
					Tanzania
					Uganda
					Zambia

CHAPTER 4

On The Relationship between Human Capital Inequality and Globalization

4.1 Introduction

The debate on the effect of globalization on income distribution is often divided between two points of view. Various studies have found that globalization leads to the rise of income, which will benefit not only the high-income, but also low-income groups. On the contrary, some studies argue that the opportunities and benefits of globalization are not shared equally among the citizens, thus widening the gap between the low and high-income groups. It is still a debate in both theoretical and empirical literature of whether globalization is associated with narrowing or widening income distribution within the developing countries. Under the Stolper-Samuelson theorem of the Heckscher-Ohlin (H-O) theory, globalization should be beneficial for poor and developing countries by reducing inequality and giving opportunities for least educated workers to acquire the benefits of globalization (Kremer and Maskin, 2003).

Consider two countries (developed and developing) with two factors (skilled and unskilled) and two goods (machinery and agriculture). The developed country has a comparative advantage in machinery because of its abundant supply of skilled labor. On the other hand, unskilled labor is concentrated in the developing country giving it a comparative advantage in agriculture. Trade integration will cause the developed country to increase machinery

production and reduce agricultural production. These will increase the demand for skilled labor and raise the price of machinery relative to agriculture and the wage of skilled workers. In contrast, the impact of trade openness in developing country is the opposite. Cross-country studies on developing countries based on H-O theory generally imply that trade liberalization is associated with higher inequality and does not benefit poor income countries as pointed out by Kremer and Maskin (2003). Others have also found insignificant effect of globalization on inequality, which contradicts the theory[39]. Calderon and Chong (2001) prove that greater openness leads to lower inequality in developing countries.

This chapter aims to contribute to the existing literature by attempting to prove and analyze the competence of the standard H-O theory on inequality and globalization. We tackle the inequality and globalization issue by departing from the usual convention and studying the effect of globalization on another distribution, which is the distribution of human capital[40]. In other words, we would like to investigate whether globalization helps to alleviate or aggravate inequality in education and benefit everyone in the observed population in the same way in terms of education. Moreover, we would also like to analyze whether the benefit or loss experienced by countries differ across the level of development. The main objectives of this chapter are to answer the following questions:

1) How is globalization related to human capital inequality?

[39] There are additional factors that may contribute to the contrasting evidence in existing literature. First, different studies use different sample countries and cover different sample periods. Second, different proxies measure the term 'globalization'. Some use openness and FDI while others use policies measures such as tariffs or quotas. Finally, researchers use different econometrics specifications in their studies. The usual approach has been the levels on levels regression in a cross-section analysis, while recently studies have focus to the panel relationship.

[40] The term 'human capital' in this chapter refers only to education. However, the term 'human capital' and 'education' is used interchangeably throughout the chapter.

2) Does the effect of globalization depend on the level of development of a country?

Deiniger and Squire (1998) argue that income inequality maybe a poor proxy for distribution of wealth and propose land inequality as an alternative measure. It is non-trivial to study human capital inequality to proxy for wealth/asset inequality for a number of reasons. First, the stock of human capital is one of the determinants of current and future income; hence, the distribution of human capital can provide a good indicator of income inequality. Glomm and Ravikumar (1992), Saint-Paul and Verdier (1993) and Galor and Tsiddon (1997) among others develop models that show the main source of inequality is the distribution of human capital. Second, the human capital distribution can be considered as approximate determinants of the distribution of earnings since it is determined by individual ability and investment financing (Thomas *et al*., 2000). Lastly, an equal distribution of human capital is an important factor in determining individual productivity and reducing poverty besides land or other wealth indicators. Human capital can be considered as an opportunity and the equal distribution of opportunity is always preferred than the distribution of wealth because of its spillover effects (Thomas *et al*., 2000).

Additionally, Checci (2001) asserts that income inequality and educational choice are two different concepts, which are often misled by the theoretical assumptions. In many theoretical models, income inequality and educational choice are assumed to be perfectly correlated and influenced by the same factors. In those models, factors like poverty, imperfect credit market and inefficient tax levying administration prevent access to education and lead to population with low earnings. Therefore, the poor and the uneducated are usually the same person, although in reality the relationship is far more complicated. Educational choice is closely

related to public provision of schools while income distribution is more related to employment composition and fiscal policies. Nonetheless, income inequality and education inequality are obviously related; the more skewed the income distribution, the higher the inequality in education (Checchi, 2001)[41]. Thus, by studying education inequality, we may be able to find the transmission mechanism in explaining the relationship between income distribution and other variables.

Our focus is on the impact of the composite index of globalization as well as its three different dimensions on education inequality. The analysis utilizes a new dataset on globalization indices recently developed by Dreher (2006) known as the KOF Index of globalization. So far, only Dreher and Gaston (2008) and Bergh and Nilsson (2010) have analyzed the relationship between the KOF index and income inequality. In addition, we also examine the impact of three additional measures of globalization that are used commonly in previous studies for comparison and robustness tests.

To anticipate our result, we find that the effect of globalization on human capital inequality differs according to the level of income. The novel finding of this chapter is that globalization matters for human capital inequality and although globalization conceptually should be beneficial for developing countries, the hypothesis only holds for low-income countries[42]. On the other hand, globalization worsens the inequality in education in middle and high-income

[41] For detailed explanation, see Checci (2001).
[42] Low-income countries are those in which 2010 GNI per capita was $1005 or less (World Development Indicator, World Bank,2010)

countries[43]. The novelty of our results clearly shows that there is a variation of effect within the developing countries itself which challenge the H-O theory. Different dimensions of globalization have similar effects on inequality, which proves that not only economic globalization, but also social and political globalization are important in the relationship. This is also true when we measure globalization by FDI inflow and EF index. Inversely, when measured by trade openness, we do not find any significant evidence.

Furthermore, we do not find any evidence of a non-linear relationship between globalization and inequality. The findings are robust to two types of sensitivity analyses. First, we verify if the results are sensitive to the presence of country outliers by excluding countries from three main regions; East Asia and Pacific (EAP), Latin America and Caribbean (LAC) and Sub-Saharan Africa (SSA). Secondly, we control for broad numbers of variables that are relevant for human capital inequality following Castello and Domenech (2002) and Checci and Garcia-Penalosa (2004).

To the best of our knowledge, no study has focused on the direct effects of globalization on human capital inequality. Basu and Guariglia (2007) have presented stylized facts related to the interactions between foreign direct investments (FDI), educational inequality (for the population 15 years and above), growth and the share of agriculture to GDP in 119 developing countries. To explain these stylized facts, they develop a growth model showing that FDI, inequality and growth are positively related. They conclude "FDI induced growth exacerbates

[43] Middle-income countries are those in which 2010 GNI per capita was between $1,006 and $12,275 and high income countries are those in which 2010 GNI per capita was $12,276 or more. This includes both OECD and non-OECD countries (World Development Indicator, World Bank,2010).

human capital inequality" (Basu and Guariglia, 2007). This study, however, does not include the high-income countries and does not take into account the different effects that FDI may have on different levels of incomes. As far as we are aware, our study is the first to analyze the effect of globalization on educational inequality and our results show that developing countries do not necessarily benefit from globalization, which clearly contradicts the standard trade theory.

The remainder of this chapter is as follows: the next section briefly discusses the related literature on globalization and income/wage inequality. Section 3 discusses in depth of the globalization index. Section 4 explains the data and section 5 outlines the empirical models. The results and conclusions are in section 6, 7 and 8 respectively.

4.2 Related Literature on Globalization and Income/Wage Inequality

Abundant research studies have been conducted in recent years on the relationship between globalization and aggregate inequality, but with conflicting evidence either from theoretical or empirical perspective. Kanbur (2000) studies the relationship between trade openness and inequality from a theoretical perspective. He describes a simple intuition of the H-O theory in a model including both skilled and unskilled workers, where skilled workers are primarily from rich countries. He predicts that trade openness will increase inequality in rich countries but reduce within country inequality in less developed countries. This is in contrast with the earlier finding by Savvides (1998), who claims that a less developed country that is more open to trade will experience increases in income inequality.

Empirical studies have tested various hypotheses about the effects of globalization on inequality within developing countries (see for example, Ravallion, 2001, Calderon and Chong, 2001; Lunberg and Squire, 2003, among others). The usual models test the hypothesis of whether the globalization-elasticity of inequality depends on the level of development by introducing an interaction term between openness and GDP per capita or a dummy for OECD countries[44]. The theoretical foundation of this empirical model is based on the basic H-O trade theory and the support of this theory requires a negative value for the level of development and a positive value for the globalization measure.

Some studies find contrasting results with the theory (Barro, 2000; Ravallion, 2001; Millanovic and Squire, 2005). Specifically, Barro (2000) studies the effects of adjusted trade on inequality for 84 countries for the period 1960-1990 and finds that globalization has negative effect in developed countries and the effect is positive in developing countries. Ravallion (2001) finds similar results on the sample of 50 countries for the years 1947-1994. These studies have employed ordinary least square and fixed effects using trade openness as indicator for globalization[45]. Recent studies have also found similar evidence; globalization worsens wage inequality in developing countries (Gaston and Nelson, 2002; Zhu and Trefler, 2005; Dreher and Gaston, 2008).

In an attempt to prove the theory, Millanovic (2005) examine the effects of trade openness and foreign direct investment on relative income shares of the lowest and highest quintile. His result shows that globalization hurts the poor, by widening the gap of income distribution. As

[44] Andersen (2005) provides details on these studies.
[45] Barro (2000) uses adjusted terms of trade (to country sizes) to GDP ratio and Ravallion (2001) uses only exports to GDP ratio.

income levels rise, the benefits flow to the poor and middle class more than the rich ones. However, he does not find any significant effect of foreign direct investment on any quintile. Calderon and Chong (2001) and Millanovic (2005) have employed the instrumental variables methods, which is a better method than linear OLS/ Fixed effects due to the presence of endogenous variables. Although different in the choices of variables of interests, our study is very close and similar to the above-mentioned studies.

Other studies on openness and inequality register insignificant correlation between globalization and inequality (Dollar and Kraay, 2002; Lundberg and Squire, 2003; Sylwester, 2005). Sylwester (2005), for example, studies the relationship for 29 Less Developed Countries (LDCs) and concludes that FDI does not have any significant effect on income inequality for these sample countries. Lundberg and Squire (2003) and Dollar and Kraay (2002) obtain similar results. The former finds weak evidence that globalization increases poverty and inequality in the short run. The latter, finds insignificant effect of openness and the income share of bottom quintiles.

The contrasting findings may be due to the use of different proxies on globalization. Openness to trade has been criticized as a poor measure of trade policy by several authors (for example, Rodrik, 2000 and Birdsall and Hamoudi, 2002). Although it is the most easily constructed and readily available measures for globalization, it only measures the overall exposure of a country to international markets. In addition, it is a common determinant of growth, where causality may run from openness to growth, thus employing a linear OLS method is inappropriate (Millanovic, 2005).

As outlined by Mills (2009), the studies on globalization and income inequality differ from each other due to the differences in the availability and quality of inequality data. Some studies on this topic have employed the Gini coefficient, whereas others, such as Sala-i-Martin (2006) and Bergh and Nilsson (2010) have used mean logarithmic deviation of income (MLD) and standardized Gini coefficient. The problem in using the income Gini coefficient is that the measure is incomparable across the sample. Developing countries usually use consumption-based Gini coefficient as opposed to developed countries, which use income-based measures. The consumption-based Gini is lower and is widely used in developing countries than income-based because the majority of the labor force is self-employed in agriculture and business (Mills, 2009). Thus, alternative measure is needed to provide a better view on the relationship between globalization and inequality.

An alternative to the usual Gini coefficient is the population-weighted inequality measure. For example, Sala-i-Martin (2006) shows that income inequality has been declining for 138 sample countries during the year 1979-2000. However, middle and high-income countries experience increases in inequality when examined by quintiles. Dreher and Gaston (2008) use industrial wage inequality and household income inequality from the University of Texas Inequality Project (UTIP) to reassess the controversial findings on globalization and inequality. They conclude that globalization reduces income inequality and the effect is significant only in OECD countries.

In short, cross-country studies have yield contrasting and controversial results on the relationship between globalization and inequality. Some studies find an insignificant effect of globalization; others find that globalization has reduced the gap between the rich and the poor.

Existing studies focus only on economic globalization, ignoring both social and political integration. Furthermore, income inequality measures are scarce and incomparable between countries, a reason in which the findings are conflicting with each other. Human capital Gini may provide a better result, as it is available for a wide range of countries and it complements the information provided by income inequality (Castello and Domenech, 2001). Human capital Gini is largely ignored in analyzing the relationship. Apart from Basu and Guariglia (2007), no other study has focused on the effects of globalization on the distribution of human capital; hence, the chapter fills in the gap.

4.3 Globalization Index (KOF Index)

Globalization is a broad concept associated with free movement of goods, services, capital as well as labor across borders. These phenomena result in lower transportation costs, lower trade barriers, effective communication and increase competition among others. It is not a new concept and no country in the world is unaffected by the phenomenon. Although often referred to economic globalization, this process is a combination of various other aspects, which affect the world in several different ways. Thus, globalization is viewed as a process of trade, financial, social and political integration that brings countries closer and strongly interrelated. Supporters of globalization view the process to be beneficial to the country's development by raising the standard of living in low-income countries (Stiglitz, 2002; Slabbert, 2003). Others argue that it is detrimental to many countries by making the rich richer and the poor poorer (Slabbert, 2003). Integration into the world market is expected to benefit developing countries but it is also expected to affect income distribution.

The term ‘globalization’ has been proxied by foreign direct investment or trade openness in existing literature but the emergence of a newly constructed globalization indices have open up a path for new and extensive empirical research. Existing studies focus solely on economic integration (openness to trade, capital flow and FDI) to measure globalization. As pointed out by Dreher and Gaston (2008), other aspects of globalization like social and political integration may affect inequality. This chapter complements previous studies by considering the usual globalization measures (openness, FDI inflow and freedom to trade) in addition to the recent index of globalization, which covers three main dimensions: Economic Integration, Social Integration and Political Integration. Keohane and Nye (2000) have highlighted the aforementioned dimensions of globalization. The index is based on 23 different variables that relate different subcomponents together. Below are the detailed explanations of the indices.

4.3.1 Economic Globalization (KOF1)

Flows of goods, services, capital and information from abroad are considered as economic globalization. Economic globalization is constructed from two components: actual flows and restrictions. Foreign direct investment is the biggest subcomponent for actual flows, followed by income payments to foreign nationals. Both trade and portfolio investments are equally weighted in this index component (22%). Foreign direct investment includes both outflow and inflow, which are common measures of globalization. Income payments to foreign nationals are included to proxy for the numbers of foreign labor and capital during the production process. The second component is on restrictions, which include tariff, taxes, import barriers and capital account restrictions. In general, this economic index combines the suggested

measure of globalization in previous literature to construct a better and extensive index to proxy globalization.

4.3.2 Social Globalization (KOF2)

Social globalization captures factors on personal contact, information flows and cultural proximity. Personal contact measures the communication between people in different countries. This measure is a combined measure of telephone traffics, international tourism, government transfers and foreign population. The stock of foreign population evaluates the existing interactions of people with people outside the country, while international calls are the estimates of the cost of interactions. Information flow includes the importance of mass media (internet, television and newspaper) as mediums for information exchanges. Cultural proximity is measured by using the number of McDonald's restaurants, number of IKEA stores and trade of books. Theoretically, no predictions have been made on the effect of social globalization on inequality. Furthermore, Dreher and Gaston (2008) classified the cultural proximity as "the most difficult dimension to grasp."

4.3.3 Political Globalization (KOF3)

Political globalization is the dimension with the lowest weight (26%). This dimension measures the number of embassies, membership in international organizations and participation in the UN Security Council Missions and international treaties. To the best of our knowledge, no theory has predicted the impact of political globalization on income inequality; hence, it is hard to expect the sign of the relationship.

4.4 Data Description and Trends

To test our first hypothesis, we analyze the linear effects of globalization on education inequality. Then, we test the second hypothesis by evaluating the effects of globalization according to level of development of a country inspired by the H-O trade theory. According to the theoretical framework, we expect that globalization narrows the education inequality gap in developing countries (low and middle-income countries) and widens it in high-income, which consists of developed countries. We utilize a global panel of 112 countries (108 effective samples) compared to existing studies that restrict the sample to developing or developed countries. We include as many countries as possible to ensure a more representative and convincing result on the relationship. Inclusion of countries from different level of income (developed and developing) is important because the globalization process includes both sample and most countries are affected by it. Furthermore, the addition of the new measures of globalization may produce a robust result than a sole measure of globalization. Finally, our choice of model specification and technique enables us to study the dynamic nature of the relationship between different levels of development.

The sample consists of an unbalanced panel of observations from 112 developing and developed countries around the world covering the period 1970-2009 for which the education inequality and the composite KOF index are available together. Because the education inequality data can only be calculated in five year averages all other variables are averaged over non-overlapping five year period to reduce the possibility of business cycles and measurement errors, thus resulting in eight distinct periods; 1970-74,1975-79,1980-84,1985-89,1990-94,1995-99,2000-04 and 2005-09. However, as we include several control variables,

the effective sample of the study is smaller than the possible observations due to missing data. The final sample reduces to 108 countries (27 low income, 49 middle income and 32 high-income countries) with a maximum of 688 observations. The number of countries and observations change depending on the variables considered in the specifications. Table C.1 in the Appendix list the sample countries included in the regression analysis[46].

4.4.1 Human Capital Gini

Gini coefficients are the most commonly used measure of inequality. Income inequality is used to proxy for wealth inequality because of the absence of data on the distributions of wealth for countries. Some studies use Gini coefficients of land distribution (Alesina and Rodrik, 1994) or land inequality together with income inequality to analyze the relationship between the distribution of assets and growth (Deininger and Squire, 1998). The stock of human capital (measured by the average years of schooling) is another important component of wealth and asset that has been neglected in measuring inequality (Castello and Domenech, 2002). Thomas *et al*. (2000) argue that an equal distribution of education is a vital necessity to lift people out of poverty and enhance individual productivity. Furthermore, Burtless (2003) has argued that income may not be the suitable proxy to examine the effect of globalization on inequality. Thus, we deviate from the usual convention by using the Gini coefficients of education as a proxy for wealth inequality to gain a better understanding of the link between globalization and inequality.

[46] The countries are listed together with the latest globalization rank.

Similarly to other measures of distributions (income, wealth or land), human capital Gini ranges from 0 (perfect equality) to 1 (perfect inequality). To measure human capital inequality, we follow the calculations from Castello and Domenech (2002). We utilize recent and updated educational attainment data from Barro and Lee (2010). The human capital Gini is calculated as follows:

$$GiniEd = \frac{1}{2\overline{H}} \sum_{i=0}^{3} \sum_{j=0}^{3} |\widehat{x_i} - \widehat{x_j}| n_i n_j \quad (4.1)$$

where $\overline{H}$ is the average years of schooling for the population aged 15 years or 25 years and above and *i* and *j* are indices of the levels of education. n_i and n_j are the share of population with a given level of education. $\widehat{x_i}$ *and* $\widehat{x_j}$ are the cumulative average years of schooling for each level and we consider four levels of education based on Barro and Lee (2010) classification: no schooling *(x=0*), primary education*(x=1*), secondary education (*x=2*) and tertiary education (*x=3*). The cumulative average years of schooling for each level are:

$$\begin{aligned} \widehat{x_0} &= x_0 = 0 \\ \widehat{x_1} &= x_1 \\ \widehat{x_2} &= x_1 + x_2 \\ \widehat{x_3} &= x_1 + x_2 + x_3 \end{aligned} \quad (4.2)$$

The average number of years of schooling, $\overline{H}$, is calculated as follows:

$$\overline{H} = n_1 x_1 + n_2(x_1 + x_2) + n_3(x_1 + x_2 + x_3) \quad (4.3)$$

Expanding (4.1) and taking (4.2) and (4.3), the education Gini is computed based on this formula[47,48]:

$$Gini\ Ed = n_0 + \frac{n_1x_2(n_2+n_3)+n_3x_3(n_1+n_2)}{n_1x_1+n_2(x_1+x_2)+n_3(x_1+x_2+x_3)} = n_0 + \frac{n_1x_2(n_2+n_3)+n_3x_3(n_1+n_2)}{\bar{H}} \quad (4.4)$$

Table 4.1 and Table 4.2 are the descriptive statistics for the education Gini coefficients for population aged 15 years and above and aged 25 years and above. The tables present the mean, standard deviations and the minimum and maximum of the two measures according to geographic regions and income levels for the period 1970-2009. We consider both populations aged 15 years and 25 years and above because as argued by Castello and Domenech (2001) in developing countries, the labor force constitutes of people younger than 25 years old. Because our sample countries comprise of both developed and developing countries, we compare both variables to see if there is a significant difference between the two populations.

[47] For more details of the calculations, refer to Castello and Domenech (2001). For similar calculations, refer to Checci (2001).

[48] Where n_0=*lu25;* n_1=*lp25;* n_2=*ls25;* n_3=*lh25,* $\bar{H}$ = *yr_sch*25, x_0=0, x_1=yr_sch_pri25/(lp25+ls25+lh25), x_2=yr_sch_sec25/(ls25+lh25) and x_3=yr_sch_h25/lh25. In the Barro-Lee dataset, *lu25* is the percentage of "no schooling"; *lp25* is the percentage of "primary school attained"; *ls25* is the percentage of "secondary school attained"; *lh25* is the percentage of "higher school attained"; *yr_sch25* is the average schooling years in the population; *yr_sch_pri25* is the average years of primary schooling in the population*; yr_sch_sec25* is the average years of secondary schooling in the population; *yr_sch_h25* is the average years of higher schooling in the population.

Table 4.1: Regional Descriptive Statistics

Regions	Gini	Country	Mean	Std Dev	Min	Max
East Asia & Pacific	Gini15	17	0.285	0.160	0.079	0.801
	Gini25	17	0.326	0.187	0.082	0.879
Europe	Gini15	23	0.402	0.205	0.108	1.097
	Gini25	23	0.435	0.233	0.110	1.208
Latin America & Caribbean	Gini15	24	0.312	0.139	0.049	0.826
	Gini25	24	0.352	0.158	0.053	0.867
Middle East & North Africa	Gini15	12	0.481	0.186	0.164	0.896
	Gini25	12	0.545	0.208	0.184	0.912
North America	Gini15	2	0.109	0.022	0.076	0.158
	Gini25	2	0.119	0.031	0.077	0.182
South Asia	**Gini15**	**5**	**0.592**	**0.226**	**0.175**	**0.937**
	Gini25	**5**	**0.642**	**0.233**	**0.173**	**0.967**
Sub Saharan Africa	**Gini15**	**29**	**0.563**	**0.210**	**0.156**	**0.944**
	Gini25	**29**	**0.627**	**0.204**	**0.187**	**0.965**
World	Gini15	112	0.378	0.221	0.049	0.944
	Gini25	112	0.421	0.241	0.052	0.967

Source: Author's own calculation from Barro and Lee (2010) education data

Table 4.2: Income level Descriptive Statistics

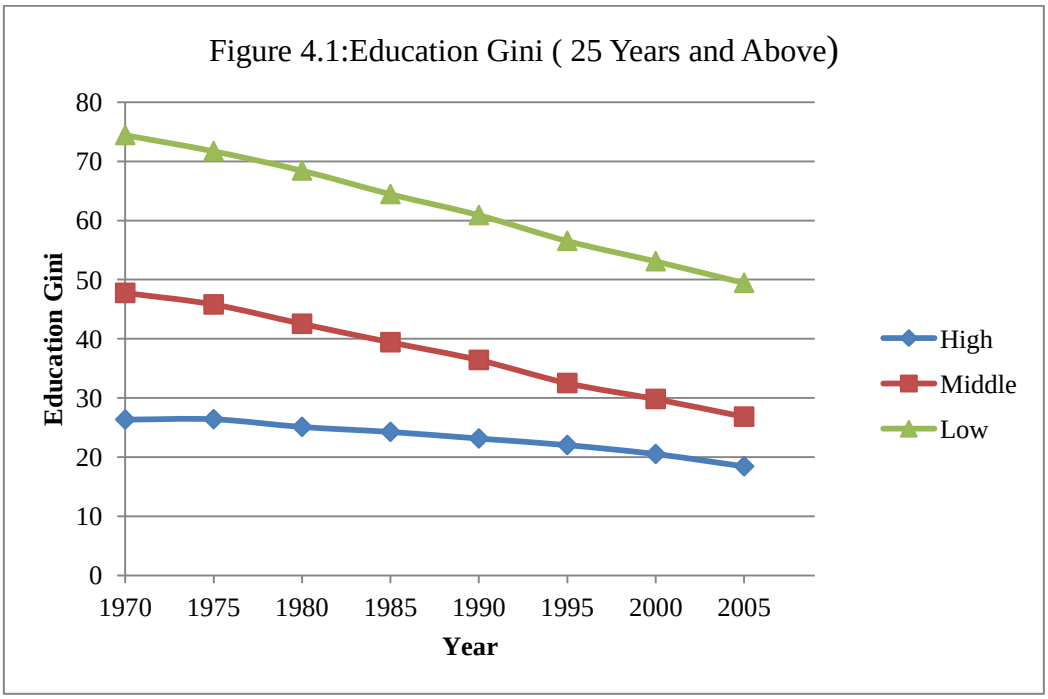
Income Level	Gini	Country	Mean	Std Dev	Min	Max
Low	**Gini15**	**36**	**0.565**	**0.209**	**0.142**	**0.944**
	Gini25	**36**	**0.624**	**0.211**	**0.156**	**0.967**
Middle	Gini15	49	0.328	0.177	0.049	0.896
	Gini25	49	0.376	0.202	0.053	0.912
High	Gini15	27	0.219	0.100	0.050	0.666
	Gini25	27	0.233	0.114	0.052	0.739

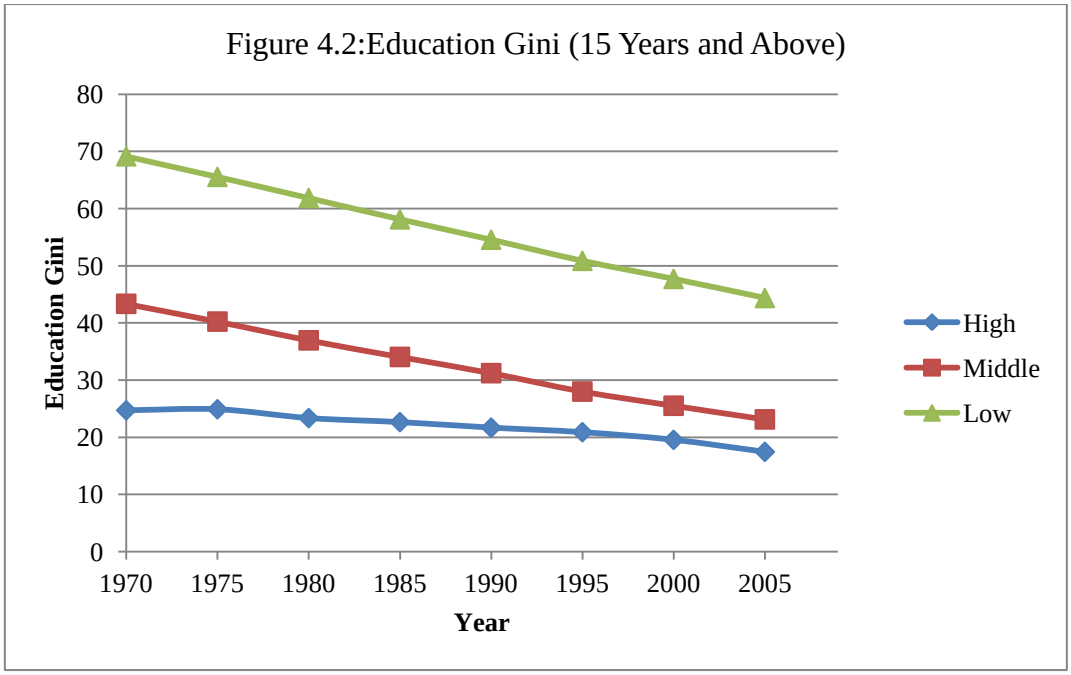
Source: Author's own calculation from Barro and Lee (2010) education data

It is important to note that the two regions with the highest education inequality are the South Asia and sub-Sahara Africa. Particularly, in South Asia, the education Gini coefficient is 1.6 percent greater than the world average for both populations. This also corresponds to the region's low GDP per capita and high dependency ratio. North America and East Asia and Pacific experience the lowest education inequality. Finally, the low-income countries have the

highest education inequality and this is mainly because most of the countries in South Asia and sub-Saharan Africa regions are categorized as low-income or less developed countries. This corresponds to the fact outlined by Holsinger and Jacobs (2009); "Countries that have highly equitable distributions of human capital in their labor force are countries whose per capita incomes grow." In overall, there exists a substantial variation in the human capital inequality among the countries in these regions. The trends for education gini (Gini15 and Gini25) for three different levels of income are illustrated in Figure 4.1 and Figure 4.2 below.

Figure 4.1:Education Gini (25 Years and Above)





4.4.2 Independent Variables

To measure globalization, we use the KOF index (Dreher, 2006; Dreher *et al*., 2008) which measures three different dimensions of globalization; economic (KOF1) (actual trade flows and restrictions); social (KOF2) (personal contact, information flows and cultural proximity) and political globalization (KOF3) (number of embassies and membership in international organizations). We also use the composite measure of the index (KOF), which is the weighted average of the three-globalization dimensions. In either case, the value of the index is between 0 and 100; values closer to 100 indicate higher globalization. Therefore, the KOF index may provide a more comprehensive view of the relationship compared to the traditional measure of globalization[49]. The details of the index and the dimensions are listed in Table C.2. We transform the index into logarithm to capture the non-linearity between human capital

[49] Previous literature has used openness to trade or foreign direct investments as proxy for globalization. Others have used Sachs and Warner (1995) openness index or Kearney/Foreign Policy globalization index.

inequality and the globalization index. Figures 4.3-4.6 are the trends for the KOF Indices. In general, the indices exhibit increasing trend for all three levels of income. The gap between the high-income, middle, and low-income countries are very similar for KOF1 and KOF2, but the gap is quite large for KOF3.

Figure 4.3:Globalization Index (KOF)

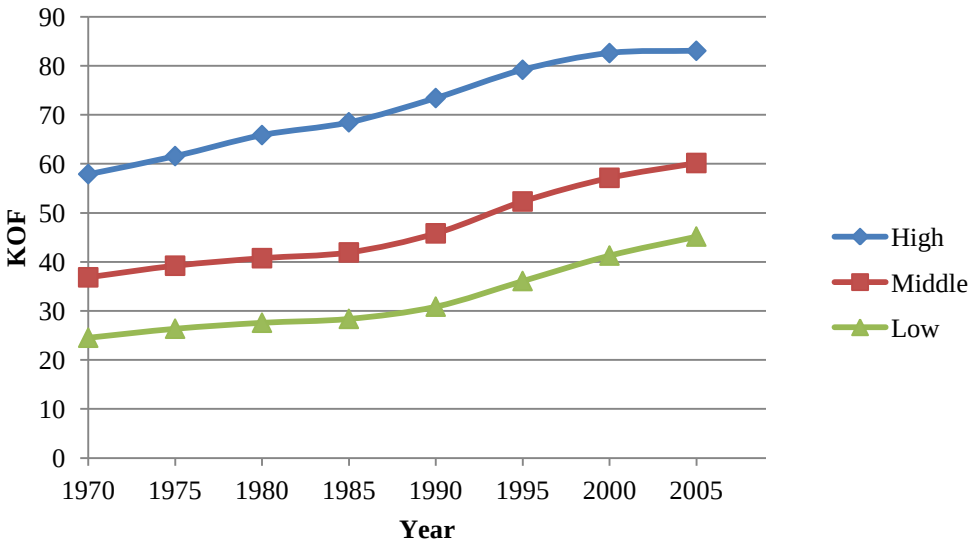
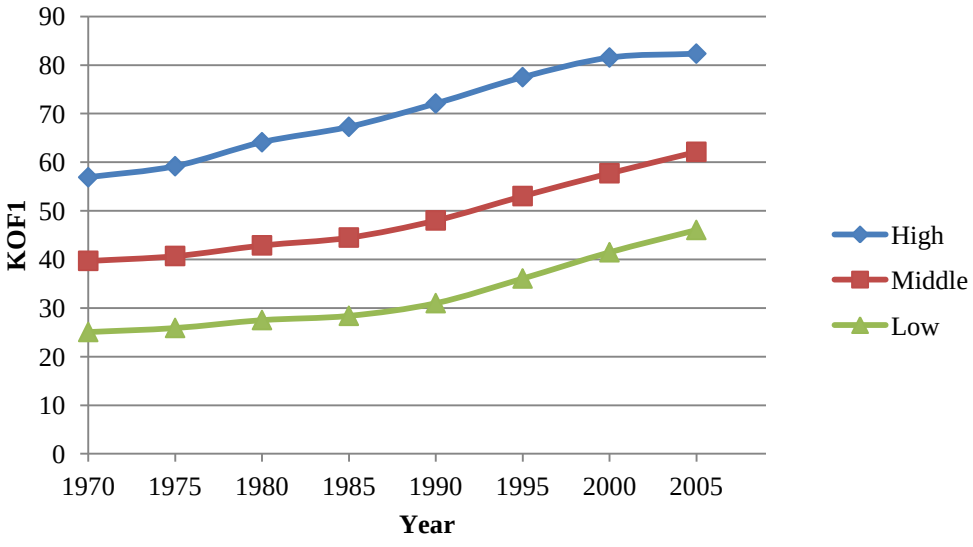
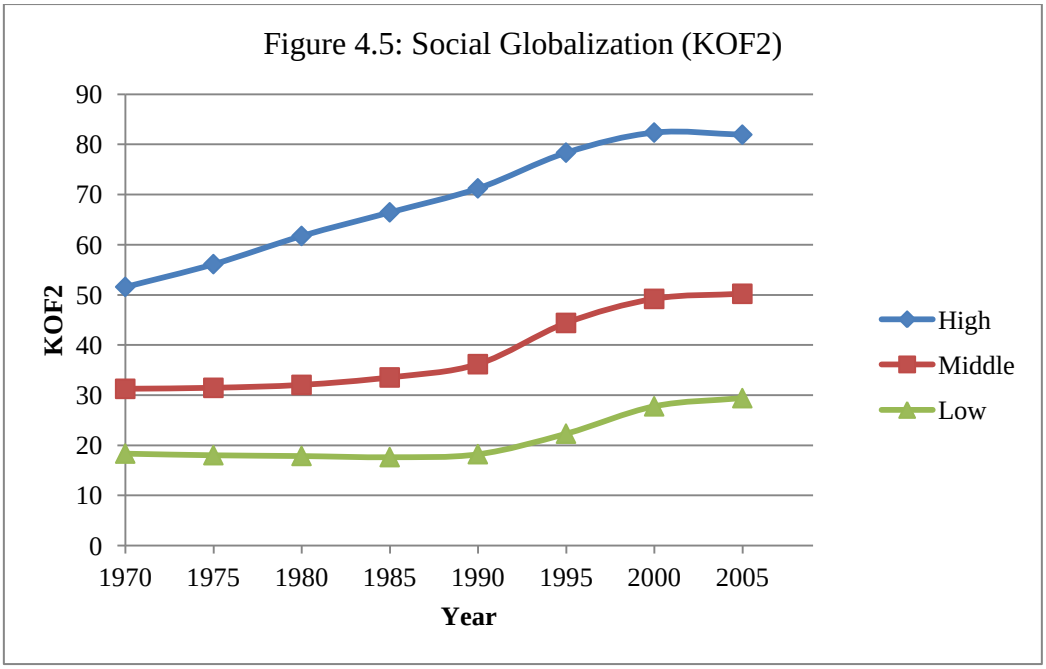
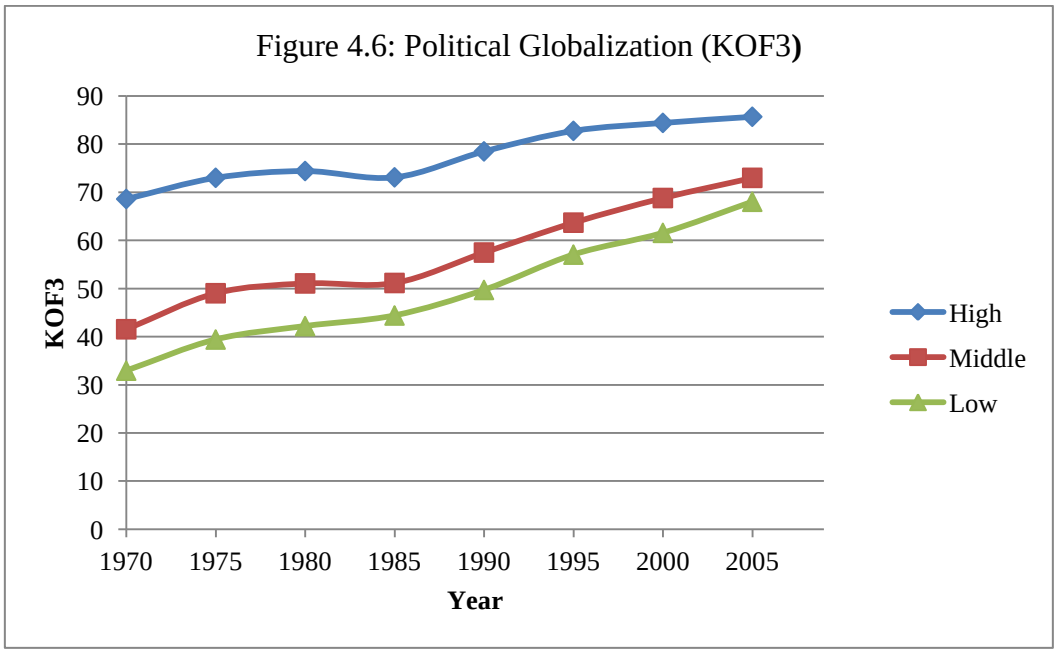


Figure 4.4: Economic Globalization (KOF1)







We also use three additional proxies for globalization, which are openness to trade (*Openness*), foreign direct investment (*FDI*) and freedom to trade internationally (*EF index)* to check the robustness of the results. Openness to trade is measured as the ratio of total trade to GDP and has been employed by previous studies on globalization. From a theoretical point of

view, openness to trade is expected to benefit developing countries that are abundant with unskilled workers. Foreign direct investment inflow (FDI) is taken from the World Bank-World Development Indicator (WDI). A number of studies have evaluated the effects of FDI on income inequality or wage inequality, but with mixed conclusions[50]. Basu and Guariglia (2007) find a positive association between FDI and human capital inequality.

We also choose the fourth dimension of the Economic Freedom of the World Index, which is the freedom to trade internationally as another proxy for globalization. This index combines the measures of trade taxes, tariffs and barriers as well as capital market controls and is closely related to economic globalization index (KOF1). The index range from 0 to 10 and is developed by Gwartney and Lawson (2003). We illustrate the trends for these three additional variables in Figure 4.7-4.9 below. Figure 4.7 displays the trend for openness to trade. In early 1970s, the degree of openness to trade is higher in middle-income countries, but from late 1990s, high-income countries display the highest degree of openness. Overall, all three countries have increasing trends although middle and low-income countries experience a drop in early 1980s.

For the EF index, as shown in Figure 4.8, both middle and low-income countries exhibit similar trends during the 40 years period. The countries demonstrate a drop in the index in 1985 and continue increasing until late 2000s. On the other hand, high-income countries show a constant trend when it starts to increase in late 1970s and rise constantly until early 2000s.

[50] For example, Tsai (1995) concludes that the relationship between FDI and inequality varies across geographical regions with positive effects only in East and South Asian countries. A similar study by Choi (2004) finds a positive relationship between the two. Other studies find that capital inflows increase the demand for skilled workers which increase their relative wages and lead to the reduction of wage inequality (see for example: Lipsey and Sjoholm, 2007 and Basu and Guariglia, 2007).

Finally, the FDI inflow as displayed in Figure 4.9 portrays three different patterns for the levels of income. The inflow for high-income countries increases steadily from 1970s to 1990s before a steep increase in the late 1990s before starting to decrease in the middle of 2000s. Conversely, low and middle-income countries have contrasting trends. FDI inflow in middle-income countries increases from 1970s up to 1990s, but a sharp fall is evident from late 1990s to late 2000s. For low-income countries, inflow increases up to 1975 before declining until 1985 and increases again after that year.

Figure 4.7: Openness to Trade

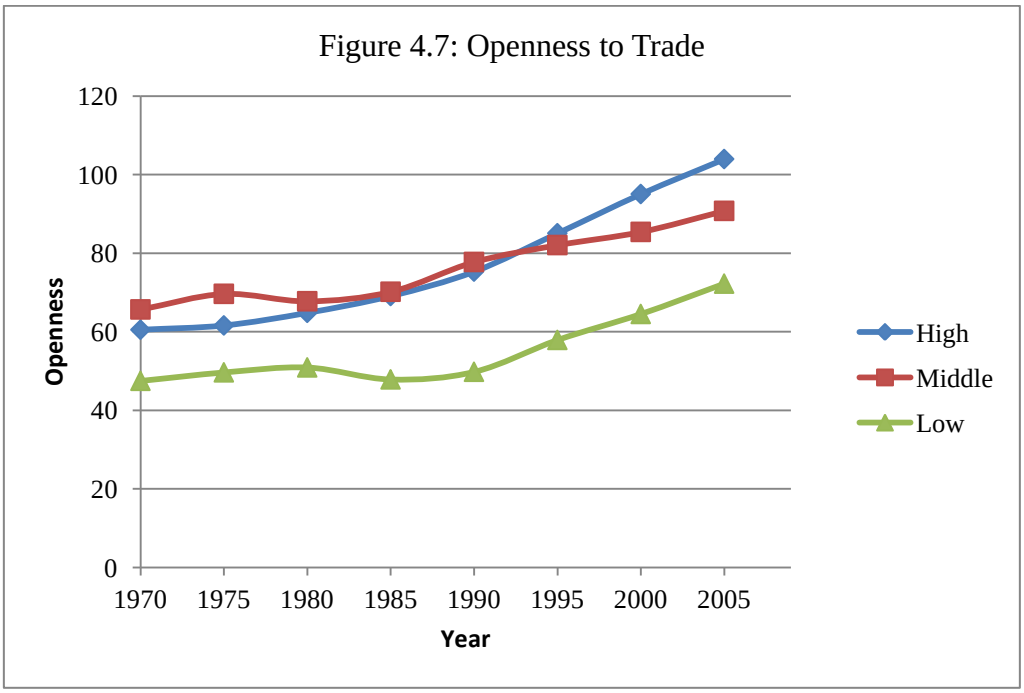


Figure 4.8: EF Index

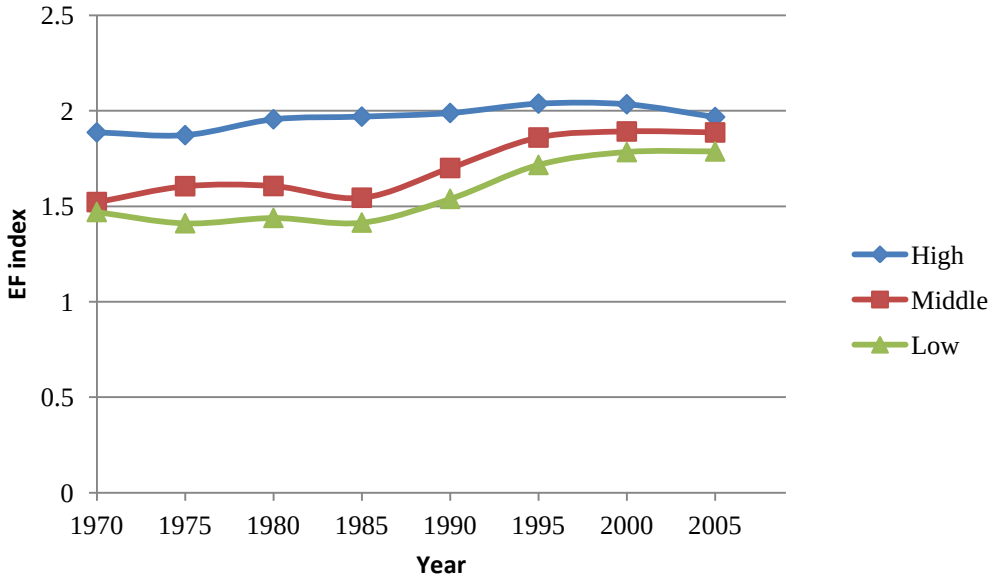
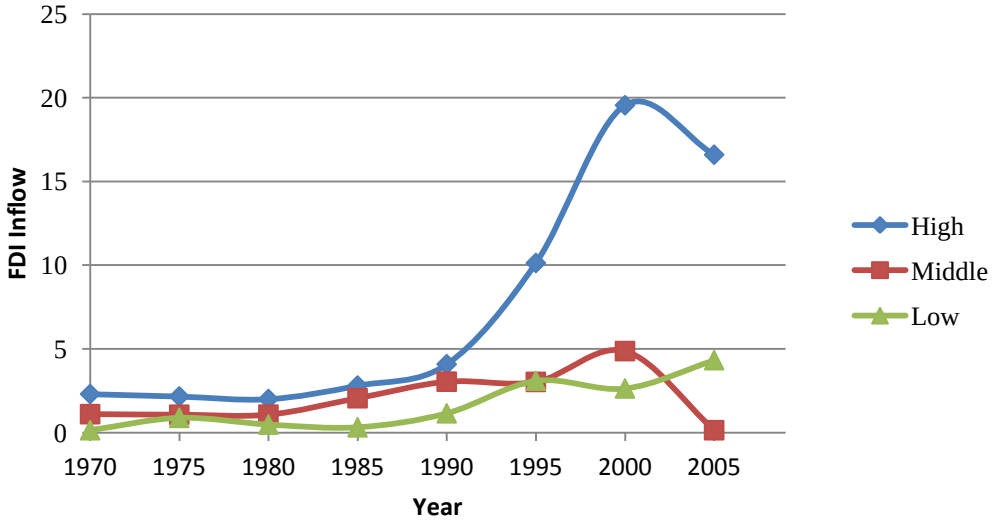


Figure 4.9: FDI Inflow



We include a number of control variables in the specifications to examine the impact of other factors on education inequality. Because of the absence of a theory that explains the determinants of education inequality, we rely on existing study (Castello and Domenech, 2001; Checci and Garcia-Penalossa, 2004) in choosing the control variables. We add three

control variables to the baseline regression model. First, we include the log of Real GDP per capita (in constant 2005, PPP adjusted) to control for the level of development. It is also a good predictor of a country's educational achievement (Checci and Garcia-Penalosa, 2004). The data on Real GDP per capita is extracted from PWT 7.0. To capture the primary effect of demographic structure, we include the age dependency ratio for population younger than 15 years old and older than 64 years old. The likelihood of seeking education might depend on the size of the household (how many children a family has) and on the age structure of the household. We expect that higher dependency ratio is associated with higher human capital inequality. Lastly, we include private credit as a percentage of GDP (ratio of credit to the private sector by deposit money banks and other financial institutions) as a measure of financial development. The data is from Beck and Demirguc-Kunt (2009) and it is an important variable to proxy for the ability to borrow to finance educational costs. All control variables and their sources are listed in Table C.3.

We also present the three main control variables explained above in plots in Figures 4.10-4.12. The first graph is plot for the log of GDP per capita for low, middle and high-income countries. There is an evident trend for this variable, it exhibits an increasing straight-line pattern and very similar for these income levels. Low and middle-income countries share similar trends of age dependency ratio, for both levels of income, age dependency exhibit a decreasing trend. High-income countries start with a low age dependency ratio that is reduced even further until 1985 and the rate does not change much until the late 2000s. Similar to GDP per capita, private credit, which is the proxy for financial development, is increasing for all three levels of income. The patterns are similar, although the high-income countries experience the highest increase in late 1990s to early 2000s.

Figure 4.10:Log of GDP per capita

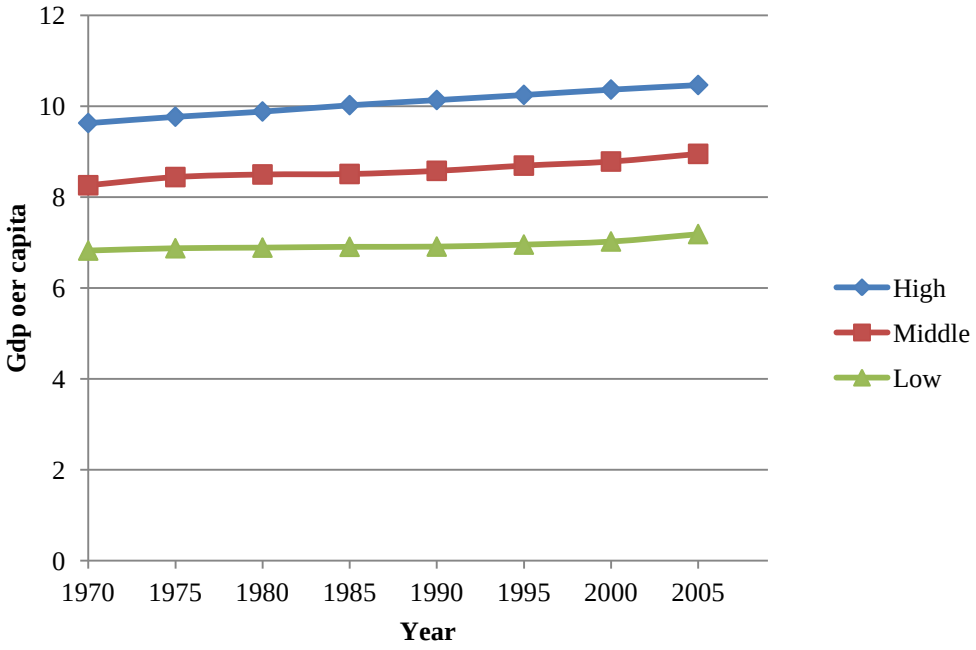
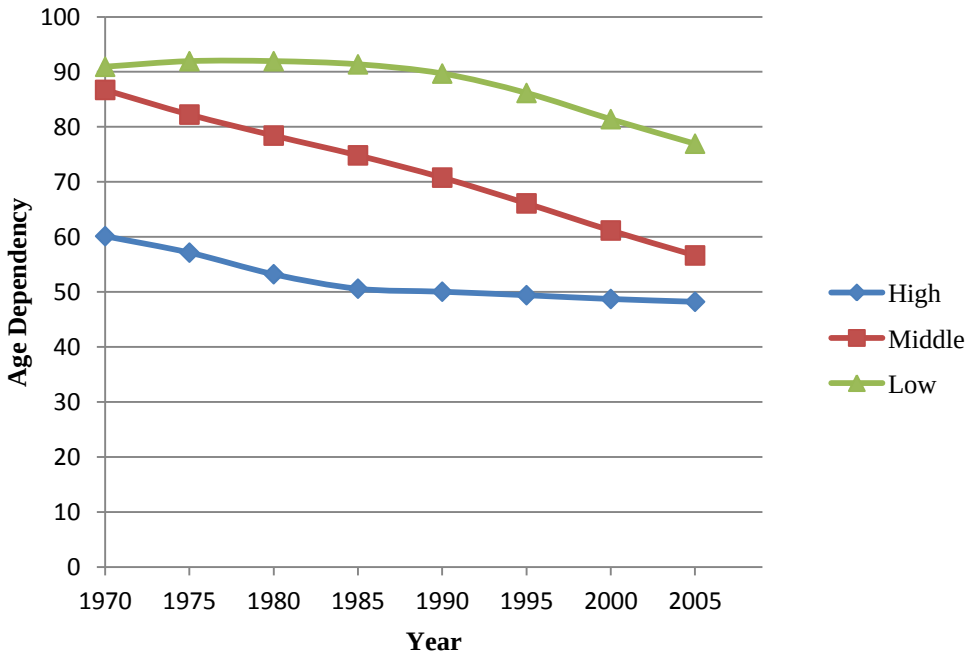
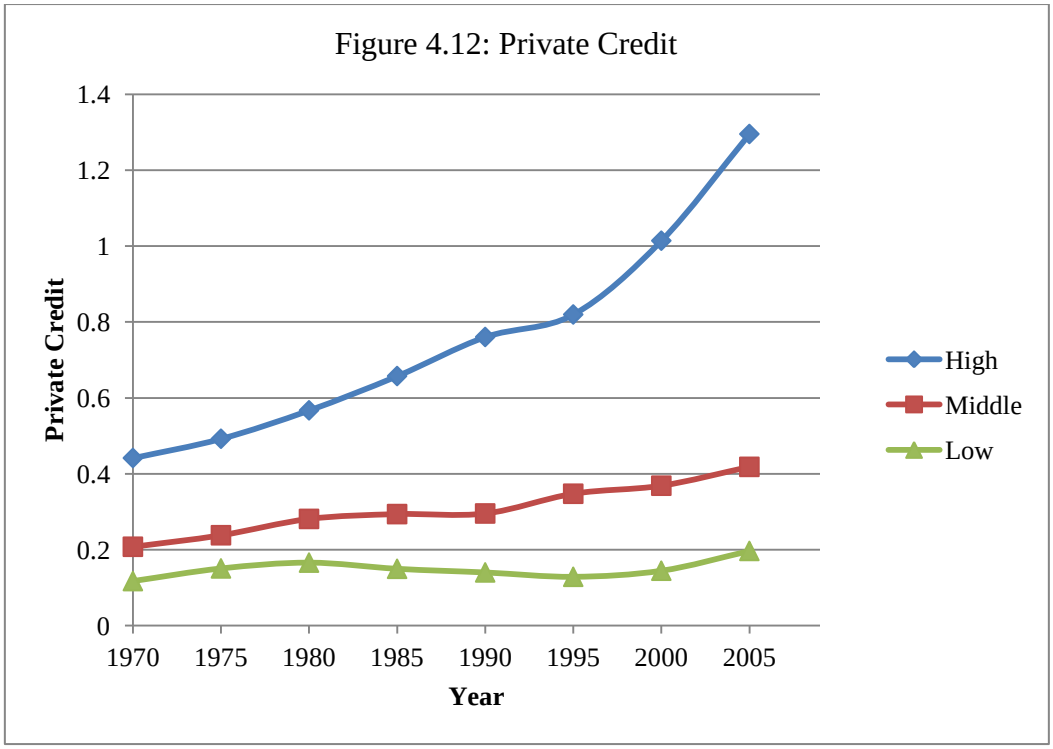


Figure 4.11:Age Dependency Ratio





To test the robustness and sensitivity of our results, we include several other control variables. Additional control variables include the standard deviations of output growth or volatility, to control for the effect of uncertainty on inequality, fertility rate to proxy for health standards[51], degree of urbanization, capital/output ratio to capture the demand for skilled workers and democracy and political rights to control for institutions. We also consider the amount of public resources invested in education as suggested by Checci (2001). We use the public spending on education as a percentage of GDP to account for the availability of funding in education. However, including this important variable leads to the undesirable decreases in the number of observations. The data for public spending presents many gaps, thus we take the averages of the variable over the 40 years to preserve the number of observations. All

[51] Alternatively, we also use life expectancy and infant mortality rates to control for health variable. The results are similar regardless of variables used.

independent variables but the institutional quality (democracy index and political rights) are expressed in natural logarithms to capture the non-linearity among the variables.

4.4.3 Descriptive Statistics and Correlation

Before discussing the results of the analysis, we discuss briefly the summary statistics and correlation of the variables. The summary statistics (Table C.3, Appendix C) show a sizeable variation in both education Gini and the KOF indices. From the correlation matrix, we can see that the KOF indices are strongly correlated to human capital inequality. Of these correlations, economic globalization shows the greatest correlation with human capital inequality; a negative coefficient of 0.579 for Gini15 and -0.582 for Gini25. The indices are also highly correlated with each sub-component, which meets our prior expectations. On the other hand, social and political globalization is negatively correlated with human capital inequality with a lower value. There is also a strong correlation between a country's development (GDP) and overall globalization of 0.831, as well as between financial development and overall globalization of 0.617.

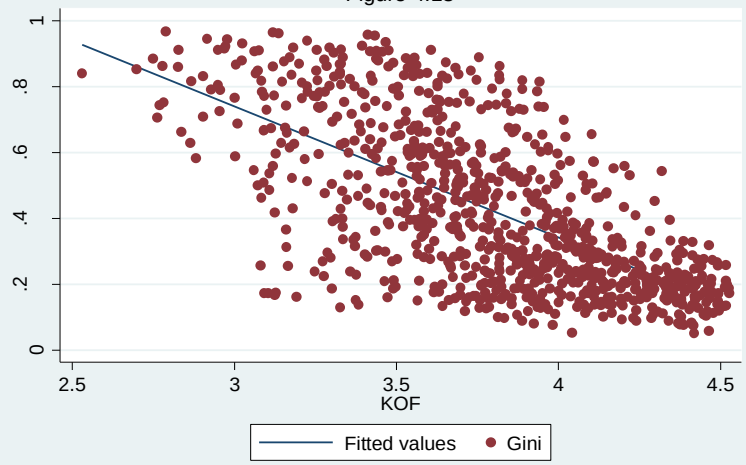
This is because the more developed economics are probably more globalized and therefore they must have a sound and strong financial market. Age dependency ratio is moderately related to human capital inequality, 0.562 with Gini15 and 0.593 with Gini25 respectively. Figures 4.13-4.22 show the bivariate correlation between human capital inequality (education gini) and the main variables in the analysis. Generally, the figures show that there is a strong negative correlation between education inequality and the globalization indices (Figures 4.13-4.16). Education inequality is also negatively correlated with the alternative measures of

globalization (Figures 4.17-4.19). In contrast with Basu and Guariglia (2007), we can see that FDI and human capital inequality is negatively correlated.

GDP per capita and private credit are negatively correlated with human capital inequality as shown in Figures 4.20 and 4.21. This is consistent with the fact that higher GDP leads to equal distribution of education. Good financial market provides access to capital for the poor and may reduce inequality. The age dependency ratio is positively related to human capital inequality, which shows that the higher the population that is not in the labor force, the higher the inequality of education will be. Although a simple bivariate correlation may be misleading, it provides an initial analysis of the empirical relationship between the variables. Nonetheless, this relationship should be evaluated with caution as it maybe a byproduct of endogeneity, a potential problem that is addressed by applying the dynamic panel model in our model.

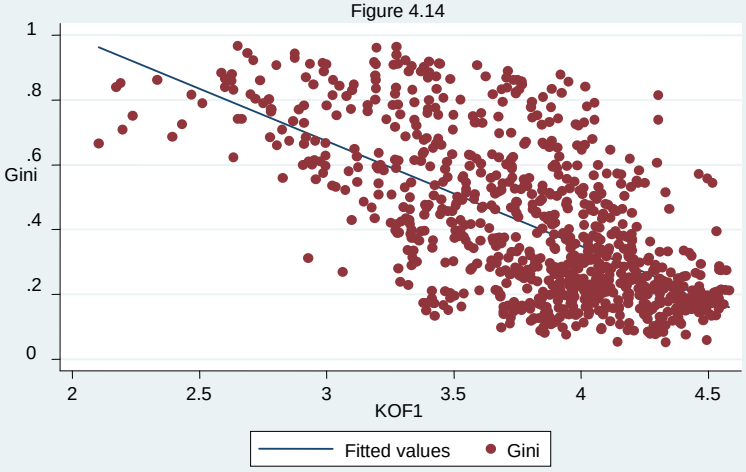
Education Gini and KOF Index: Bivariate Prediction

Figure 4.13



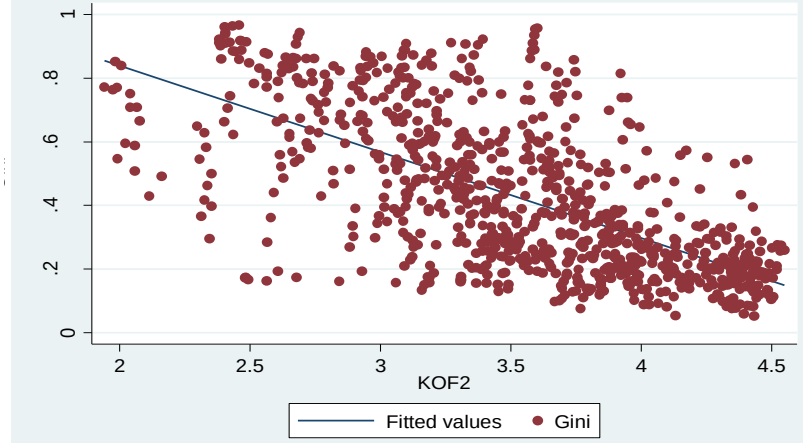
Education Gini and Economic Globalization (KOF1): Bivariate Prediction

Figure 4.14



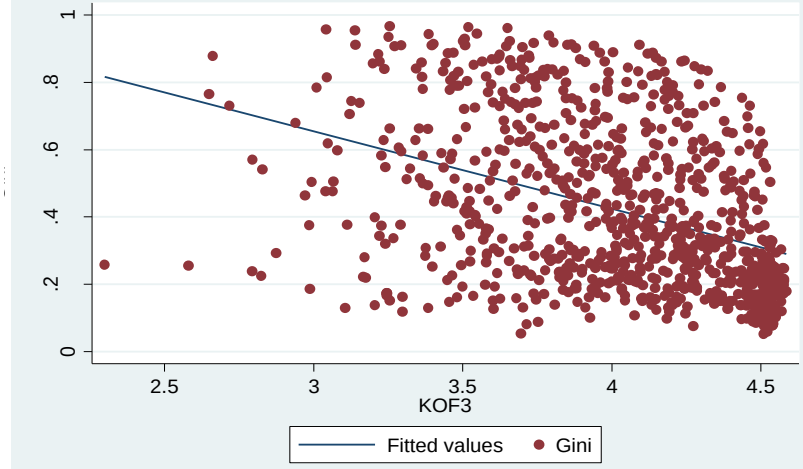
Education Gini and Social Globalization (KOF2): Bivariate Prediction

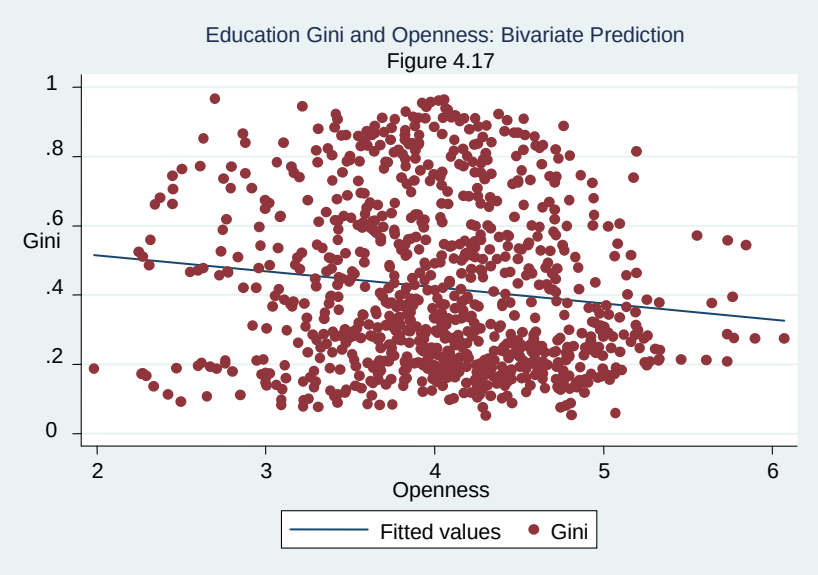
Figure 4.15

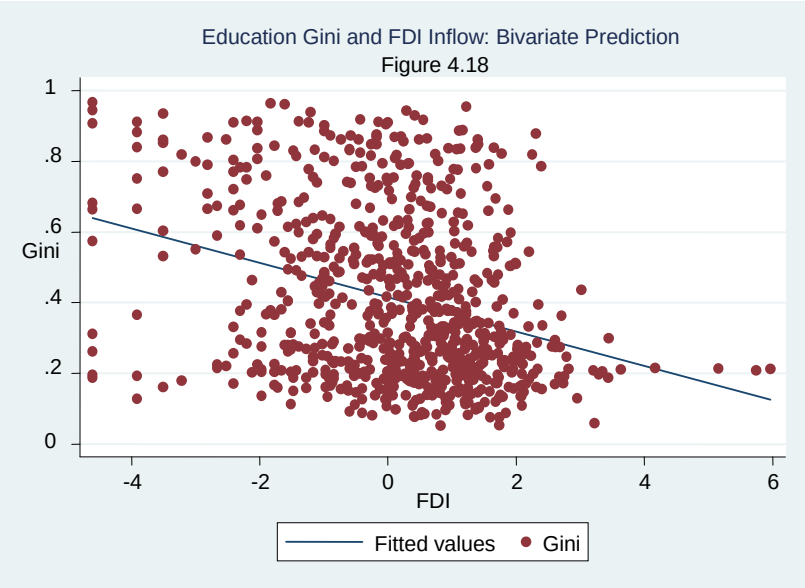


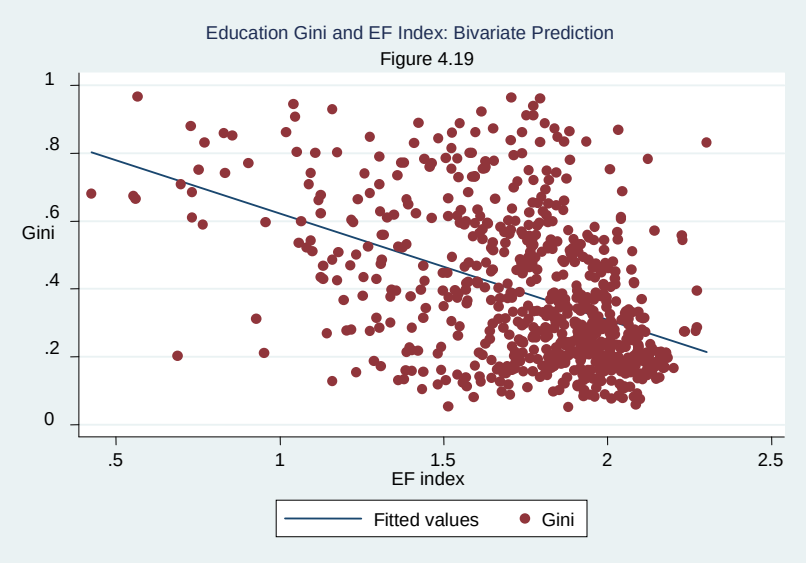
Education Gini and Political Globalization(KOF3): Bivariate Prediction

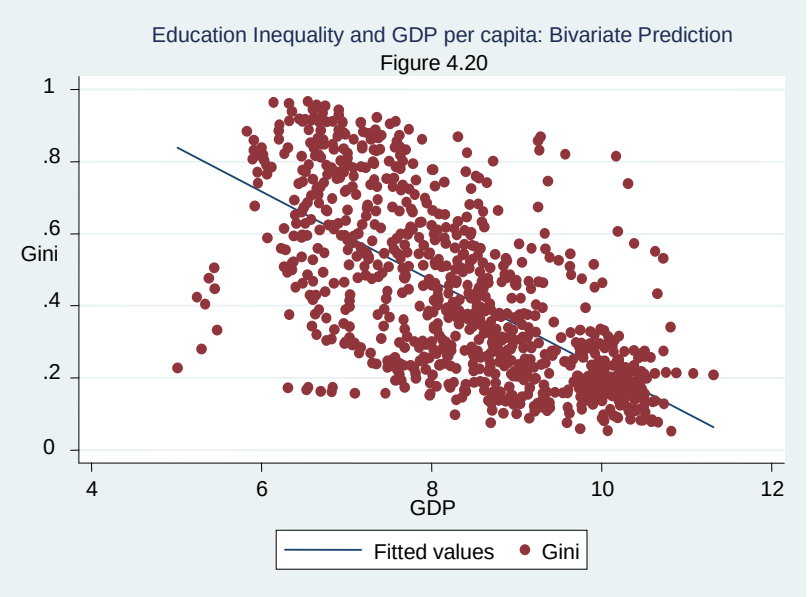
Figure 4.16

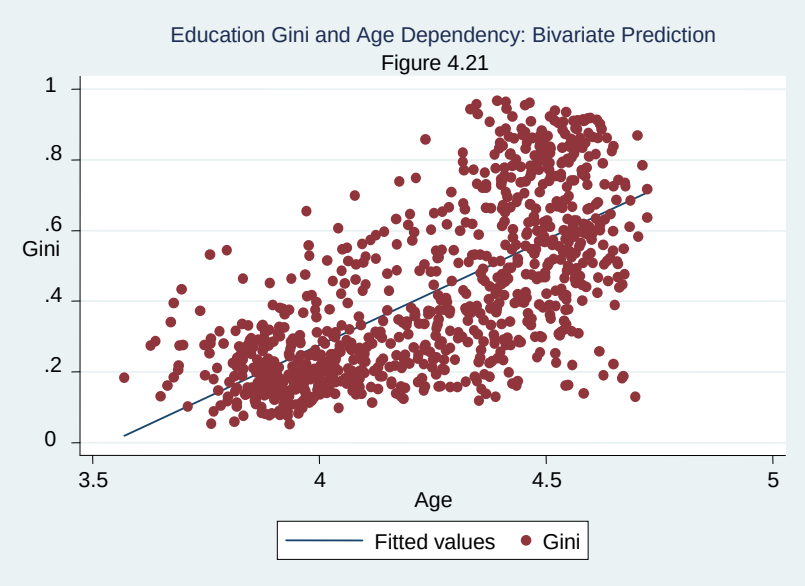


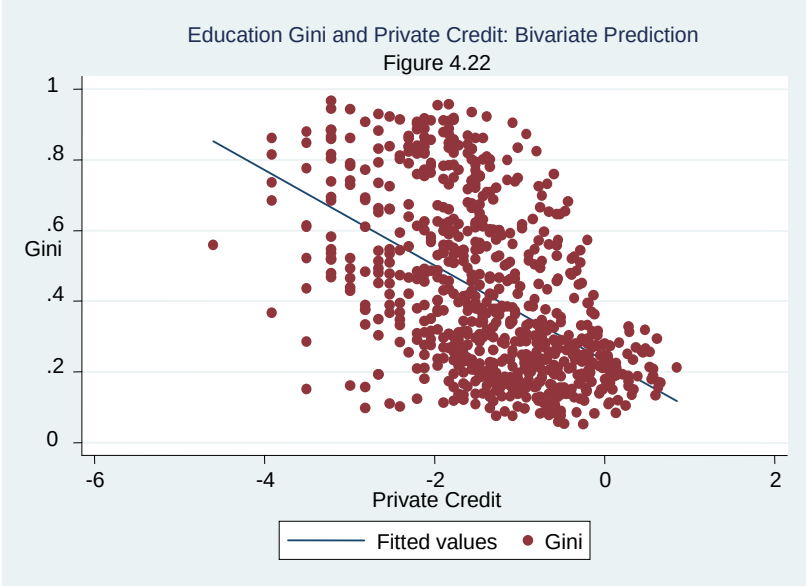

Education Gini and Openness: Bivariate Prediction
Figure 4.17
Gini
Openness
Fitted values
Gini


Education Gini and FDI Inflow: Bivariate Prediction
Figure 4.18
Gini
FDI
Fitted values
Gini


Education Gini and EF Index: Bivariate Prediction
Figure 4.19
Gini
EF index
Fitted values
Gini


Education Inequality and GDP per capita: Bivariate Prediction
Figure 4.20
Gini
GDP
Fitted values
Gini


Education Gini and Age Dependency: Bivariate Prediction
Figure 4.21
1
.8
.6
.4
.2
0
Gini
3.5
4
4.5
5
Age
Fitted values
Gini


Education Gini and Private Credit: Bivariate Prediction
Figure 4.22
1
.8
.6
.4
.2
0
Gini
-6
-4
-2
0
2
Private Credit
Fitted values
Gini

4.5 Empirical Specification

We adopt an empirical model similar to Bergh and Nillson (2010) to study the effect of globalization on inequality and to answer our first question. A panel regression model is formulated as below:

$$E_{it} = \alpha + Global_{it}\beta + X_{it}\gamma + \delta_i + \rho_t + \epsilon_{it} \quad (4.6)$$

The dependent variable, E_{it} is the Education Gini for population aged 25 years and above and $Global_{it}$ is the vector of globalization indices and measures. We include several covariates in X'_{it} stated explicitly in the previous section. δ_i is the country fixed effect, ρ_t is the year fixed effect and ϵ_{it} is the error term. *i* and *t* represent countries and time respectively.

To examine whether the effect of globalization varies by level of income, we construct two variables: *($Global_{it}$ * $DummyMid_{it}$) and ($Global_{it}$ * $DummyHi_{it}$).* The first variable is an interaction term between the globalization measure with a dummy variable, 1 for middle income countries and 0 for others ($DummyMid_{it}$). Similarly, the second variable is the interaction between globalization and dummy variable for high-income countries ($DummyHi_{it}$). All variables are expressed in 5-year averages.

$$E_{it} = \alpha + \beta_1 Global_{it} + \beta_2 DummyMid_{it} + \beta_3 DummyHi_{it} + \beta_4 (Global_{it} * DummyMid_{it}) + \beta_5 (Global_{it} * DummyHi_{it}) + \beta_6 X'_{it} + \delta_i + \rho_t + \epsilon_{it} \quad (4.7)$$

Estimating the above equation by least squares will raise the issue of potential endogeneity among the variables of interests. This may be due to the correlation of the explanatory variables. It is possible that the level of globalization is affected by the changes in human capital inequality or vice versa.

There are different ways to control for endogeneity problems. One of the common ways is to use a dynamic estimation technique. In this chapter, it corresponds to regressing education inequality on its lagged value and other control variables. Pooled Ordinary Least Square (OLS) estimation will yield inconsistent results due to the presence of the lagged dependent variables and the country fixed effects. However, as argued by Nickell (1981), within estimator and dynamic models also yield biased estimates. The within estimator is consistent when *T* is large, but due to the presence of dummy variables in the second model, we cannot apply this estimator.

The deal with the bias problem in dynamic panel data models, Generalized Method of Moments (GMM) estimators has been developed. The first-difference GMM proposed by Arellano and Bond (1991) has been the most common approach in estimating a dynamic panel data model. Nevertheless, Bond *et al.* (2001) have pointed out some weaknesses of this estimator although it controls the problem of unobservable heterogeneity. The estimator is known to be weak when the sample size is small and persistent. In this study, the globalization index varies significantly across countries, but changes slowly and remains stable within a country. Thus, the lagged levels of this variable are weak instruments for the following first difference. In small sample, this weak instruments problem will lead to large finite sample bias (Bond *et al.*, 2001).

There is a more powerful method to handle the endoegeneity problem, which is the system GMM estimator introduced by Arellano and Bover (1995) and further developed by Blundell and Bond (1998). The system GMM estimator uses additional moment condition compared to the first-difference estimator originally developed by Holtz-Eakin *et al.* (1998) and Arellano and Bond (1991). This method uses lagged differences as instruments in the level equation and lagged levels as instruments for the difference equation (Arellano and Bover, 1995, and Blundell and Bond, 1998). The estimator is consistent in the presence of endogenous variables and suitable instruments.

System GMM controls for the unobserved country specific effects by differentiating the model to eliminate the country specific effects or any time-invariant country specific variable and is suitable for panels with small *T* and large *N*. The system GMM regressions are conducted by implementing Roodman (2009a, 2009b) two-step method and Windmeijer (2005) finite sample corrections. Dreher and Gaston (2008) and Bergh and Nilsson (2010) have used system GMM in their study. The system GMM estimator is consistent under the absence of second order serial autocorrelation and the presence of valid instruments. We compute two diagnostic tests for first order and second order serial correlation in the disturbances. We should reject the null of the absence of first order serial correlation and accept the null of the absence of second order serial correlation. For the validity of the instruments, we conduct the Hansen-J test of over-identifying restrictions, which we should not reject the null that the instruments are uncorrelated with the error term. The moment conditions have been illustrated in the previous two chapters.

4.6 Empirical Results

4.6.1 Baseline Results

We begin the empirical analysis by estimating equation (4.6) by three different methods, pooled OLS, random effects (RE) and fixed effects (FE). The dependent variable in all analysis is the education Gini for population aged 25 years and above. To account for heterokedasticity, we undertake the analysis using robust standard errors. All regressions include significant time dummies.

Results are presented in Table 4.3 and 4.4. Table 4.3 is the result for the KOF indices and Table 4.4 is the result for alternative measures. Across three different methods, the overall KOF index is consistently negative and significant, implying the fact that more globalization leads to the reduction in education inequality. However, when analyzed separately by components of globalization, the results vary across methods. Economic globalization is only significant in OLS and RE analysis although it has the expected sign in the FE regression. Social globalization is only significant in OLS regression while political globalization is negative and significant in both RE and FE regressions.

For the control variables, only age dependency is consistently positive and significant for all three methods. GDP per capita is negative as expected in the OLS regression, but when analyzed by FE, the variable changes sign. It is also possible for GDP and education inequality to have a positive association because larger share of population with higher education (as a result from higher income) may increase inequality. Financial development is positive and

significant as expected for both OLS and RE, but there is no significant association between financial market and education inequality in the FE analysis.

The alternative measures of globalization however display a contrasting result. Openness to trade is insignificant in the OLS regression, but positive and significant in the RE and FE model. This is also true for FDI inflow, but FDI is negative and significant in the OLS model. The EF index is only significant in the OLS regression. The results prove that the alternative measure is not robust, and explain the contradicting results from previous literature. Briefly, the control variables perform plausibly like the previous table. These three methods however, do not take into account the potential problem of endogeneity or causality. Fixed effects for example, only account for unobserved country-specific effects that are constant over time. Kandiero and Chitiga (2003) argue that endogeneity is the main interference when dealing with data from developing countries, thus they utilize the first difference GMM that uses lagged regressors as instruments. Basu and Guariglia (2007) also use first difference GMM to control for possible endogeneity between FDI and education inequality.

As we indicated previously, this chapter employs the system GMM estimator. The results of this analysis are reported in Table 4.5.Compared to the previous methods, system GMM reveal expected results: all the indices and the alternative measures of globalization are negative and significant as expected. With the inclusion of the lagged dependent variable, age dependency loses its significance in three of the analyses. GDP is negative and significant in the alternative measures regressions and finance is positive and significant in all regressions. The regressions also passed the over identification test for instrument validity and first and second order serial correlation.

Table 4.3: Human Capital Inequality and Globalization: Baseline Regression: KOF indices

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) RE	(6) RE	(7) RE	(8) RE	(9) FE	(10) FE	(11) FE	(12) FE
KOF	-0.174***				-0.158***				-0.106**			
	(0.037)				(0.044)				(0.044)			
KOF1		-0.164***				-0.068**				-0.025		
		(0.020)				(0.032)				(0.031)		
KOF2			-0.139***				-0.029				0.011	
			(0.024)				(0.027)				(0.028)	
KOF3				0.010				-0.135***				-0.147***
				(0.022)				(0.026)				(0.025)
GDP	-0.071***	-0.061***	-0.059***	-0.104***	-0.006	-0.019	-0.020	-0.009	0.059**	0.057*	0.054*	0.062**
	(0.013)	(0.011)	(0.013)	(0.010)	(0.019)	(0.019)	(0.019)	(0.018)	(0.028)	(0.029)	(0.027)	(0.024)
Finance	0.033***	0.040***	0.032***	0.020**	0.022**	0.021**	0.018**	0.016*	0.015*	0.012	0.010	0.011
	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)
Age	0.214***	0.269***	0.229***	0.238***	0.155***	0.193***	0.186***	0.156***	0.163***	0.193***	0.196***	0.149***
	(0.041)	(0.039)	(0.040)	(0.042)	(0.055)	(0.055)	(0.056)	(0.051)	(0.055)	(0.053)	(0.055)	(0.049)
Constant	0.835***	0.473**	0.508**	0.305	0.465	0.070	-0.043	0.422	-0.319	-0.744*	-0.861**	-0.109
	(0.244)	(0.230)	(0.233)	(0.258)	(0.408)	(0.390)	(0.370)	(0.341)	(0.457)	(0.421)	(0.417)	(0.377)
Observations	760	733	760	760	760	733	760	760	760	733	760	760
Countries	108	104	108	108	108	104	108	108	108	104	108	108
R^2	0.579	0.596	0.585	0.562	0.523	0.541	0.501	0.356	0.579	0.563	0.568	0.625

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

Table 4.4: Human Capital Inequality and Globalization: Baseline Regression: Alternative Measures

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) RE	(5) RE	(6) RE	(7) FE	(8) FE	(9) FE
Openness	-0.012			0.053***			0.053***		
	(0.010)			(0.017)			(0.018)		
FDI		-0.016***			0.007**			0.008**	
		(0.005)			(0.004)			(0.003)	
EF index			-0.064**			-0.008			-0.005
			(0.029)			(0.025)			(0.022)
GDP	-0.104***	-0.100***	-0.097***	-0.028	-0.030*	-0.030*	0.045*	0.049*	0.047
	(0.010)	(0.010)	(0.010)	(0.018)	(0.017)	(0.018)	(0.027)	(0.028)	(0.029)
Finance	0.022**	0.030***	0.037***	0.011	0.020**	0.018*	0.005	0.015	0.012
	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
Age	0.234***	0.249***	0.223***	0.190***	0.211***	0.234***	0.187***	0.204***	0.235***
	(0.042)	(0.042)	(0.043)	(0.049)	(0.049)	(0.051)	(0.048)	(0.046)	(0.046)
Constant	0.413*	0.260	0.461*	-0.312	-0.167	-0.272	-0.913**	-0.815**	-0.958**
	(0.247)	(0.248)	(0.256)	(0.341)	(0.315)	(0.350)	(0.355)	(0.354)	(0.376)
Observations	761	695	643	761	695	643	761	695	643
Countries	108	108	98	108	108	98	108	108	98
R^2	0.560	0.583	0.553	0.412	0.482	0.496	0.584	0.604	0.558

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

Table 4.5: Human Capital Inequality and Globalization: Baseline Regression [System GMM]

VARIABLES	(1) System	(2) System	(3) System	(4) System	(5) System	(6) System	(7) System
KOF	-0.043**						
	(0.019)						
KOF1		-0.047***					
		(0.017)					
KOF2			-0.020*				
			(0.012)				
KOF3				-0.029*			
				(0.017)			
Openness					-0.020**		
					(0.008)		
FDI						-0.005***	
						(0.001)	
EF Index							-0.051***
							(0.014)
$Gini25_{(t-1)}$	0.831***	0.821***	0.837***	0.840***	0.899***	0.867***	0.831***
	(0.026)	(0.024)	(0.023)	(0.025)	(0.018)	(0.021)	(0.022)
GDP	-0.006	-0.004	-0.005	-0.010**	-0.007***	-0.008**	-0.007*
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Finance	0.008***	0.009***	0.007**	0.006*	0.008***	0.007**	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age	0.022	0.027**	0.027**	0.018	0.018	0.025*	0.026**
	(0.015)	(0.012)	(0.012)	(0.017)	(0.012)	(0.013)	(0.012)
Constant	0.177	0.158	0.050	0.174	0.094	0.005	0.092
	(0.117)	(0.101)	(0.069)	(0.127)	(0.070)	(0.062)	(0.070)
Observations	687[108]	662[104]	687[108]	687[108]	688[108]	649[108]	590[108]
AR1 *p*-value	0.02	0.02	0.02	0.02	0.01	0.02	0.03
AR2 *p*-value	0.11	0.12	0.12	0.12	0.08	0.23	0.21
Hansen J *p*-value	0.30	0.12	0.16	0.06	0.10	0.17	0.13

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

4.6.2 Globalization and Different Level of Development

The results for estimating equation 4.7 are presented below. As we did in previous section, we first estimate the equation by pooled OLS, random effects and weighted least square. Fixed effects regression is unsuitable in this analysis because of the presence of dummy variables. Thus, we also present the results from weighted least square (WLS) estimation for robustness test. Table 4.6a and 4.6b show the results for the KOF indices.

In general, the analysis suggests that the composite KOF index is negatively related to human capital inequality. The dimensions of the index, on the other hand, behave similarly with the composite index except for political globalization (KOF3). KOF3 is only significant in the RE regression while social globalization (KOF2) is insignificant in the WLS regression. Middle-income countries are associated with lower human capital inequality that corroborates to the descriptive statistics in Table 4.1. The dummy for high-income countries also show a negative significant association. Inspired by the Heckscher-Ohlin (H-O) theory, we analyze the effect of globalization on human capital inequality between different levels of development. The effect of globalization according to the level of development provides a different view. In middle-income countries, globalization is expected to widen the gap of education inequality and the result holds for high-income countries. Nevertheless, it is also shown that political globalization has a weak correlation with inequality.

Briefly, the control variables perform rationally. GDP per capita has a negative effect on inequality (for OLS and WLS) which is expected, as higher income would presumably lead to equal distribution. As expected, age dependency is positively correlated with inequality in all

regressions. Financial development is positive and significant, implying that the existence of a developed credit market to finance education is presumed to widen the gap of educational attainment in the population.

We now turn to examine the relationship between human capital inequality and alternative measures of globalization in Table 4.7a and 4.7b. We note that the effect of FDI appears to be insignificant compared to the other two measures. Both openness and freedom to trade have similar effects on human capital inequality with the KOF indices. In addition, the positive effect of globalization in middle and high-income countries hold for all three globalization measures. Other control variables behave expectedly with high significance. Overall, the magnitudes of the estimated effects for the KOF indices and the alternative measures on different levels of development are very close. Nonetheless, the results should be taken as indicative as we will focus on our preferred method, which is the system GMM estimator.

Table 4.6a: Human Capital Inequality and Globalization: Different Levels of Development: KOF Indices

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) RE	(6) RE	(7) RE	(8) RE	(9) WLS	(10) WLS	(11) WLS	(12) WLS
KOF	-0.317***				-0.166***				-0.369***			
	(0.039)				(0.041)				(0.136)			
KOF*Mid	0.244***				0.132***				0.619***			
	(0.053)				(0.051)				(0.137)			
KOF*High	0.281***				0.288***				0.684***			
	(0.048)				(0.058)				(0.142)			
KOF1		-0.235***				-0.109***				-0.333***		
		(0.026)				(0.029)				(0.085)		
KOF1*Mid		0.140***				0.143***				0.750***		
		(0.037)				(0.040)				(0.091)		
KOF1*High		0.266***				0.260***				0.596***		
		(0.037)				(0.046)				(0.090)		
KOF2			-0.172***				-0.048*				0.087	
			(0.033)				(0.029)				(0.086)	
KOF2*Mid			0.052				0.075**				0.188**	
			(0.042)				(0.036)				(0.092)	
KOF2*High			0.193***				0.190***				0.251**	
			(0.038)				(0.042)				(0.100)	
KOF3				-0.046				-0.151**				-0.103
				(0.042)				(0.033)				(0.085)
KOF3*Mid				0.093*				0.034				0.191**
				(0.050)				(0.048)				(0.085)
KOF3*High				-0.054				0.090				0.096
				(0.053)				(0.076)				(0.093)

Table 4.6b: Human Capital Inequality and Globalization: Different Levels of Development: KOF Indices (Continued)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) RE	(6) RE	(7) RE	(8) RE	(9) WLS	(10) WLS	(11) WLS	(12) WLS
GDP	-0.050***	-0.050***	-0.047***	-0.059***	0.011	0.009	0.014	0.035	-0.050***	-0.026***	-0.051***	-0.016
	(0.017)	(0.016)	(0.016)	(0.016)	(0.027)	(0.026)	(0.025)	(0.025)	(0.009)	(0.008)	(0.010)	(0.011)
Finance	0.036***	0.036***	0.031***	0.024***	0.014*	0.013*	0.012	0.013*	-0.013	-0.065***	0.009	-0.003
	(0.008)	(0.009)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.008)	(0.011)	(0.015)	(0.011)	(0.012)
Age	0.279***	0.293***	0.248***	0.292***	0.174***	0.199***	0.183***	0.161***	0.098***	0.055*	0.112***	0.033
	(0.040)	(0.038)	(0.042)	(0.040)	(0.058)	(0.055)	(0.058)	(0.050)	(0.031)	(0.029)	(0.034)	(0.035)
Middle	-0.974***	-0.559***	-0.243*	-0.497**	-0.697***	-0.730***	-0.491***	-0.408**	-2.553***	-2.946***	-1.106***	-1.109**
	(0.196)	(0.139)	(0.144)	(0.201)	(0.197)	(0.158)	(0.142)	(0.197)	(0.477)	(0.335)	(0.315)	(0.290)
High	-1.131***	-1.086***	-0.806***	0.121	-1.467***	-1.349***	-1.113***	-0.771**	-2.873***	-2.368***	-1.424***	-0.767**
	(0.188)	(0.149)	(0.142)	(0.219)	(0.242)	(0.188)	(0.180)	(0.330)	(0.503)	(0.329)	(0.357)	(0.321)
Constant	0.943***	0.555**	0.471*	0.012	0.422	0.110	-0.065	0.316	1.936***	1.520***	0.341	1.083***
	(0.257)	(0.242)	(0.253)	(0.308)	(0.423)	(0.392)	(0.399)	(0.373)	(0.501)	(0.350)	(0.357)	(0.343)
Observations	760	733	760	760	760	733	760	760	760	733	760	760
Countries	108	104	108	108	108	104	108	108	108	104	108	108
R^2	0.613	0.622	0.606	0.586	0.578	0.569	0.549	0.510	0.517	0.385	0.465	0.415

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression. KOF*Mid is the interaction term between the KOF indices with middle income countries. KOF*High is the interaction term between the KOF indices with high-income countries

Table 4.7a: Human Capital Inequality and Globalization: Different Levels of Development: Alternative Measures

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) RE	(5) RE	(6) RE	(7) WLS	(8) WLS	(9) WLS
Openness	-0.129***			-0.050***			-0.407***		
	(0.021)			(0.018)			(0.062)		
Openness*Middle	0.133***			0.123***			0.654***		
	(0.025)			(0.025)			(0.065)		
Openness*High	0.183***			0.161***			0.479***		
	(0.023)			(0.032)			(0.064)		
FDI		-0.043***			-0.006			-0.021	
		(0.008)			(0.004)			(0.013)	
FDI*Middle		0.033***			0.018***			0.044***	
		(0.011)			(0.005)			(0.014)	
FDI*High		0.051***			0.027***			0.040***	
		(0.009)			(0.006)			(0.014)	
EF Index			-0.209***			-0.117***			-0.265**
			(0.040)			(0.026)			(0.128)
EF index*Middle			0.190***			0.165***			0.643***
			(0.055)			(0.032)			(0.130)
EF Index*High			0.264***			0.195***			0.273**
			(0.052)			(0.060)			(0.129)

Table 4.7b: Human Capital Inequality and Globalization: Different Levels of Development: Alternative Measures (Continued)

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) RE	(5) RE	(6) RE	(7) WLS	(8) WLS	(9) WLS
GDP	-0.060***	-0.075***	-0.061***	0.017	0.020	0.015	-0.021**	-0.062***	-0.054***
	(0.015)	(0.016)	(0.017)	(0.023)	(0.025)	(0.024)	(0.010)	(0.008)	(0.006)
Finance	0.025***	0.023**	0.039***	0.009	0.014	0.018**	-0.031***	-0.059***	0.027***
	(0.009)	(0.009)	(0.009)	(0.007)	(0.009)	(0.009)	(0.011)	(0.013)	(0.010)
Age	0.271***	0.269***	0.265***	0.180***	0.201***	0.259***	0.121***	-0.018	0.009
	(0.038)	(0.039)	(0.041)	(0.047)	(0.050)	(0.045)	(0.031)	(0.025)	(0.019)
Middle	-0.655***	-0.085***	-0.430***	-0.756***	-0.258***	-0.510***	-3.279***	-0.334***	-1.414***
	(0.109)	(0.027)	(0.101)	(0.118)	(0.052)	(0.072)	(0.275)	(0.029)	(0.211)
High	-0.865***	-0.072*	-0.585***	-1.026***	-0.384***	-0.683***	-2.398***	-0.239***	-0.751***
	(0.103)	(0.042)	(0.099)	(0.151)	(0.078)	(0.137)	(0.273)	(0.033)	(0.206)
Constant	0.445*	0.007	0.305	-0.016	-0.341	-0.373	2.003***	1.131***	1.498***
	(0.235)	(0.254)	(0.258)	(0.328)	(0.341)	(0.320)	(0.316)	(0.159)	(0.229)
Observations	761	695	643	761	695	643	761	695	643
Countries	108	108	98	108	108	98	108	108	98
R^2	0.610	0.613	0.586	0.550	0.544	0.555	0.525	0.538	0.417

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

We discuss the results from system GMM regressions as displayed in Table 4.8a and 4.8b. The Tables present the analysis results for the KOF indices and alternative measures controlling for level of development, demographic structure and financial development for 1970-2009. We report the results for two-step system GMM with corrected standard errors to account for heteroscedasticity of the composite globalization index and its dimensions. We preferred the two-step estimations due to the possible autocorrelation when using the one-step system GMM.

The regressions suggest that the composite KOF index is negatively related to human capital inequality. When testing the dimensions of the index separately (columns 2-5), it appears that all the dimensions show similar results. It is worth noting that while our results generally claim that globalization has decreased human capital inequality, it is still difficult to argue which dimension of globalization is most responsible for the overall impact. This is because the effect of different dimensions varies across the sample and population age. We note that the effect of openness and FDI appears to be insignificant compared to EF index. The EF index (freedom to trade) has similar effects on human capital inequality with the KOF indices, but the coefficients are quite large. The results for the alternative measures are different once we account for endogeneity and possible reverse causation.

The dummy for middle-income countries shows expected sign. This implies that these countries have higher GNI/GDP per capita and have the means (financial system or good educational policies) to increase participation in both lower and higher education. High-income countries dummy, on the other hand, is rarely significant although they have the expected sign. The effect of globalization according to the level of income provides a different

view. In middle-income countries, globalization is expected to widen the gap of education inequality and the result is similar for high-income countries. On the contrary, there is no significant association between country's level of development and human capital inequality when we use openness and FDI as globalization measure.

However, the results also reveal that there exists a different variation on the impact of globalization within the developing countries itself. This is the main contribution of the chapter, where we prove that the H-O theory assumption does not hold in developing countries and explain why previous studies find conflicting or no significant evidence on the relationship between globalization and inequality[52]. As predicted by the H-O theory, globalization should be beneficial for developing countries, which include both low and middle-income countries. When we distinguish the income level separately, it becomes obvious that globalization is beneficial to low-income countries only. For middle-income countries, globalization is associated with the increase in education inequality. It is also likely that, most of the middle-income countries (which are developing countries) in the sample are classified as 'upper middle income' which explains the variations in our findings.

Briefly, the control variables perform plausibly. The lagged dependent variables are positive and highly significant with coefficients range from 0.8- 0.9, signifying a high degree of persistence of the inequality measure. GDP per capita has a consistent negative effect on inequality only in the alternative measures regressions. As hypothesized, age dependency is

[52] We find opposite effects of globalization compared to Bergh and Nillson (2010) and Dreher and Gaston (2008). The former find that economic globalization has positive effect on the distribution of income in low and middle-income countries, while the latter find insignificant effect of aggregate globalization in non-OECD countries.

positively correlated with inequality although it is insignificant in three of the analyses. Financial development is positive and significant, implying that the existence of a developed credit market to finance education is expected to widen the gap of educational attainment in the population. Even though financial development increases the access to capital for the poor and may reduce inequality, the benefit depends on the quality of institutions (World Economic Outlook, 2009). A positive effect of financial development may also be a sign for weak institutions which indicates that the benefits of financial development are unevenly distributed.

The diagnostic tests for system GMM confirm that the set of instruments is valid. This can be inferred from the non-rejection of the Hansen-J over identification test. We expect the presence of first order autocorrelation in the model, and we reject the null for the absence of second order autocorrelation. The test for first order serial correlation AR (1) shows that the null hypothesis is rejected in all estimations. The estimations have no second order serial correlations for Gini25 since the AR (2) test statistics fail to reject the null of second order serial correlation.

Overall, the magnitudes of the estimated effects for the KOF indices and its dimensions on different levels of income are very close. The traditional measure of globalization, openness, does not seem to affect inequality, which confirms the finding from Dollar and Kraay (2002), Edwards (1997), and Higgins and Williamsons (1999). This also suggests that conceptually, the basic H-O theory does not hold for openness. As for the FDI, we find contrasting results with Basu and Guariglia (2007). The finding for FDI is in line with Sylwester (2005), in which he finds no association between FDI and the distribution of income in a sample of Less Developed Countries (LDCs).

In general, the preliminary evidence suggests that different dimensions of globalization are also important for inequality and the significance of the effect of globalization on inequality depend on the measure of globalization used (generally negative and significant and support the H-O theory partially for globalization index, generally insignificant for openness/GDP and FDI).

Table 4.8a: Human Capital Inequality and Globalization: Different Levels of Development: System GMM

VARIABLES	(1) KOF	(2) KOF1	(3) KOF2	(4) KOF3	(5) Openness	(6) FDI	(7) EF
KOF	-0.054***						
	(0.016)						
KOF*Middle	0.059***						
	(0.014)						
KOF*High	0.038*						
	(0.020)						
KOF1		-0.056***					
		(0.016)					
KOF1*Middle		0.048***					
		(0.015)					
KOF1*High		0.044**					
		(0.020)					
KOF2			-0.028**				
			(0.014)				
KOF2*Middle			0.034**				
			(0.015)				
KOF2*High			0.018				
			(0.016)				
KOF3				-0.046***			
				(0.015)			
KOF3*Middle				0.053***			
				(0.014)			
KOF3*High				0.045**			
				(0.019)			
Openness					-0.102		
					(1.243)		
Openness*Middle					-0.256		
					(1.322)		
Openness*High					0.125		
					(1.244)		
FDI						-0.085	
						(0.110)	
FDI*Middle						0.116	
						(0.116)	
FDI*High						0.098	
						(0.110)	

Table 4.8b: Human Capital Inequality and Globalization: Different Levels of Development: System GMM (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	KOF	KOF1	KOF2	KOF3	Openness	FDI	EF
EF Index							-1.361**
							(0.608)
EF*Middle							1.090*
							(0.645)
EF*High							1.537**
							(0.637)
$Gini25_{(t-1)}$	0.864***	0.837***	0.864***	0.879***	0.920***	0.887***	0.869***
	(0.018)	(0.020)	(0.018)	(0.018)	(0.014)	(0.021)	(0.019)
Middle	-0.221***	-0.172***	-0.114**	-0.208***	3.116	1.882	-5.354
	(0.051)	(0.058)	(0.046)	(0.059)	(5.661)	(1.557)	(3.975)
High	-0.116	-0.138*	-0.024	-0.145*	5.771	6.223**	-5.703
	(0.080)	(0.077)	(0.058)	(0.080)	(5.819)	(2.605)	(4.382)
GDP	-0.009	-0.013	-0.014	-0.020**	-2.740***	-3.176***	-2.137**
	(0.006)	(0.009)	(0.010)	(0.009)	(0.827)	(0.915)	(0.905)
Finance	0.006**	0.007**	0.005*	0.006**	0.543*	0.509*	0.658*
	(0.002)	(0.003)	(0.003)	(0.002)	(0.304)	(0.291)	(0.336)
Age	0.032***	0.033**	0.029**	0.014	-0.324*	-0.219	-0.031
	(0.011)	(0.013)	(0.013)	(0.016)	(0.190)	(0.186)	(0.155)
Constant	0.181*	0.218*	0.119	0.317**	22.767***	27.504***	28.289***
	(0.105)	(0.128)	(0.132)	(0.139)	(7.826)	(7.175)	(8.365)
Observations	687	662	687	687	653	646	559
Countries	108	104	108	108	105	105	95
AR1 *p*-value	0.02	0.02	0.02	0.01	0.01	0.02	0.02
AR2 *p*-value	0.11	0.10	0.11	0.11	0.08	0.10	0.13
Hansen J *p*-value	0.35	0.38	0.27	0.31	0.37	0.28	0.46

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

4.7 Robustness Test

4.7.1 Country Outliers

The evidence from the previous section presents two novel findings; firstly, globalization is good for educational inequality; higher globalization is associated with lower education inequality. Secondly, globalization has contrasting effects on the distribution of education for different level of income. Higher degree of globalization will lead to more equal distribution in low income countries and but it widens the gap in middle and high-income countries. The findings, however, only support the H-O theory partially. This is because the effects vary within the developing countries itself; only the low-income countries benefit from globalization, while on the other hand, middle-income countries is associated with higher inequality. In this section, we examine the robustness of our findings by conducting several sensitivity and robustness tests.

The first sensitivity analysis concerns in the presence of country outliers in the sample. It is possible that the results are driven by a particular country or region. We then re-estimate the model by excluding countries from three regions; East Asia and Pacific (EAP), Latin America and Caribbean (LAC) and Sub-Saharan Africa (SSA), one at a time. LAC is known to be the region with high levels of volatility while SSA has very low growth and educational achievement. Some countries in the EAP are advanced countries and have very remarkably high growth and more equal distribution of income and human capital. The results of the analysis are shown in Table 4.9-4.11. For brevity, we only report the coefficients on the globalization measures and corresponding specification tests.

Excluding 17 EAP countries does not alter the overall results. Nonetheless, the coefficients on the indices are quite close suggesting that the results are not driven by these countries. The exclusion of 24 countries from the LAC region alters the result on FDI where it is now insignificant. The EF index, on the other hand, is only significant for high-income countries. Other KOF indices behave expectedly and finally, the exclusion of SSA countries reveals different results as above. The KOF indices are only significant for economic (middle-income countries) and political (high-income countries) globalization. Conversely, openness (in middle and high-income countries) is the only significant alternative measures. As explicated earlier, this region is associated with low level of education and a high degree of inequality in the distribution of education. Thus, this region could possibly be influencing our results.

Since we are interested in the interaction terms, we can safely conclude that country outliers do not influence the baseline results. In addition, reducing the number of observations in the sample does not have any effect on the model because it passes the tests for dynamic estimations. Moreover, alternative measures of globalization are quite unstable with the exclusion of certain countries. Thus, we can safely conclude that the KOF indices are robust to sample variations compared to the traditional measures of globalization.

Table 4.9: Human Capital Inequality and Globalization: Country Outliers (EAP)

VARIABLES	(1) KOF	(2) KOF1	(3) KOF2	(4) KOF3	(5) Openness	(6) FDI	(7) EF
KOF*Middle	0.068***						
	(0.017)						
KOF*High	0.059**						
	(0.028)						
KOF1*Middle		0.052***					
		(0.017)					
KOF1*High		0.038					
		(0.024)					
KOF2*Middle			0.041***				
			(0.015)				
KOF2*High			0.034*				
			(0.019)				
KOF3*Middle				0.070***			
				(0.018)			
KOF3*High				0.065***			
				(0.023)			
Openness*Middle					0.014		
					(0.014)		
Openness*High					0.020		
					(0.015)		
FDI*Middle						0.009**	
						(0.004)	
FDI*High						0.010**	
						(0.004)	
EF*Middle							0.051*
							(0.029)
EF*High							0.082***
							(0.029)
Observations	590	576	590	590	591	556	513
Countries	92	90	92	92	92	92	86
AR1 *p*-value	0.03	0.04	0.04	0.03	0.03	0.04	0.05
AR2 *p*-value	0.24	0.19	0.23	0.24	0.16	0.67	0.31
Hansen J *p*-value	0.60	0.78	0.58	0.63	0.74	0.26	0.92

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

Table 4.10: Human Capital Inequality and Globalization: Country Outliers (LAC)

VARIABLES	(1) KOF	(2) KOF1	(3) KOF2	(4) KOF3	(5) Openness	(6) FDI	(7) EF
KOF*Middle	0.056***						
	(0.015)						
KOF*High	0.047*						
	(0.024)						
KOF1*Middle		0.045***					
		(0.013)					
KOF1*High		0.037**					
		(0.019)					
KOF2*Middle			0.038***				
			(0.014)				
KOF2*High			0.024				
			(0.018)				
KOF3*Middle				0.047***			
				(0.015)			
KOF3*High				0.059***			
				(0.021)			
Openness*Middle					0.004		
					(0.011)		
Openness*High					0.003		
					(0.013)		
FDI*Middle						0.001	
						(0.002)	
FDI*High						0.001	
						(0.003)	
EF*Middle							0.044
							(0.027)
EF*High							0.065**
							(0.028)
Observations	540	515	540	540	540	509	451
Countries	85	81	85	85	85	85	75
AR1 *p*-value	0.04	0.04	0.05	0.04	0.04	0.03	0.05
AR2 *p*-value	0.12	0.11	0.11	0.12	0.11	0.29	0.17
Hansen J *p*-value	0.84	0.94	0.78	0.76	0.78	0.19	0.99

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

Table 4.11: Human Capital Inequality and Globalization: Country Outliers (SSA)

VARIABLES	(1) KOF	(2) KOF1	(3) KOF2	(4) KOF3	(5) Openness	(6) FDI	(7) EF
KOF*Middle	0.030						
	(0.027)						
KOF*High	0.002						
	(0.026)						
KOF1*Middle		0.045*					
		(0.025)					
KOF1*High		0.038					
		(0.028)					
KOF2*Middle			0.023				
			(0.019)				
KOF2*High			0.004				
			(0.020)				
KOF3*Middle				-0.038			
				(0.028)			
KOF3*High				-0.057*			
				(0.031)			
Openness*Middle					0.031*		
					(0.019)		
Openness*High					0.035*		
					(0.019)		
FDI*Middle						0.008	
						(0.008)	
FDI*High						0.009	
						(0.008)	
EF*Middle							0.029
							(0.041)
EF*High							0.048
							(0.042)
Observations	516	505	516	516	517	490	481
Countries	81	79	81	81	81	81	77
AR1 *p*-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR2 *p*-value	0.07	0.08	0.06	0.08	0.06	0.10	0.10
Hansen J *p*-value	0.86	0.92	0.98	0.90	0.90	0.32	0.98

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

4.7.2 Sensitivity Analysis and Additional Variables

Table 4.12 lists the coefficient estimates of the globalization measures (both KOF and the alternative measures) for three additional types of sensitivity tests, which include the complete sets of existing control variables in the baseline model. Firstly, we include all globalization dimensions in one specification simultaneously despite the high collinearity among the dimensions. This is also done by Dreher and Gaston (2008). The only significant dimension for the whole sample regression in their study is political globalization[53]. In our regression, social globalization does not appear to be significant, while economic globalization in high-income countries is positive and significant at 10% and political globalization is significant in middle-income countries.

Secondly, we include the quadratic term for each globalization measures to examine the possible nonlinear relationship[54]. We do not find any evidence of non-linearity since the coefficients on both globalization and its square terms are insignificant. However, the interaction terms show that the baseline model for the composite index is not affected by the addition. This, however, does not apply for social globalization. Similar conclusions can be concluded from the alternative measures. We then continue to test the robustness of our results with the addition of different control variables. This analysis is important because of potential omitted variable bias; if we omit other important variables that affect education inequality and related to globalization, our results could be biased.

[53] Economic globalization is insignificant and social globalization is only significant in the income inequality regression for the OECD countries. For non-OECD countries, political globalization appears positive and significant.

[54] We also include the square term for log GDP per capita to capture the possible presence of Kuznets effects. We find no evidence concerning the "inverted-U hypothesis" and our baseline results are unaffected by the additional variable.

We add several other control variables that are potential determinants of human capital inequality following Checci and Garcia-Penalosa (2004) as well as other existing literature on inequality. The control variables are added one by one in addition to the existing control variables. For brevity, we only show the coefficients of interests (the globalization variables). The coefficients of the additional variables are reported in the Appendix. Additional control variables include the standard deviations of output growth or volatility; to control for the effect of uncertainty on inequality; fertility to proxy for the standards of living; degree of urbanization, capital/output ratio to capture the demand for skilled workers and democracy and political rights to control for institutions as well as public spending on education.

Overall, the results suggest that controlling for these additional determinants of inequality does not change the main result of the chapter. In all cases, the coefficient of the KOF indices remains positive and statistically significant for both medium and high-income countries, which also imply the negative coefficient of the low-income countries. These verify that our baseline results are not driven by the omission of these additional control variables. However, it is important to note that, both the economic and political globalization are robust to the changes of relevant control variables, while social globalization seems to be fragile to the addition of further covariates indicating significance mostly for middle-income countries only. Similarly, the alternative measures behave expectedly with the addition of different covariates. We observe contrasting result when democracy index is added into the regression, openness in middle-income countries appears to be negative and significant.

Turning to the impact of the additional variables (Table C.6 and C.7 in Appendix C), output volatility significantly affects human capital inequality in the KOF and openness regression only. Human capital inequality is positively associated with output volatility, a finding in line with Checci and Garcia-Penalosa (2004). Fertility rate and urbanization do not have any significant impact on human capital inequality while capital/output ratio raises human capital inequality at 5% significance. Having more democratic government leads to greater education redistribution as suggested by the political literature (Reuveny and Li, 2003 and Dreher and Gaston, 2008). When we change the democracy index to political rights index, the results change signs with higher significance level. It seems that the effect of governance / institutions on human capital inequality depends on the measures used. Finally, we do not find any evidence relating educational spending on human capital inequality, which again agrees with Checci and Garcia-Penalosa (2004). Summing up, our results are robust to the exclusion of countries, analysis of possible non-linearity and inclusion of several other control variables.

Table 4.12: Sensitivity Analysis: Summary of Results

Variations	KOF Indices Significant Component		Alternative Measures Significant Component	
All Index	KOF1*High	0.035* (0.02)		
Adding Square Terms	KOF*Middle	0.043** (0.019)	FDI*Middle	0.008** (0.004)
	KOF1*Middle	0.031* (0.016)	FDI*High	0.009* (0.005)
	KOF3*Middle	0.031** (0.013)	EF*Middle	0.037** (0.014)
			EF*High	0.074*** (0.019)
Adding Volatility	KOF*Middle	0.055*** (0.015)	FDI*Middle	0.008** (0.004)
	KOF1*Middle	0.050*** (0.015)	FDI*High	0.009** (0.004)
	KOF1*High	0.045** (0.02)	EF*High	0.074** (0.032)
	KOF2*Middle	0.039** (0.016)		
	KOF3*Middle	0.054*** (0.016)		
	KOF3*High	0.048*** (0.018)		
Adding Fertility	KOF*Middle	0.058*** (0.015)	FDI*Middle	0.008** (0.004)
	KOF*High	0.040* (0.021)	FDI*High	0.008* (0.004)
	KOF1*Middle	0.052*** (0.017)	EF*Middle	0.046* (0.027)
	KOF1*High	0.050** (0.021)	EF*High	0.071** (0.031)
	KOF2*Middle	0.039** (0.016)		
	KOF3*Middle	0.057*** (0.015)		
	KOF3*High	0.051** (0.021)		
Adding Urban Population	KOF*Middle	0.053*** (0.014)	FDI*Middle	0.008** (0.004)
	KOF1*Middle	0.044*** (0.016)	FDI*High	0.009** (0.004)
	KOF1*High	0.040** (0.02)	EF*High	0.067** (0.029)
	KOF3*Middle	0.052*** (0.014)		

Table 4.12a: Sensitivity Analysis: Summary of Results: Continued

Variations	KOF Indices Significant Component		Alternative Measures Significant Component	
Adding Capital	KOF*Middle	0.053***	FDI*Middle	0.008**
		(0.015)		(0.004)
	KOF1*Middle	0.044***	FDI*High	0.009*
		(0.016)		(0.005)
	KOF1*High	0.042**	EF*High	0.075**
		(0.021)		(0.028)
	KOF2*Middle	0.029*		
		(0.016)		
	KOF3*Middle	0.056***		
		(0.015)		
	KOF3*High	0.052**		
		(0.023)		
Adding Democracy	KOF*Middle	0.059***	FDI*Middle	0.006*
		(0.015)		(0.004)
	KOF*High	0.043*	FDI*High	0.007*
		(0.023)		(0.004)
	KOF1*Middle	0.051***	EF*High	0.065**
		(0.016)		(0.029)
	KOF1*High	0.046**		
		(0.021)		
	KOF2*Middle	0.034***		
		(0.013)		
	KOF3*Middle	0.071***		
		(0.015)		
	KOF3*High	0.065***		
		(0.018)		
Adding Political Rights	KOF*Middle	0.057***	FDI*Middle	0.007**
		(0.014)		(0.004)
	KOF*High	0.039*	FDI*High	0.009**
		(0.021)		(0.004)
	KOF1*Middle	0.044***	EF*High	0.069**
		(0.015)		(0.027)
	KOF1*High	0.041**		
		(0.019)		
	KOF2*Middle	0.031**		
		(0.014)		
	KOF3*Middle	0.055***		
		(0.015)		
	KOF3*High	0.048**		
		(0.02)		

Table 4.12b: Sensitivity Analysis: Summary of Results: Continued

Variations	KOF Indices Significant Component		Alternative Measures Significant Component	
Adding Expenditure	KOF*Middle	0.065***	FDI*Middle	0.007**
		(0.015)		(0.004)
	KOF*High	0.047**	FDI*High	0.007*
		(0.022)		(0.004)
	KOF1*Middle	0.050***	EF*Middle	0.052*
		(0.017)		(0.027)
	KOF1*High	0.045**	EF*High	0.075***
		(0.02)		(0.028)
	KOF2*Middle	0.032**		
		(0.014)		
	KOF3*Middle	0.052***		
		(0.014)		
	KOF3*High	0.045**		
		(0.021)		

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is human capital gini for population aged 25 years and above. Significant time dummies are included in every regression.

4.8 Conclusions

This chapter goes a step further from the usual study on globalization and inequality and examines whether globalization matters for human capital inequality. This is important because we believe that human capital inequality is the channel through which globalization is related to the reduction of income inequality. We examine two hypotheses empirically using data from 112 developed and developing countries over the 1970-2009 periods and several measures of globalization. Our main globalization proxy is the KOF globalization index and its subcomponent. To validate our hypotheses, we also use openness to trade, EF index and FDI inflow as additional measures of globalization. In addition, we perform the dynamic estimations to account for endogeneity and country fixed effects.

In the first part of our chapter, we test the hypothesis whether globalization and inequality are linearly related. Analyzing the link between the composite index of globalization (and its three dimensions) and human capital inequality, we find that the most robust finding is the negative relationship between economic and political globalization and human capital inequality. We then show that the effect of globalization on human capital inequality varies according to the level of income. This is the main novelty of our chapter, where we find two different patterns within the developing countries, which disapprove the standard H-O theory. The results imply that low-income countries benefit from globalization; while in contrast, globalization widens the educational gap in middle-income countries. The findings suggest that, the benefits gained from globalization by developing countries as theorized by the basic H-O theory is actually distributed only to the countries with very

low GDP per capita. For developed or high-income countries, education inequality increases with globalization, which follows the assumptions of the H-O theory.

These results might be an important lead for policy considerations. We prove that unraveling the different dimensions of globalization is important and globalization affects the distribution of education differently according to the level of development. On the other hand, the effect of globalization is less robust and insignificant when globalization is measured by openness, FDI or EF index. In fact, openness does not seem to be significant in all specifications. It is also safe to conclude that the effect of globalization on inequality depends on the proxy or measures used. We show that an aggregate indicator of globalization provides better and more robust result compared to the traditional measures of globalization. We also prove social and political globalization as important determinants of human capital inequality.

We find no evidence of a non-linear relationship between globalization and human capital inequality or support on the Kuznets hypothesis. Our analysis generates additional findings corresponding to the sensitivity analysis as well as findings worthy to discuss about. Firstly, the effect of social globalization often is insignificant and less robust. This may suggest that, social globalization is trivial compared to economic and political globalization. Secondly, we find that whenever significant, the positive effect of globalization in middle-income countries is more robust than high-income countries. Our sensitivity analysis confirms that the results are not driven by the exclusion of sample countries from EAP and LAC region but the indices and alternative measures are sensitive to the exclusion of countries from SSA region. Finally, our choice of dependent variable deviates this chapter from the existing debate concerning the effect of globalization on

income inequality, which has attracted much attention in the recent years. We do not assert that human capital inequality is free from measurement errors but we do argue that the effects of globalization on inequality are better understood by examining its effects on different proxies or through an alternative channel. We believe that the results motivate a new finding; the effects of globalization on inequality vary even in the developing countries, with beneficial effects only in low income countries.

Furthermore, we find the effect of other variables on human capital inequality in the study. Higher GDP per capita is capable of reducing inequality, while on the other hand, higher dependency ratio is related to the increase of inequality. Finally, we find a highly significant impact of financial development on education inequality; better financial market is expected to widen the distribution of education. Our study reveals some interesting results, which open the door for further research both theoretically and empirically. Further research is needed based on the novelty findings and scarcity of theoretical models on globalization and human capital inequality. For the theoretical study, we suggest in depth analysis to investigate further the validity and reliability of the standard H-O theory especially for the developing countries, by differentiating the low and middle-income countries. Empirically, more study should focus on globalization and human capital inequality and studying the impact of globalization on the educational quintiles may provide an additional support on this novel finding.

Appendix C

Table C.1: Sample Countries and Globalization Ranks

Low Income	Rank	Low Income	Rank	Middle Income	Rank	Middle Income	Rank	High Income	Rank
Bangladesh	154	Senegal	96	Albania	78	Korea, Rep.	60	Australia	21
Benin	142	Sierra Leone	163	Algeria	95	Malaysia	29	Austria	4
Burundi	174	Sudan	168	Argentina	77	Mauritius	58	Belgium	1
Cambodia	131	Tanzania	162	Bahrain	42	Mexico	70	Canada	15
Cameroon	137	Togo	124	Barbados	85	Morocco	66	Cyprus	11
Central African Republic	173	Uganda	128	Belize	123	Namibia	89	Denmark	7
Congo, Rep.	112	Vietnam	130	Bolivia	101	Panama	46	Finland	17
Cote d'Ivoire	126	Zambia	102	Botswana	107	Papua New Guinea	132	France	18
Gambia	109	Zimbabwe	116	Brazil	74	Paraguay	82	Germany	22
Ghana	94			Bulgaria	38	Peru	52	Greece	23
Haiti	172			Chile	36	Philippines	84	Iceland	37
Honduras	64			China	73	Poland	25	Ireland	2
India	110			Colombia	86	Romania	34	Italy	24
Indonesia	87			Costa Rica	59	South Africa	53	Japan	55
Kenya	119			Dominican Republic	92	Sri Lanka	118	Kuwait	39
Lao PDR	184			Ecuador	98	Swaziland	111	Luxembourg	12
Lesotho	148			Egypt	75	Syria	147	Malta	31
Malawi	155			El Salvador	57	Thailand	54	Netherlands	3
Mali	134			Fiji	100	Tonga	207	New Zealand	27
Mongolia	93			Gabon	90	Trinidad and Tobago	79	Norway	20
Mozambique	121			Guatemala	68	Tunisia	72	Portugal	9
Nepal	165			Guyana	103	Turkey	41	Singapore	5
Nicaragua	91			Hungary	8	Uruguay	51	Spain	16
Niger	164			Iran	156	Venezuela, RB	115	Sweden	6
Pakistan	108			Jamaica	65			Switzerland	10
Rwanda	159			Jordan	40			United Kingdom	14
								United States	35

Note: Rankings are based on the composite index of globalization for the year 2009.

Table C.2: The KOF Index of Globalization

2011 KOF Index of Globalization		
	Indices and Variables	**Weights**
A.	**Economic Globalization**	**[36%]**
	i) Actual Flows	(50%)
	Trade (per cent of GDP)	(22%)
	Foreign Direct Investment, stocks (per cent of GDP)	(29%)
	Portfolio Investment (per cent of GDP)	(22%)
	Income Payments to Foreign Nationals (per cent of GDP)	(27%)
	ii) Restrictions	(50%)
	Hidden Import Barriers	(22%)
	Mean Tariff Rate	(28%)
	Taxes on International Trade (per cent of current revenue)	(27%)
	Capital Account Restrictions	(23%)
B.	**Social Globalization**	**[38%]**
	i) Data on Personal Contact	(33%)
	Telephone Traffic	(26%)
	Transfers (per cent of GDP)	(2%)
	International Tourism	(26%)
	Foreign Population (per cent of total population)	(20%)
	International letters (per capita)	(25%)
	ii) Data on Information Flows	(36%)
	Internet Users (per 1000 people)	(36%)
	Television (per 1000 people)	(37%)
	Trade in Newspapers (per cent of GDP)	(28%)
	iii) Data on Cultural Proximity	(31%)
	Number of McDonald's Restaurants (per capita)	(43%)
	Number of Ikea (per capita)	(44%)
	Trade in books (per cent of GDP)	(13%)
C.	**Political Globalization**	**[26%]**
	Embassies in Country	(25%)
	Membership in International Organizations	(28%)

Participation in U.N. Security Council Missions	(22%)
International Treaties	(25%)

Source:

Dreher, Axel, 2006, Does Globalization Affect Growth?
Empirical Evidence from a new Index, *Applied Economics* 38, 10: 1091-1110.

Updated in:

Dreher, Axel; Noel Gaston and Pim Martens, 2008, *Measuring Globalization - Gauging its Consequence*, New York: Springer.

Table C.3: Summary Statistics and List of Variables

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max	Source
	Baseline						
Gini15	Human capital inequality(15 years and above)	896	0.378	0.221	0.049	0.944	Barro and Lee(2010)
Gini25	Human capital inequality(25 years and above)	896	0.421	0.241	0.052	0.967	Barro and Lee(2010)
KOF	Composite globalization index	893	3.797	0.403	2.531	4.526	Dreher(2006)
KOF1	Economic globalization	861	3.797	0.469	2.104	4.582	Dreher(2006)
KOF2	Social Globalization	893	3.539	0.585	1.942	4.548	Dreher(2006)
KOF3	Political Globalization	893	4.009	0.415	2.300	4.584	Dreher(2006)
Openness	Openness to trade	893	4.031	0.661	1.983	6.069	Penn World 7.0
EF Index	Freedom to trade internationally	707	1.762	0.311	0.425	2.302	Freedom House(2009)
FDI	Foreign Direct Investment Inflow	815	0.143	1.514	-4.605	5.962	WDI,World Bank (2010)
GDP	Real GDP per capita (constant price)	893	8.410	1.301	5.013	11.317	Penn World 7.0
Age Depend	Age Dependency ratio	896	4.244	0.274	3.570	4.724	WDI,World Bank (2010)
Finance	Private Credit(% GDP)	765	-1.320	0.927	-4.605	0.850	Beck & DemigucKunt(2009)
	Additional Variables						
Volatility	Standard Deviation of output growth	893	4.087	3.480	0.15	27.4	Penn World 7.0
Fertility	Total Fertility Rate	856	1.210	0.535	0.157	2.113	WDI,World Bank (2010)
Urbanization	Share of urban population	896	3.734	0.658	1.000	4.605	WDI,World Bank (2010)
Capital/Output	Capital/Output Ratio	858	0.736	0.381	0.15	3.93	Marquetti &Foley(2011)
Democracy	Democracy Index	831	4.815	4.127	0	10	Polity IV Project (2009)
Political Rights	Political Rights Index	886	3.570	2.128	1	7	Freedom House(2009)
Expenditure*	Public Spending on Education (% GDP)	896	1.425	0.490	0.172	4.233	WDI,World Bank (2010)

Notes: All independents variables are expressed in log form.
* This is the average of the variable for the period 1970-2009

Table C.4: Correlation Matrix

	Gini15	Gini25	KOF	KOF1	KOF2	KOF3	GDP	Finance	Age
Gini15	1.000								
Gini25	0.992	1.000							
KOF	-0.620	-0.629	1.000						
KOF1	-0.579	-0.582	0.916	1.000					
KOF2	-0.524	-0.533	0.930	0.847	1.000				
KOF3	-0.404	-0.417	0.658	0.387	0.456	1.000			
GDP	-0.491	-0.505	0.831	0.729	0.863	0.467	1.000		
Finance	-0.501	-0.515	0.617	0.650	0.609	0.412	0.635	1.000	
Age	0.562	0.593	-0.665	-0.553	-0.645	-0.515	-0.691	-0.578	1.000

Notes: GDP is the log of Real GDP per capita; Finance is the log of private credit and Age is the log of age dependency ratio

Table C.5: Correlation Matrix for Globalization Measures

	KOF	KOF1	KOF2	KOF3	Open	FDI	EF
KOF	1.000						
KOF1	0.915	1.000					
KOF2	0.941	0.858	1.000				
KOF3	0.643	0.369	0.459	1.000			
Open	0.310	0.433	0.342	-0.162	1.000		
FDI	0.502	0.609	0.452	0.125	0.545	1.000	
EF	0.689	0.737	0.616	0.354	0.354	0.486	1.000

Notes: Open is the log of openness (% of GDP); FDI is the log of foreign direct investment inflow and EF is the Economic Freedom index.

Table C.6: Additional Variables for KOF Regressions

VARIABLES	KOF	KOF1	KOF2	KOF3	Openness	FDI	EF Index
Volatility	0.001**	0.001*	0.001***	0.001**	0.001**	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Fertility	0.011	0.026*	0.018	0.010	0.003	0.011	0.006
	(0.013)	(0.014)	(0.013)	(0.013)	(0.013)	(0.015)	(0.012)
Urbanization	0.002	0.001	-0.004	-0.001	-0.010	0.003	-0.001
	(0.007)	(0.006)	(0.006)	(0.007)	(0.006)	(0.005)	(0.006)
Capital/Output	0.007	0.002	0.009*	0.005	0.007*	0.008	-0.002
	(0.004)	(0.006)	(0.004)	(0.005)	(0.004)	(0.005)	(0.008)
Democracy	0.001***	0.001*	0.001**	0.002***	0.002***	0.001***	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Political Rights	-0.003**	-0.001	-0.002**	-0.003***	-0.003***	-0.003**	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Expenditure	-0.011	-0.011	-0.006	-0.004	0.003	-0.027	-0.010**
	(0.012)	(0.013)	(0.011)	(0.014)	(0.008)	(0.028)	(0.005)

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The variables are included into the regression separately.

CHAPTER 5

Overall Conclusions

5.1 Summary of Empirical Essays

This thesis presents studies on education and its distribution in relation to three important topics in economics; growth-volatility relationship, poverty and globalization. We summarize the main conclusions from the three different essays as below.

In the first essay, we examine the significance of education as a channel through which volatility affects growth. We prove the detrimental effect of volatility on growth, which concurs with existing studies, and show that when interacted with education, the effect is mediated. Our work sheds an important empirical insight on the robustness of the volatility-growth and the mechanism through which volatility impacts on growth. The mediation effect of the interaction term between education and volatility provides support to the theoretical models which claim that volatility induces precautionary savings. We find similar evidence on different levels of education, but the effect differs across level of income and volatility. The interaction terms are insensitive to the addition of the usual determinants of growth and alternative definitions of education and volatility.

In the second essay, we study the importance and effectiveness of education in reducing poverty in developing countries. This essay is probably the first that studies the empirical assessment of the direct impact of education on poverty. Employing dynamic panel technique,

we find that higher human capital investment is crucial in reducing poverty which corroborates policy findings by the World Bank. In addition, we also prove the importance of growth as one of the main factors in alleviating poverty. Interestingly, we find that higher education and women's education to be significant and important in this relationship. This proves that basic education is insufficient in reducing poverty. Hence, the goal of achieving universal primary education should be revised to include higher level of education (at least junior secondary) in order to achieve its primary target. Our results are robust to the use of different measures of poverty, different methods and inclusion of a set of control variables.

In the third essay, we study the relationship of globalization and education inequality. We utilize the newly constructed globalization index that includes three different dimensions of globalization; economic, social and political in addition to the usual measures of globalization. We show that the effect of globalization on education inequality differs according to the level of income. The main contribution of this essay is that we prove that there exists a variation of impact within the developing countries which is in contrast with the standard trade theory. The results suggest that globalization decreases education inequality in low-income countries, but the effect is the opposite in middle-income countries. In addition, we demonstrate that not only economic globalization, but social and political globalization are important in this relationship. The exclusion of countries from specific regions and inclusion of additional covariates does not change our main result. However, the usual measures of globalization are sensitive to the addition of control variables and not robust across samples.

5.2 Limitations and Future Research

Although the results in the thesis provide important policy implications in both developing and developed countries, there are still limitations. Because the first and the second empirical essay focus on developing countries, data quality is an important issue to consider. In many developing countries, data quality is poor and missing for some (or long) period and this may affect the accuracy of the results. However, we hope that using the data from two prominent sources (The World Bank and the Penn World Table) will minimize the possibility of biased results. To support this, the World Bank states that:

"The application of internationally accepted standards and norms results in a consistent, reliable source of information (Data Overview, the World Bank (2012)).

In addition, the education (human capital) data is fairly unreliable and measured with errors as pointed out by previous literature (de la Fuente and Domenech (2002, 2006) and Krueger and Lindahl (2001)). However, Barro and Lee (2010) have built and improved the earlier (1993) datasets on educational attainment of population aged 15 years and 25 years and over by minimizing the measurement errors. This dataset is constructed from the UNESCO database using the perpetual inventory method. Moreover, this is the primary source of data used in existing literature on education and growth.

In the second essay, the poverty data is the primary concern of our limitation. The poverty measures (the headcount ratio, poverty gap and square poverty gap) are far from perfect and is based on survey data which is incomparable across countries and over time. It is also a

concern because the data presents gaps and may not accurately capture the effect studied. Despite the caveat, the Povcal data is updated frequently (every 3 years) and signifies the best available source of information on the proportions of people living below a certain standard of living. The gross enrollment data in the second essay is another concern. The gross enrollment ratio (GER) for primary education can exceed 100 percent in some countries due to grade repetition or late entrants. In this regard, the net enrollment ratio (NER) may serves as better proxy. However, the proxy does not have enough data points to conduct a meaningful regression. We also ensure that the inclusion of country with GER greater than 100 percent does not affect the results.

Further to the limitations of specific variables described above, the use of average data reveals problems. Averaging the data over three or five year periods removes useful variation from the data and reduces the number of observations. In the first essay, we also lost information by dividing countries into a sub-sample of low and high-income countries. Thus, it is useful for future research to consider annual study or focus on individual countries to test the sensitivity of the results presented in the essay. The endogeneity of education in the first essay is another concern and limitation to the study. We use the lagged values as instruments in the two stages least square regression due to the lack of suitable external instruments. The instruments are weak and affect the robustness of the results.

For the second essay, it is beneficial to extend the research by studying the effect of education quality on poverty reduction if data on educational quality is available in the future. Furthermore, the impact of aid for education (total and different levels of education) may provide a useful insight on poverty alleviation, but data availability hinders such analysis. For

the third essay, a possible extension to the research is to evaluate the potential determinants of human capital inequality. On the theoretical part, we suggest in depth analysis to investigate further the validity and reliability of the standard H-O theory especially for the developing countries, by differentiating the low and middle-income countries. Empirically, more study should focus on globalization and human capital inequality and studying the impact of globalization on the educational quintiles may provide an additional support on this novel finding.

Additionally, it may be relevant to study the relationship between education inequality with poverty and education; by including the inequality variable to help mediate the effect of education on growth and poverty. However, because of data limitations and sample selection, it is not possible to proceed with the analysis. This is because, the poverty and gross enrollment data in essay two is calculated in three-year averages, while the education inequality data is only available in five-year averages. Education inequality is constructed from another proxy of education, which is the average year of schooling.

Nevertheless, the findings from the three empirical essays reveal; the importance of education in mitigating the effect of volatility on growth; the direct effects of education on poverty reduction and how globalization affects the distribution of human capital. In particular, it provides insights to the policy makers on how to improve the quality of life and development in developing countries.

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